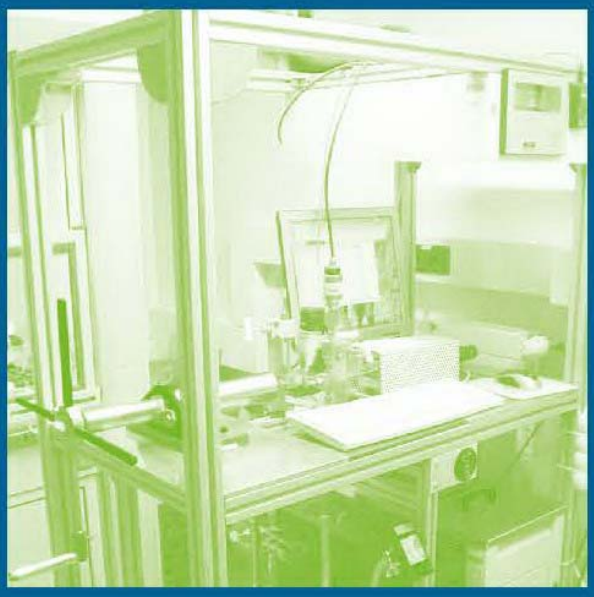
BOOK OF ABSTRACTS

THERMAM 2015

INTERNATIONAL CONFERENCE ON THERMOPHYSICAL AND MECHANICAL PROPERTIES OF ADVANCED MATERIALS



4th ROSTOCKER INTERNATIONAL SYMPOSIUM

THERMOPHYSICAL PROPERTIES FOR TECHNICAL THERMODYNAMICS

BOOK OF ABSTRACTS

17 – 18 SEPTEMBER 2015, BAKU, AZERBAIJAN

THERMAM 2015

THERMAM 2015

INTERNATIONAL CONFERENCE:
"THERMOPHYSICAL AND MECHANICAL PROPERTIES OF ADVANCED MATERIALS"
and
4th ROSTOCKER INTERNATIONAL SYMPOSIUM:
"THERMOPHYSICAL PROPERTIES FOR TECHNICAL THERMODYNAMICS"

17 - 18 September 2015

Azerbaijan Technical University
Huseyn Javid Avn. 25

Baku, AZERBAIJAN

Co-organized by:

Azerbaijan Technical University, Baku, **AZERBAIJAN**

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2015

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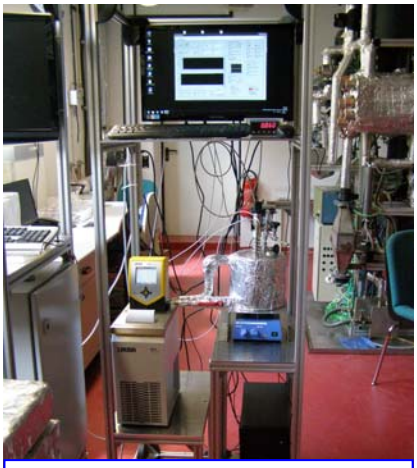
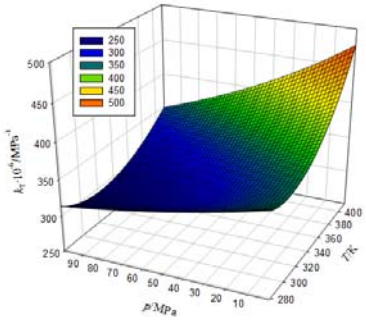
Density measurements at high pressures and temperatures

Gas solubility measurements in liquids at high pressures and temperatures



Vapor pressure measurements at high temperatures



Vapor pressure measurements at small temperatures

BOOK OF ABSTRACTS

International Conference on Thermophysical and Mechanical Properties of Advanced Materials –

THERMAM 2015

and

4nd ROSTOCKER INTERNATIONAL SYMPOSIUM
Thermophysical Properties for Technical Thermodynamics

17 – 18 September 2015

Azerbaijan Technical University
Huseyn Javid Avn. 25,
AZ1073 Baku, AZERBAIJAN

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Preface

International Conference on Thermophysical and Mechanical Properties of Advanced Materials – THERMAM 2015 and 4nd ROSTOCKER INTERNATIONAL SYMPOSIUM Thermophysical Properties for Technical Thermodynamics

Thermodynamics is a very fascinating scientific field which has to do with many different phenomena in nature and technique. As an interesting example we can regard climate change which at the moment is on the agenda of many political decision makers and scientists. Climate change is partly caused by the emission of the carbon dioxide molecule to the atmosphere from farming, from technical combustion in energy technique and transport and from many other human related processes. The heat transfer processes in the atmosphere clearly have to do with thermodynamics. On the other hand, measures to reduce human impact on the environment, like CCS, carbon capture and storage, from combustion also involve thermodynamics processes. To solve and handle thermodynamics problems one needs "Thermophysical and Mechanical Properties of Advanced Materials". One example is the possible capture of carbon dioxide from atmosphere or exhaust gases in ionic liquids. To make this technically feasible data for the thermophysical property of solution of carbon dioxide in the advanced material of an ionic liquid are needed.

Within this conference we want to bring together international scientists and engineers who work in the very broad field of "Thermophysical and Mechanical Properties of Advanced Materials". This is a very interesting and modern research field. It covers experimental and theoretical new results for thermophysical properties, new measurement techniques and their applications, molecular modeling with new theoretical insights, applications which show the improvement done with the described research for thermophysical properties and mechanical properties for materials like nanofluids, nanocomposites, alternative solvents, metals, alloys, ceramics, composites, etc. These subjects cover fundamental and applied research and engineering aspects.

We want to foster lively discussions and future international collaborations on this important and stimulating field with this conference.

We choose the venue of the conference as the exciting city of Baku with all the amenities of such a place in a very nice surrounding and with the possibility to explore the old and new city and even excursions to historically interesting tourist sites like Old City, Ateshgah etc.

We wish you a very pleasant, joyful, interesting and stimulating conference at the Azerbaijan Technical University, Baku, AZERBAIJAN.

THE ORGANIZING COMMITTEE

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Keynote Presentations

INFLUENCE OF TEMPERATURE AND MAGNETIC FIELD ON DEAROMATIZATION OF DISTILLATES OF NAPTHALENE OIL

Vagif ABBASOV, Gultekin NADJAFOVA, Arzu ALIZADEH, Pervane MOVSUMOVA

Petrochemical Processes named after Yu.G. Mamedaliyev of Azerbaijan National Academy of Sciences, AZERBAIJAN
e-mail: vagif_abbasov@hotmail.com; azmea_nkpi@box.az; gultekin_najafova@hotmail.com;
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The Naphthalan oil has no analoqs in the world and its importance for health is connected with a special structure of naphthenic hydrocarbons. Therefore, the development of process for separation of naphthenic hydrocarbons has a special importanc. In the Institute of Petrochemical Processes the technology for separation of of naphthenic hydrocarbons from Naphthalan oil was developed yet in 2000. On 23rd of October 2014, "White Naphthalan oil" was registered as a medicinal preparation in The Ministry of Health of Azerbaijan Republic. But in order to be more effective in its cleaning technology, the researches are continued. The choosing of adsorbents (natural and synthetic), the influence of temperature on the adsorbtion process, different powerful magnetic field and the flow rate of liquid are investigated on the level of adsorption. For this purpose, the magnetron, having a wide range of power (5-380 mT) and working in 21 different power modes, was installed. The influence of magnetic field and temperature on dearomatization is investigated.

Synthetic adsorbents are not useful for cleaning distillates. Only natural adsorbent together with maqnetic field impact distillates. The influence of flow rate and number of periods of distillates staying in magnetic field was studied. In the composition of the white oil, there are no rezins, asphaltenes, aromatic hydrocarbons and natural oil acids. Aromatic hydrocarbons, rezins, asphaltenes and natural oil acids have a toxic effect and that's why make impossible use of healing crude oil in native state in treatment of several diseases. On the other hand, the healing crude oil is used in 38 ^{o}C temperature bath method and that's why during a long time of using, polycyclic aromatic hydrocarbons are condensed and form poorly-soluble associates in oil. At the same time resistance of "White Naphthalene oil" to temperature was investigated. The oil was affected by temperature in range 20 - 100 ^{o}C (20 ^{o}C increase each time) within 1 - 5 hours. Then, by spectral analysis it was determinate that in the noted temperature interval "White Naphthalene oil" does not change its chemical composition.

From the spectral analysis methods NMR -, IQ - spectroscopic methods were used. The analysis was shown that thermal effects had not influenced on "White Naphthalene oil". Thus, there was not any decomposition in "White Naphthalene oil", and no oxygenous compounds were produced.

On the other hand, the physical-chemical, as well as thermal properties of "White Naphthalene oil", including refractive index, remained unchanged. These studies have shown that "White Naphthalene oil" can be used in conjunction with physical therapy techniques.

Vagif ABBASOV is Academician of the Azerbaijan National Academy of Sciences and director of the Petrochemical Processes named after Yu.G. Mamedaliyev of Azerbaijan National Academy of Sciences of Azerbaijan. He is leading specialist in the field of oil and gas chemistry research investigations. Under his leadership various inhibitors, motor oils, medical oil "White Naftalan oil" were synthesized and investigated.

PUZZLES OF COLD WATER

Mikhail A. ANISIMOV

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Liquid water is still a puzzle. This is probably the most studied and yet least understood state of matter. Something dramatic happens with liquid water below the "biological" temperature (30-40 ºC). Unlike ordinary substances, one can regard water near the triple point and in the supercooled region, on the one side, and water near the vapor-liquid critical point, on the other side, as "the same substance – two different liquids". Highly-compressible, low-dielectric-constant near-critical water is commonly used as a supercritical-fluid solvent. On the low-temperature side of the phase diagram, water is an almost incompressible, high-dielectric constant solvent with mysterious thermodynamic anomalies. These anomalies become especially pronounced in the supercooled water that exists between the melting line and the line of homogeneous ice formation. A popular hypothesis that explains the anomalies of cold and supercooled water is the existence of a metastable liquid-liquid transition hidden just below the line of homogeneous ice nucleation. We have developed an equation of state for the thermodynamic properties of cold and supercooled water, in which water is considered as a non-ideal "mixture" of two alternative structures. The equation is valid for temperatures from the homogeneous ice nucleation temperature up to 300 K and for pressures up to 400 MPa, and can be extrapolated up to 1000 MPa. Currently, this equation is considered by the International Association for the Properties of Water and Steam (IAPWS) as an official Guideline for scientific and industrial use.

Mikhail A. ANISIMOV is Professor in the Department of Chemical and Biomolecular Engineering and in the Institute for Physical Science and Technology at the University of Maryland, College Park, U.S.A. His research group at the University of Maryland is one of the leading authorities in the field of critical phenomena and phase transitions in fluids, fluid mixtures, liquid crystals, polymers, and other soft-matter materials.

LOHC AS A FLUID FOR ENERGY STORAGE AND TRANSPORT

Wolfgang ARLT[1], Daniel TEICHMANN[2]

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The sea change of German energy policy provokes a lot of research in systems, based on renewable energy. In the German state of Bavaria, a new center for research (Nuremberg Energy Campus) and several initiatives (like Bavarian Hydrogen center) were started to make possible the phase-out of nuclear energy in the year 2022.

The main problem is to make renewable energy like photovoltaics (PV) or wind able to replace the base load of electricity supply as it was done by nuclear power stations. This leads to energy storage. The authors are convinced that medium to long term storage of large amounts of electrical energy is only possible by chemical storage. Hydrogen is suited but not in its pure state. One option is to use LOHC's (liquid organic hydrogen carrier), chemical compounds that exist in an energy-lean state (not hydrogenated) and in an energy-rich state (hydrogenated). To find such a pair of chemicals is a challenge for thermodynamics and chemistry.

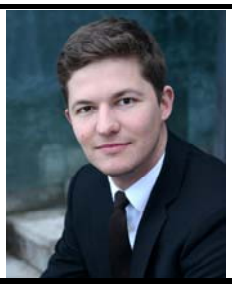
In THERMAM conferences 2013 (Rostock) and 2014 (Izmir) the author reported on the process and its thermodynamics.

This report is about the findings so far and the application of the technology.

KEYWORDS: thermodynamics, energy, hydrogen, transport.

Wolfgang ARLT is Professor and chair at the University of Erlangen-Nuremberg in Bavaria/Germany. The chair is called Separation Science & Technology. His research interest includes: thermodynamics of mixtures, thermodynamical models including those stemming from quantum chemistry (COSMO-RS), application to thermodynamics to energy engineering, separation processes like chromatography and distillation, tomography of separation equipment. Prof. Arlt is founder and director of the Energy Campus Nuremberg and advisor to the Bavarian government."

Daniel TEICHMANN is CEO and co-founder of Hydrogenious Technologies GmbH, a spin-off of the university of Erlangen-Nuremberg and technology leader in the commercialization of Liquid Organic Hydrogen Carriers (LOHC) for hydrogen and energy storage. Prior to founding Hydrogenious Technologies, Daniel Teichmann has worked for BMW and McKinsey and has earned his PhD at Prof. Arlt's chair over the evaluation of how LOHCs can become the basis for a future renewable energy system.



THERMODYNAMIC DATA DETERMINATION FOR IMPROVEMENT OF IC ENGINE COMBUSTION

Egon HASSEL

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Local and global mobility of persons and material is a very important aspect of modern life. This mobility today is mostly ensured by internal combustion (IC) engines, momentarily mostly depending on fossil fuels and most of the engines work with direct high pressure fuel injection. Besides the problem of pollutant emissions, the outlet of carbon dioxides (CO_2) from the IC engines into the atmosphere today is considered a major issue for the environment called global warming. To tackle these problems the combustion within the combustion chamber of the IC engines is constantly improved, today with e.g. downsizing, implementation of common rail technology, optimisation of the engine management software, etc. All these measures crucially depend on thermodynamic data for the specific fuel used for the individual engine and task at hand. The net CO_2 emissions from combustion is reduced if so called alternative fuels or renewable fuels, like rape seed or coconut oil, are used, or at least mixtures of conventional and alternative fuels are used. Worldwide more and more regulations are to be found which aim in this direction.

The price of traditional fuel is increasing every day. Also for these alternative fuels or mixtures thermodynamic data are needed to design and optimise IC engine combustion. Use of alternative to conventional gasoline and diesel fuels dramatically increased last years. They can be successful use as a fuel in an IC and can demonstrate to work in vehicles with gasoline engines without modification. A challenge is caused by the use of fuels and alternative fuels at very high pressures up to 200 MPa. In a near future, injection systems can be designed for higher pressures up to 400 MPa. Number of injections at such high pressures per cycle can be expanding and the time of one injection process can be reduced.

That is why it is so important to have reliable knowledge of basic thermophysical properties (density, vapor pressure, viscosity, speed of sound, heat capacity etc.) of fuels and alternative fuels under high pressures for modeling, understanding, and optimizing the processes in an internal combustion engine. Within the literature the data base for this kind of fuels is scarce. With this talk we present measurement techniques, measurement data for (p,ρ,T) properties, isobaric and isochoric heat capacities, speed of sound, vapor pressure, and also various derivated thermal properties (thermal properties isothermal compressibility, isobaric thermal expansibility, thermal pressure coefficient, internal pressure, isentropic exponent) of fuels and alternative fuels at temperatures T=(263.15 to 468.15) K and pressures up to 200 MPa using the experimental and theoretical investigations for an example of a modern fuel mixture.

ACKNOWLEDGEMENT: Prof Buchholz, Prof Harndorf, Dr Schümann, Dr Nocke, Dr Safarov, Dr Fink, support by BmWi LEDF-Projekt Nr. 03SX369A.

Egon HASSEL is Professor and chair of Technical Thermodynamics at the University of Rostock in Germany since 1999. He studied physics at Technical University of Aachen, Germany, and went early into Mechanical Engineering, where he received his PhD at Technical University of Aachen and later his Habilitation at Mechanical Engineering from Technical University of Darmstadt, Germany. His interests mainly cover the fields of energy technique, IC engine combustion and measurements of thermodynamic properties. In November 2012 he received an honorary doctorate from Azerbaijan Technical University in Baku.

EXPERIMENTAL INVESTIGATION AND NUMERICAL MODELING OF THE IGNITION AND COMBUSTION PROPERTIES OF FUELS

Ulrich MAAS

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Fuels as chemical energy carriers cover a large amount of the energy demand. Although alternative methods for fuel conversion gain increasing interest, the major part of the fuels are still used in combustion systems like internal combustion engines, gas turbines or furnaces. In order to allow a clean, safe operation of these combustion systems, it is necessary to know the thermokinetic properties of these fuels. This is a challenging task, because the variety of fuels is increasing considerably.

- New fuels derived from biomass are emerging for which the thermochemical properties are not yet adequately known.
- New fuels (i.e. mixtures of chemical compounds) are specifically designed for different combustion processes.

Whereas some thermodynamic properties like calorific values are known for these fuels, many interesting properties are not yet known adequately. Here we can distinguish between thermokinetic properties needed for the design of the combustion system (e.g. burning velocities) and thermokinetic properties needed for a safe handling of the fuels (e.g. flammability limits).

In this work we discuss first how a combination of experimental methods and numerical modelling can be used to derive thermokinetic properties of fuels (single compounds and mixtures). Examples are

- reaction rates
- transport processes
- laminar burning velocities
- ignition delay times
- flammability limits
- minimum ignition energies

Although these "generic" properties already allow a good characterization of the different fuels, it is important for practical applications to characterize the overall combustion process based on the known thermokinetic properties. Therefore we shall discuss in the second part of this work how the detailed information on the fuel properties can be used to devise models for the overall combustion system. The problem in modelling these (typically turbulent) processes is that the description of chemically reacting systems leads to scaling problems in space and time. In particular, an oversimplification of the coupling processes between chemical reaction and turbulent flow should be avoided by all means to allow a predictive character. In the presentation it is shown how hierarchical concepts can be used to solve this problem. Different examples like turbulent flames and ignition by hot jets show, that such hierarchical concepts allow a reliable description of combustion systems.

Ulrich MAAS is a full Professor at Karlsruhe Institute of Technology, Germany. His research interests include mathematical modeling and experimental investigation of reacting flows. The focus is on chemical kinetics, coupling of chemistry with turbulent flow, statistical models for turbulent reacting flows, ignition processes, droplet combustion and hierarchical model reduction concepts. Prior to working in Karlsruhe he was a full professor at Stuttgart university.

GENERALIZED SUBLATTICES IN FRANK-KASPER PHASES, THE Z-MODULE APPROACH

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The pentagonal Frank-Kasper phases which form in superalloys containing Mo and/or W elements, can give rise to electron diffraction patterns with an apparent five or tenfold symmetry together with some diffuse scattering. This result suggests the existence of some hidden (average) symmetry.

The corresponding micro/nanostructure, revealed by High Resolution Electron Microscopy, exhibits nanodomains of Laves phases (C14, C15) with many faults which can be described by layer of other Frank-Kasper phases (□, Zr_4Al_3, …) and some regions are highly disordered (1) (2). After simulation of such images, the distribution of white dots can be correlated with the distribution of parallel columns built with pentagonal antiprisms (icosahedral columns) and the white dot distribution reflects the local linkage between the columns. Consequently, the microstructure is completely described by the knowledge of the 2-D tesselation of the icosahedral columns.

By analogy with the description used for quasicrystals, this tessellation can be analysed as a decoration of a Z-module of rank 5 (reducible in a Z-module of rank 4 because the sum of the five vectors gives the zero vector) where all column positions (simultaneously in nanocrystals, faulted or disorderd regions) are defined by five integers with respect to the five basis vectors defined by the regular pentagon in 2-D space. The tessellation is a 2-D projection along the [1, 1, 1, 1, 1] diagonal of a 5-D periodic structure embedded in a large space of dimension 5 (4+1), in a way similar to the Penrose pattern.

The different Frank-Kasper phases will be discussed in terms of the rules selection of nodes of the 5-D space which have to be projected in the parallel space (the physical space) for the generation of the phase. These selected nodes are located in planes the 3-D perpendicular space and the defects are associated to specific shifts in this space.

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2. D. Carron, PhD dissertation, University Paris VI (1995).

Richard A. PORTIER is Emeritus Professor at Chimie-ParisTech, France in the group of Structural Metallurgy. During his career, his research interest was mainly focussed on Electron Microscopy (fast electron/matter interactions, symmetry properties, defects contrast, high resolution images and image processing), Reconstructive Structural Phase Transformations in oxydes ans alloys (Short and Long Range Order, Precipitation) and Displacive Structural Phase Transformations (Martensite, Shape Memory Alloys), Quasicrystals and Commensurate or Incommensurate Modulated Alloys, Group Action Theory applied to defects and phase transformations (bicrystallography), Genesis and Evolution of microstructures (non conventionnal elaboration methods). He is now studying the description of complex metallic structures with the concept of Z-modulus and some approximant structures.

INVESTIGATION OF THERMALLY UNSTABLE FLUIDS BY THE METHOD OF CONTROLLED PULSE HEATING: 1. CRITICAL PARAMETERS FOR MULTICOMPONENT LIQUIDS INCLUDING OILS 2. HEAT CONDUCTION IN NANOFLUIDS UNDER HIGH-POWER HEATING

Sergey RUTIN, Pavel SKRIPOV

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The critical parameters are usually investigated for stable liquids. However, in practical applications one deals primarily with thermally unstable mixtures (the temperature of thermal decomposition onset for these mixtures is lower than the critical one). Because of experimental difficulties, the properties of these substances are less studied. The second part of the report is devoted to heat conduction in nanofluids in a wide temperature range.

The most reliable results for the critical parameters for thermally unstable pure liquids can be obtained by the method of pulse heating [1]. This method is based on tracking the evolution of the signal of spontaneous boiling-up of a liquid under stepwise pressure increase. This approach, however, becomes less efficient for multicomponent liquids characterized by significantly lower intensities of boiling-up. To overcome this limitation, we have designed new technique within the framework of the method of controlled pulse heating of a wire probe – resistance thermometer [2]. The technique is based on the phenomenon of threshold changes in the thermal properties of substance in the course of transition from subcritical to supercritical state along the isobar [3]. By selecting the probe heating trajectory and an increment in pressure, we find, at certain pressure value, a reproducible signal indicating the entrance into supercritical region, and, as a result, an approximation for the critical pressure of substance. The corresponding value of critical temperature is calculated with an accuracy of 1%, as in the basic method [1]. The report discusses the technique of measurement, its validation using reference substances, and the results for a number of industrial oils used in power and refrigeration applications.

Nanofluids are considered as potential "next generation" working fluids for advanced heat-exchanging devices [4]. By our method [2, 3], we compared the heat conduction for nanofluids in the region of stable states and superheated ones. The content of nanopowder in the base liquid served as parameter. The experimental data are reliably resolved at small contents of nanoparticles, where, due to complex competition between the different factors contributing to the thermal conductivity of nanofluids, the resulting trends are difficult to access *a priori.* The regime of deteriorated heat conduction in nanofluids has been revealed as a general case.

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Pavel V. SKRIPOV is Professor of the Ural Institute of State Fire Service of EMERCOM of Russia, leading researcher of the Institute of Thermal Physics, Ural Division of Russian academy of sciences. He has developed new approaches for studying pulse-heated liquids in short-lived states which are of interest from both fundamental and practical considerations. Using novel experimental methodology combined with the original in-house hardware and software solutions, his research team obtained robust experimental results describing thermophysical properties and heat transfer in superheated liquids and supercritical fluids under high-power heating regimes.

THERMAL AND OPTICAL RADIATIVE PROPERTIES OF GRAPHENE NANOCOMPOSITES

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There is a considerable interest in developing nanoscale thermal and photonic devices by using graphene nanocomposites for terahertz (THz) applications [1-4]. This is because the thermal (i.e. phonons) and optical (surface polaritons) energies of graphene lie in the THz range. Here we consider the nanocomposite is fabricated by depositing graphene on the top of the polar materials. Examples of polar materials are SiO_2, SiC and CdS. We will calculate the thermal properties such thermal conductivity and specific heat of these nanocomposites using the tight binding method. Optical properties such as photoluminescence and absorption coefficient of these nanocomposites will be calculated by using the density matrix method. Graphene nanocomposites can be used in wide variety of applications such as thermal sensing and chemical and biological sensing. It is well known that polar materials have optical phonons. It is found that these optical phonons couple with surface electrons of the graphene and produce surface phonon- polaritons (SPPs). Recently, thermally excited radiative modes of SPPs in highly doped polar material GaAs and SiO_2 deposited on metals were studied for the selective thermal THz device applications. Most of the work on SPPs research has been focused mainly on noble metal. It is found that noble metals are hardly tunable and exhibit large Ohmic losses which limit their applicability to fabrications of devices. Graphene provide an attractive alternative to noble metal because of not much thermal energy loss [2-4]. We found that temperature dependence of the specific heat and thermal conductivity of the graphene is very different than that of other semiconductors such as Si, Ge. We have that the absorption and photoluminescence spectrum of the nanocomposites have two peaks whose height can be controlled by the external radiation and temperature. Hence these materials can act as thermal and electrical sensors.

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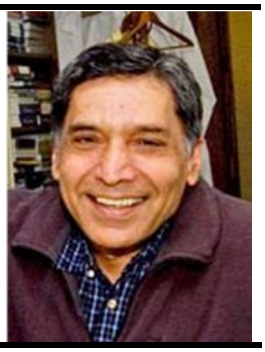

THEORETICAL ESTIMATION AND MEASUREMENTS OF THERMAL CONDUCTIVITY AND DIFFUSIVITY FOR TWO-PHASE SYSTEMS

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The estimation of the thermal conductivity of many kinds of two-phase systems is a problem often encountered in many fields of engineering and sciences. The types of systems vary from the thermal conductivity and diffusivity of metal or other materials-filled polymers to the thermal conductivity and diffusivity of packed beads, porous materials, composites, and foams. Many equations have been proposed for the transport properties, such as electrical and thermal conductivity, of two-phase systems, the oldest theory is derived by Maxwell [1]. Using potential theory, Maxwell [1] obtained an exact solution for the conductivity of randomly distributed and non-interacting homogeneous spheres in a homogeneous medium: This model predicts fairly well the effective thermal conductivities at low filler concentrations, up to 10%; whereas for higher filler concentrations, particles begin to touch each other and form conductive chains in the direction of heat flow, so that this model underestimated the value of effective thermal conductivities in this region. There are many other theoretical as well as numerical and analytical model studies on thermal conductivity of two-phase systems. Generally, the conductivities of the two components and their concentration are considered in all models. Some of these theories neglect several important factors, such as the effects due to the shape of the particles, how the particles pack, and possible anisotropy. The conductivity of a system containing two components is not the same when the dispersed phase is in the form of spheres as it is when the dispersed phase is aligned rods or fibers. Thus, shape and anisotropy of the system should be considered. The conductivity changes with the concentration range near the maximum packing fraction as the particle-particle contacts at this concentration provides a path for the flow of heat.

Many experimental measurement methods for measuring thermal diffusivity and conductivity such as flash method, hot wire method, photothermal radiometry, 3 omega method and other transient methods will be explained and the experimental results for many two-phase systems such as polymer composites and granular materials will be given and compared with theoretical models.

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PREDICTING VISCOSITY BASED ON A MOLECULAR DESCRIPTION

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Industrial process design creates a considerable demand for reliable values of the viscosity of a wide variety of fluid mixtures over extensive ranges of temperature and pressure. The economic case for improving the accuracy with which viscosity is determined is strong; however, the plethora of fluid mixtures and wide range of conditions of interest precludes obtaining the relevant data by experimental means alone. There is, therefore, a clear need for predictive methods that are accurate, reliable and internally consistent.

The modern trends for viscosity prediction are moving away from empirically based methods to those that make use of a sound theoretical framework and are validated against primary experimental data. The Vesovic-Wakeham (VW) method [1-5] is in the forefront of these developments. It is founded on the kinetic theory of hard-sphere fluids that is appropriately modified to take into account the behaviour of real fluids. The molecules of the fluid are modelled as chains of equal sized, tangentially-joined, hard segments. It is assumed that the collision dynamics in such a fluid can be approximated by instantaneous collisions between two segments belonging to different chains. The VW method makes use of mixing rules that are thermodynamically consistent and more importantly have no adjustable parameters. So, far it has been demonstrated that the VW method can accurately predict the viscosity of supercritical mixtures, refrigerants mixtures, natural gas and some alkane mixtures.

Recently the VW model has been extended and used to predict the viscosity of compositionally specified multi-component mixtures that are of interest to the oil and gas industry. In particular, we examine the predictive capabilities of VW model by comparing against accurate experimental data on liquid hydrocarbon mixtures consisting of cyclic molecules and short and long alkane molecules. The experimental data used for validation purposes, covers a wide range of temperatures and pressures of interest to oil industry, including high pressures. We demonstrate that the viscosity of these mixtures can be reproduced, on average, with the uncertainty of 4%. Thus indicting the modelling approaches, based on molecular description, provide us with an accurate, reliable and internally consistent method to predict the viscosity of fluid mixtures over wide ranges of thermodynamic states.

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Oral Presentations

TEMPERATURE-DEPENDENCE OF SURFACTIVITY AND SPECIFIC ELECTROCONDUCTIVITY OF NOVEL IONIC LIQUIDS BASED ON HIGHER ALKANOLS, EPICHLOROHYDRIN AND ETHANOLAMINES

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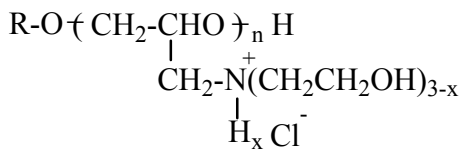
As is known, salts melting at temperatures lower than 100 °C are referred to as ionic liquids (IL). They occupy a special place among modern solvents and catalysts. But ILs have a number of other application fields, too. A wide range of liquid state, low volatility, thermal stability, high ionic conductivity, wide electrochemical "window" and some other particularities stipulate a perspectivity of ILs application in various fields and open a way to "green" chemistry. For us, it was of great interest to obtain and study novel surfactants of IL type.

In the present work new ILs of the following formula have been synthesized on the basis of higher alkanols (C_8–C_{10} and C_{12}), epichlorohydrin and aminoalcohols (di-and triethanolamine):



where R is hydrocarbon group, "n" is chloropropoxylation degree; "x" may be 0 or 1.

The structure and composition of these salts have been identified by IR, NMR- and UV-spectroscopical methods. Their main physico-chemical indices have been determined and a high surface activity of these compounds have been revealed. So, by stalagmometric measurements it was found that at the water-air border these salts lower surface tension from 72.5 down to 32.1 mN/m (20 °C).

By the laboratory tests on the example of thin petroleum films on the surface of water (distilled, fresh, sea and layer) a high petrocollecting and petrodispersing capacity of the obtained salts has been shown. So, using these reagents it is possible to remove ecologically hazardous petroleum slicks off the water surface.

Taking into account temperature conditions of natural water basins, surfactivity and specific electroconductivity of the shown Ils were studied in the range 10-40 °C. It was observed that with an increase of temperature in the indicated interval, the surface tension at the water-air border in the presence of the synthesized Ils decreases, i.e. their surfactivity increases. Main colloidal-chemical (critical micellization concentration - CMC, maximum surface excess, minimal cross-sectional area of the polar group, adsorption effectiveness and efficiency, degree of counterion binding to micelles) parameters were calculated at 10, 20, 30 and 40 °C. Dependence of these parameters from temperature and length of IL alkyl group has been determined. The obtained results show, in general, a decrease in surface tension values at the CMC in homologous series. The same regularity is seen in the efficiency values. Elongation of the hydrocarbon (alkyl) group increases the hydrophobicity of the salt therefore, hydrophobic interactions get enhanced and surface tension becomes lowered. Rise in temperature increases the efficiency of the mentioned salts.

The thermodynamic parameters (Gibbs free energy, entropy and enthalpy of adsorption and micellization processes) were computed for each salt in the shown temperature range.

By electroconductrometric measurements it was shown that with an increase of the indicated Ils specific electroconductivity, at first, sharply rises in a linear mode and then continues to increase linearly with a relatively smaller slope (in the range from ~55 to 75 μS/cm, these values being very much higher than for distilled water). As temperature rises from 10 °C up to 40 °C, specific electroconductivity of the mentioned ILs increases. It is explained by an increase in mobility and a decrease in viscosity with a temperature rise.

CAPACITY BUILDING IN THE DEPLOYMENT OF RENEWABLE ENERGY SOURCES IN AZERBAIJAN

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Increased adoption of renewable energy confronts the energy sector with a number of transformational challenges. Renewable energy technologies are evolving fast and offer a wide range of possible applications. This confronts actors in the already complex energy sector with a variety of skills and capacity challenges that have to be developed. Capacity in the context of renewable energy is the set of capabilities a country needs to nurture, strengthen and sustain the adoption and deployment of renewable energy technologies and systems. The strategy for capacity building for deploying renewable energy should therefore consist of a set of actions in a number of essential areas: institutional, policy and regulatory capacity building, capacity building on financing renewable, capacity of private sector actors, technical capacity building through education and training, capacity in data and information collection, capacity to achieve behavioural change and raise awareness.

In the talk the problems of capacity building in the deployment of RES in Azerbaijan will be discussed and the appropriate possible strategy will be outlined.

EFFECT OF SORPTION AND CAPILLARY PHENOMENA ON PHASE BEHAVIOR AND HYDRATE FORMATION OF N-ALKANES IN WATER SATURATED AND DRIED POROUS MEDIA

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Adiabatic calorimetry is used for investigation of phase behavior of liquid and gaseous hydrocarbons in wettable and non-wettable porous media. N-alkanes (methane, ethane, propane, i-butane) and their two-component and three-component mixtures (methane – propane, methane – propane – heptane, methane – propane – hexadecane etc.) have been measured in the temperature range 200 - 430 K and at pressure up to 40 MPa. Measurements have been executed in the volume and in the dried and water saturated quartz powders with average grain size 2.32 μm and 31.5 μm. Water saturation was about 0.2 – 0.25.

Based on the data of specific heat and of isochoric temperature derivative of pressure, the phase diagrams of hydrocarbons in the volume and in the quartz powders have been plotted. Parameters of equilibrium curves at the phase transitions were determined based on the extremal values of parameters measured at phase transitions.

Effect of sorption is developed as transformation of phase diagrams of hydrocarbons. Method of the experimental assessment of the gas and sorption phase compositions of two and three-component mixtures on the basis of the thermal and caloric parameter measurements is represented. Adsorption isotherms of the investigated hydrocarbon mixtures are plotted.

Capillary effects on phase behavior of liquid and gaseous hydrocarbons are developed as capillary condensation (for water-wet and for hydrocarbon-wet porous media) and capillary evaporation (for hydrocarbon-non wet surface of water which covers the water-wet rock).

The unique aspect of capillary condensation in porous medium is that vapor condensation of hydrocarbons occurs at the pressure that below the saturation vapour pressure of these hydrocarbons in bulk.

Capillary evaporation of liquid hydrocarbons (propane, i-butane) takes place in the quartz powders saturated by water. Surface of water covering the water-wet quartz is lyophobic. Capillary evaporation of hydrocarbons occurs at pressure above than their saturation vapor pressure in bulk. As a result the shift of the liquid – vapor equilibrium line of propane and i-butane in the quartz powders saturated by water with respect to the liquid – vapor equilibrium line of these n-alkanes in bulk takes place.

Due to transformation of the hydrate formation system as a result of capillary effect the shift of the upper quadruple point of propane and i-butane hydrates into the region of the higher temperature and pressure takes place. As result the domains of propane hydrate and of i-butane hydrate stability is enlarged and the state of "overheated hydrate" is developed.

THERMOMECHANICAL PROPERTIES OF MWCNTs/PLACL NANOCOMPOSITES

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Biodegradable, biocompatible, and shape memory polymers such as poly(L-lactide) (PLLA), poly(ε-caprolactone) (PCL), and their copolymers (PLACL) have been widely studied for various pharmaceutical and medical applications such as surgical sutures, tissue engineering, and controlled drug delivery systems. In order to expand the medical application fields, it is very important to give these materials novel functional properties. The addition of MWCNTs can impart such properties to PLLA, PCL, PLACL, and other biodegradable polymers.

Two functional characteristics are considered for MWCNTs/PLACL80 multifunctional composites. The first functional characteristic is shape memory effect and the seconed one is biodegradability. Thermal sensitive shape memory polymers (SMP)s usually have two phases, Crosslinking segment and swiching segment. The physical crosslinking structure, chemical crosslinking structure and hard phase (crystalline or amorphous) act as crosslinking segment. The amorphous phase, liquid crystal phase and low temperature transition of crystalline are serve as switching segment. The SMPs in general exhibit lower strength and stiffness, which limits their use for many advanced applications. The low stiffness of SMPs produces only a small recovery force in the temperature change process. Furthermore, in an effort to boost the naturally low stiffness and low recovery stress of SMPs, efforts are underway to create composites using a shape memory polymer matrix material. Thus incorporation of MWCNTs as reinforcing fillers is considered to improve the mechanical and recovery properties and to diversify the applications of mentioned SMPs.

The shape memory properties of MWCNT-g-PLACLs/PLACL80 and pMWCNTs/PLACL80 composites are investigated systematically by thermo mechanical cycles and the main conclusions are as follows:

(1) The strain fixity (Rf) of the composites almostly keep a stable value with the increase of the fillers content at low initial strain deformation. At high initial strain deformations, the addition of MWCNT-g-PLACLs increase the strain fixity of the composites, however, the addition of pMWCNTs have not significant effect on the strain fixity of the composites.
(2) The addition of pMWCNTs decreases the strain recovery of the composites. When the MWCNT-g-PLACLs content is less than 2 wt%, the strain recovery initially decreases and then increases with the increase of the MWCNT-g-PLACLs content. With further increasing MWCNT-g-PLACLs content up to 3 wt%, the strain recovery decreases again.

(3) The recovery stress of the composites increases gradually with increasing the amount of both kinds of reinforcing fillers. The maximum recovery stress can be obtained at the MWCNTs-g-PLACLs content of 2 wt% and the pMWCNTs content of 1 wt%, respectively. After that, with further increasing the reinforcing fillers content, the recovery stress of the composites decreases. The addition of MWCNTs is beneficial to store the internal elastic energy during stretching and fixing, which leads to the improvement of recovery stress. The strain fixity, strain recovery and recovery stress of the PLACL80 and its composites decrease slightly after degradation in PBS at 37 °C.

MODELING OF THERMODYNAMIC AND THERMOPYSICAL PROPERTIES OF REFRIGERANTS

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In order to analyse a refrigeration system as a thermodynamic or heat transfer system, a complete thermodynamic and thermophysical property sets should be available in computer environment. Thermophysical properties such as thermal conductivity, viscosity, surface tension, and thermodynamic properties of saturated, liquid and vapor phases are needed in a complete system analysis. Thermodynamic and thermophysical properties of refrigerants are modelled as a set of programs in java language in order to simulate and analyse refrigeration systems.

Due to recent adaptations of new refrigerants and phase out of old refrigerants, data for all new set of refrigerations shold be available for utilisation of researchers. International standard office (ISO) is started an afford to make a standard equation of states, and developed equations for some refrigerants as ISO 17584-2005. This standards covers the basic equation of states for refrigerants R744, R717, R12, R32, R123, R125, R134a, R143a, R152a, R404A, R407C, R410A and R507A. The basic equations are in the form of helmholts free energy eqautions for pure gases and mixtures. This standards as is, not covers all the possible refrigerants and the thermodynamic properties of remaining refrigerants can be found from several research papers. Afford of NIST should be specially noted. Data found for the remaining gases covers a varity of equation of states such as Benedict-Webb-Rubin, Martin-Hou, Peng-Robinson-Stryjek-Vera. Equation of states are usually given as a function of temperature and specific volume of Helmholtz free energy or pressure. The remaining properties derives from Legendre transforms of these equation of states called Maxwell relations. In order to use any other set of independent variables requeries root finding methods. Root finding from thermodynamic processes is a challenging process due to enoumous differences in properties of liquid and gaseous state such as specific volume. In order to overcome this difficulty a general form of equation of states with easier methods of root solving such as cubic equation of states can be utilised as first estimation method. For the saturation(phase change) region of the equation of state and for thermophysical properties, it is found out that using cubic spiline and B-spline interpolation methods supply minimum errors in data.

By combining all these methods, numerical models of thermophysical and thermodynamic models of refrigerants R22, R12,R124, R23, R744, R32, R123, R125, R134a, R143a, R152a, R404A, R407C, R410A, R507A, R728, R1150, R50, R702, R508B, R1270, R740, R732, R717, R718, R704, R720, R142b, R402A, R401A, R401B, R1234yf are developed as java programs, furthermore by using these thermodynamic and heat transfer simulations of refrigeration system components and complete systems are developed. Programs are freely avalable for all scientists requires to use such analysis. Program codes are availabale from adress www.turhancoban.com

ACCURATE $P\rho T$ DATA FOR ARGON FROM MONTE CARLO SIMULATIONS USING *AB INITIO* TWO-BODY AND NONADDITIVE THREE-BODY POTENTIALS

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Monte Carlo simulations allow for the calculation of accurate thermodynamic properties of a substance provided that the true intermolecular potential energies are known. We have performed Monte Carlo simulations in the isothermal-isobaric ensemble for argon covering a wide range of density along subcritical and supercritical isotherms. We utilized the accurate *ab initio* potentials of Jäger et al. for the pair interaction energies [1] and the nonadditive three-body contributions [2]. Quantum effects were accounted for by using the quadratic Feynman-Hibbs effective pair potential [3]. Comparison with the best experimental data [4] gives proof to the high accuracy of our results for the gas, liquid, and supercritical phases. We also demonstrate the effects on the results when exchanging the three-body potential for a simple Axilrod-Teller-Muto potential, and what happens when the three-body contributions or the quantum corrections are neglected. We conclude that our approach is able to add accurate values for thermodynamic properties to the available experimental data, especially at extreme temperatures and pressures, and we are confident that it provides the foundation for constructing reliable fundamental equations of state from pure theory for substances where experimental data are difficult to obtain.

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APPLIED INVERSE HEAT TRANSFER FOR MOISTURE CONENT ESTIMATION

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In building, the actual work lies in the thermal characterization scope. An autoclaved aerated concrete (ACC) panel was initially saturated and equipped with thermocouples placed at the boundaries and through the thickness. The tested panel is placed between two test environments. The first environment reproduces inside building conditions, mean values are: temperature ≈ 22 °C and humidity ≈ 35%. The second one reproduces summer outside conditions, mean values are: temperature ≈ 26 °C and humidity ≈ 80%. 20 days thermocouples temperatures recorded were exploited numerically. The numerical analysis is achieved thanks to a Matlab built algorithm. This allows moisture content monitoring through the panel by estimation. The numerical algorithm connects a difference finite numerical model -for heat transfer simulation- to a Levenberg Marquardt estimation algorithm.

Before performing tests on the panel, prior tests were conducted on an ACC block. Prior tests are based on guarded hot plate and heat flow meter methods. This provides the thermophysical properties (thermal conductivity: λ and volumetric heat capacity ρC) evolution related to moisture content (ω). Thus, thanks to the prior experimental work, empirical relationships between these different properties were defined: $\lambda(\omega)$ and $\rho C(\omega)$. The last two relationships are incorporated in the numerical model to connect the parameters (λ, ρC, ω) and thus solve heat transfer equation.

The obtained promising results are a crucial step before the next validation steps - performing other laboratory or in-situ tests applied on different materials - of the developed method.

MATHEMATICAL SIMULATION OF ENERGY-TECHNOLOGICAL COGENERATION COMPLEX

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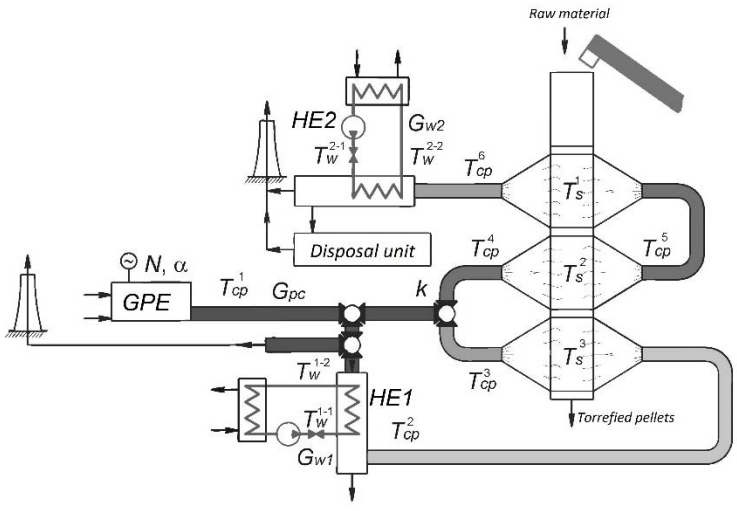
In recent years, the hydrocarbon fuel of plant origin is increasingly being used for energy purposes. The reason for this is development of stand-alone generation, increasing attention to environmental aspects of energy production, availability and renewability of biomass as a fuel, price increase of fossil fuel. A significant place in the balance of biomass usage for energy purposes occupy fuel pellets used both as a domestic fuel and as a fuel for electricity and heating plants. The disadvantage of fuel pellets is their high hygroscopicity, making them difficult to storage and transportation. One way to improve thermal and mechanical characteristics of pellets is the use of technology of low-temperature pyrolysis (torrefaction) [1]. Among the companies working in the field of torrefaction we can distinguish Topell Energy (Netherlands), Thermya (France), Atmosclear (United Kingdom), IntegroEarthFuels (USA) [2]. Despite the interest to the development of technological process and to the creation of installations, realizing it, most of the projects today are in the state of establishing pilot samples. The lack of significant progress in this direction is associated primarily with low energy efficiency of the process and, consequently, unsatisfactory economic indicators of technology.

It is well known that technologies of combined production are almost always more profitable than separate production. A classic example in the energy sector is the use of cogeneration and trigeneration schemes. In Joint Institute for High Temperatures of RAS (JIHT RAS) the research, dedicated to justification of the combined torrefaction technology is being conducted [3]. The commercial production of this technology consists of torrefied pellet fuel, electricity and, if necessary, thermal energy. Schematic diagram of the power technological complex is shown in the figure.

The raw materials (pellets) are loaded into the hopper and subsequently pass three zones of reactor: pretreatment zone, reaction zone and cooling zone (unloading zone). Holdup time in each zone is determined by the desired properties of torrefied pellets (rate of weight loss).

Part of the combustion products of gas-piston engine (GPE) passes through the gas-water heat exchanger (HE1) and then is sent to the cooling zone. After cooling zone the combustion products are mixed in a mixer with hot gas. The mixing ratio is regulated so that the temperature of the combustion products at the inlet of torrefaction zone keeps at a predetermined value. Further, the products of combustion consistently pass torrefaction zone, zone of preliminary preparation of pellets, and then enter the gas-water heat exchanger (HE2) of disposal unit.



The selection of the optimal scheme and composition of energy-technological complex and characteristics of its units and installations, the determination of the optimal operating modes require large amount of variant calculations. For this purpose it is necessary to develop an adequate mathematical model and corresponding program code.

This paper presents the mathematical model of energy-technological cogeneration complex (ETCC) and the program implementation of it. The structure of the ETCC mathematical model consists of mathematical models of main and auxiliary units included in ETCC and inter-

coupling between them, determined by calculation algorithms. The model of GPE is based on empirical relations – bench tests data. Thermodynamic characteristics of combustion products are calculated in the approximation of thermodynamic equilibrium. For the calculation of tube heat exchangers the classic calculation scheme is used.

The mathematical model of low-temperature pyrolysis thermochemical reactor (torrefaction reactor) is based on the conservation equations describing the process of filtering the combustion gases through a porous medium, formed by a layer of pellets. The pellets layer is simulated as a layer of spheres of equal diameter with regular packing. Geometric characteristics of the package are defined in the approximation of linear Darcy's law according to the filtration experiments data.

Calculation program consists of five separate blocks: the calculation block of GPE and properties of the combustion products; the calculation block of the pellets cooling section and combustion products mixing node, the calculation block of the heat exchange, the calculation block of preheating and torrefaction sections and calculation block of heat exchanger of disposal unit.

The software package work results in: capacity of the complex on the main commercial products - torrefied pellets, electricity and thermal energy; efficiency of fuel usage of the complex; operation modes of heat exchangers and combustion products mixer, which define the algorithm of automatic regulation. The results of calculations are presented.

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RUSSIAN AND COMMUNITY OF INDEPENDENT STATES (CIS) SYSTEMS OF STANDARD REFERENCE DATA ON FUNDAMENTAL CONSTANTS AND PROPERTIES OF SUBSTANCES AND MATERIALS

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National Standard Reference Service – NSRDS, was founded in 1965 -50 years ago, as an analogous USA Service OSRD NBS. Russian NSRDS acts on a base of the Federal low "Assurance of Measurement Uniformity" and a corresponding Order of Russian government. Under the frame of NSRDS there was developed around 1000 Data on properties of substances and materials tables and Property measurement methods. They approved by Russian federal agency on standards, have a legal status as a National standard for official using in Science and Technology. According to Agreement between CIS Countries ("Agreement on cooperation on development and use Data on fundamental constants and properties of substances and materials", Russia, Kazan, 2006) there was developed CIS Data System. To the beginning of this year over over 250 Tables and Methods were approved by a corresponding CIS Committee.

APPLICATION OF THE SIMPLEX METHOD FOR SOLVING OPTIMIZATION PROBLEMS OF DISTRIBUTED POWER SYSTEMS

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In recent decades Russia has seen a steady increase in the proportion of decentralized energy production. Applied schemes of small energy systems become more and more complicated: cogeneration and trigeneration, with thermal and electrical batteries, hybrid circuits, including the installation of renewable energy. Such complexes are operated in either autonomous mode or as a part of local distribution grid. The work of energy complexes is usually designed for consumers of housing and social sectors, which are characterized by significant fluctuations in the load: daily, seasonal. All this creates considerable difficulties in choosing the composition and characteristics of the equipment of power facilities, their operation modes and control algorithms. As in «big power», the main trend of distributed energy is introduction of technologies of intelligent control of power facilities and power complexes, smart grids and power distribution systems. All these areas can be combined in one term – «microgrid».

The development of universal mathematical models of power facilities and creation of modern computational programs that allow determining optimal composition, configuration and operation modes of energy complex in reasonable time are necessary for solving the microgrid tasks. Universal program should take into account the daily, weekly and seasonal fluctuations of consumer's load, and also - changing of climatic conditions, if the complex includes installation of renewable energy. The necessity of using large calculation horizons (1 year) with a small time step leads to the large dimension of the task, and the non-linearity characteristics make the task even more difficult to solve. When using the methods of nonlinear optimization calculation time can be decades of hours.

To solve the task of optimization of power complexes of distributed energy we used the method of linear optimization – simplex method. The task, formalized by system of balance equations for the flows of energy with appropriate linearized models of the energy complex components, is reduced to a linear programming task. The purpose of calculations is minimizing the objective function – linear functional, built by the criterion of cost of energy produced. Constructed system of constraints (direction of energy flows, non-negativity of energy amount in accumulators, constraints on their capacity, etc.) reflects the physical essence of the task. To reduce the dimension of the task we consider the conditions of applicability of the decomposition method. Generalized universal model of energy complex includes the entire set of possible within the task elements. A preliminary calculation eliminates from the scheme of energy complex elements with the lowest usage factor. The results of comparative calculations of power complexes of various configurations are presented.

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INFLUENCE OF ILLUMINATION INTENSITY OF ZnO/*p*-Si HETERO JUNCTION STRUCTURE

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In this work, undoped and ruthenium (Ru) doped nanostructure ZnO films were prepared by sol–gel method using spin coating technique. We investigated electrical properties of undoped, 1% and 5% Ru-doped ZnO/p-Si heterostructure in dark and under 20 40, 60, 80 and 100 mW/cm^2 white light (visible light) illuminations using current–voltage (*I*–*V*) measurements. The ZnO/*p*-Si diode exhibits a non-ideal behavior due to the interfacial layer and the series resistance. The values of main parameters such as ideality factors, barrier heights and series resistances obtained from different methods decreased with increasing illumination. It is seen that the values of main parameters obtained from different methods are in agreement with each other.

VAPORIZATION STUDY OF THE [BMIM][BF_4] IONIC LIQUID BY KNUDSEN EFFUSION MASS SPECTROMETRY

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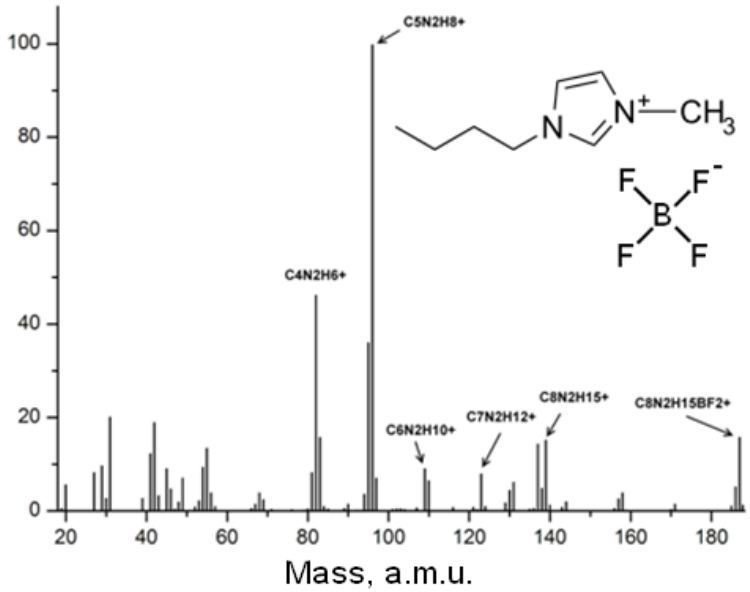
Ionic liquids (ILs) due to their unique physicochemical properties are very attractive objects for industrial applications. Ionic liquids (ILs) have very low vapour pressure within their thermal stability range. Various high performance techniques such as quartz microbalance, transpiration, torsion, and Knudsen methods are currently used for the determination of vapour pressures and vaporization enthalpies of ILs. However, the common disadvantage of all these methods consists in impossibility to determine the vapour composition. This problem can be successfully solved using mass spectrometric approach. However, the mass spectrometric data on vaporization of ILs are still very scanty. This work is devoted to investigation of 1-butil,3-methylimidazolium tetrafluoroborate [BMIM][BF_4] by Knudsen effusion mass spectrometry.

A serial sector magnetic mass spectrometer modified for thermodynamic investigation was used. IL under study (Sigma-Aldrich, 99.9%) was loaded into the molybdenum cell with the vaporization to effusion area ratio of ~400. Gaseous species were ionized by the electrons with energy of 40 eV and emission current of 0.25 mA. Registration of ion currents was performed by Keythley 6485 picoammeter combined with Hamamatsu R595 electron multiplier.

In electron ionization mass spectra at 472 K have been registered the ions presented in figure below which can be considered as the products of detachment of the methyl groups from cation as a result of its dissociative ionization by electrons. Besides, for the first time the fragment ion $BMImBF_2^+$ of ion pair was observed in mass spectra of ILs. The mass spectra did not change with time. It is an evidence of thermal stability of [BMIM][BF_4] within the temperature range 454-515 K. The decomposition of $BMImBF_4$ was also controlled by IR spectroscopy. The IR spectra before and after mass spectrometric experiment were identical that confirm the conclusion on the absence of decomposition $BMImBF_4$. The temperature dependencies of ion currents were measured and the vapor pressure and the sublimation enthalpy were determined.



ACKNOWLEDGEMENT: This work was supported by Russian Foundation for Basic Research, project № 15-03-04770.

INFLUENCE OF DEFECTS ON THE THERMOELECTRIC FIGURE OF MERIT OF Ag_2Se

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In the last few years, it has become important to use semiconductor compounds with a complex structure of energy bands, in which the delay in the onset of intrinsic conductivity is provided for a reasonably high charge-carrier concentration. The materials with such features can be found among silver chalcogenides having a non-spherical isoenergetic surface and a fairly large number of defects. Silver selenide is one of these materials. Silver selenide is a narrow-gap semiconductor, which has large values of electron and defect concentrations, as well as a low thermal conductivity of the phonon.

The assumption of Ioffe [1] that an increase in U/χ_{ph} (U-is the mobility of charge carries, χ_{ph} - is the phonons thermal conductivity) is caused by a change in the kinetic properties of materials, is based on the fact that the additional number of defects is formed during the crystalline-lattice distortion. It means that a decrease in the phonon-phonon scattering is completely compensated by an increase in the scattering at impurities (or defects) [2]. Since the electron wavelength is larger than the phonon wavelength, this leads to the general increase in U/χ_{ph} , which is favorably satisfied in Ag_2Se.

The mentioned features can be the cause of a high thermoelectric figure of merit Z of silver selenide. With the purpose of refining the descerибed features, we investigated the temperature dependences of the electrical conductivity σ(T), Hall coefficient R(T), thermopower α_0(T) and the thermal conductivity $\chi_{ph}(T)$. We list the data obtained for Ag_2Se with the excess of Ag as high as -1,0 at.% and Se as high as 0,1 at.%. The Ag excess leads to an increase in electron concentration to $\sim 6\cdot10^{20}$ sm^{-3}, and the Se excess leads to its decrease to $\sim 1\cdot10^{18}$ sm^{-3}.

As is known [3, 4], the basic parameter of a thermoelectric cell are δ (the quantity determining the cell efficiency) and Z, which also describes its efficiency; they are related by what follows:

$$\delta = \frac{1}{\alpha_0}\cdot\frac{Z}{1+ZT} \qquad (1)$$

where: $Z = \dfrac{\alpha_0^2\sigma}{\chi_{tot}}$.

Due to high concentration of defects in crystal of Ag_2Se they are considered as radiation-proof materials and they can be used in the high-level radiation environment.

KEYWORDS: Thermoelectric power, thermoelectric sensitivity, thermoelectric figure of merit, thermal conductivity, defect.

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PREPARATION AND MEASUREMENT OF HEAT CAPACITY OF HIGH DENSITY POLYETHYLENE –SILVER NANOCOMPOSITES

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Recently, thermally and electrically conductive polymer nanocomposites have attracted considerable attention because of their potential applications in advanced technologies, for example, in light emitting devices, batteries, electromagnetic shielding, anti-static, corrosion resistant coatings, and other functional applications. The introduction of conductive fillers such as graphite, carbon black, metal and metal oxide powders into the polymeric matrix is a promising approach to fabricate electrically conductive polymeric materials. The recent advancement of nanoscale compounding technique enables the preparation of highly electrically conductive polymeric nanocomposites with low loading of conductive fillers. Nanocomposites may offer enhanced physical features such as increased stiffness, strength, barrier properties and heat resistance, without loss of impact strength in a very broad range of common synthetic or natural polymers. In this study the conductive fillers was silver nanoparticles (Ag), the matrix material was high density polyethylene (HDPE). Nanocomposites containing up to 5 volume % of Ag filler material were prepared by mixing them in a Brabender Plasticorder at 180 °C for 15 minutes.

The heat capacity measurement of the samples was carried out at a heating rate of 10 ºC/min between -10 ºC and 200 ºC temperature range. For these measurements Perkin Elmer Diamond DSC (Differential Scanning Calorimeter) was used. Calibration process of the DSC was performed by means of Indium, Zinc and Sapphire samples. Measurements were conducted according to the ASTM E1269 standard.

PLASMA IMMERSION ION IMPLANTATION (PIII) METHOD

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Surface treatments of materials can be done with plastic deformation and especially cold deformation. But, in this method, shape of parts changes. Surface treatment of a part in its final shape can also be done with manufacturing methods such as casting, plastic deformation, welding, machining without any plastic deformation. Various quenching types, carburization, ion implantation in plasma and various nitriding methods such as salt bath nitriding, gas nitriding, plasma nitriding can be given as examples for this situation. Plasma nitriding and ion implantation show some differences from rest of these methods. But, mechanisms of plasma nitriding and ion implantation methods are also different from each other. In plasma nitriding, nitrogen ions (N^+) were accelerated towards to the material surface with low velocities and low forces that were generated with low electric field strengths. Herein, penetration of nitrogen ions (N^+) to surface is mostly takes place with diffusion. In ion implantation, nitrogen ions (N^+) are implanted to the surface of material with high velocities and high forces by applying high electric field forces to nitrogen ions in plasma. Implantation of nitrogen ions to surface takes place due to the high velocities that depend on the high kinetic energies. In this study, treatment of material surfaces with ion implantation is discussed. In this process, nitrogen plasma is generated in a vacuum chamber where also samples are found in. By applying high electric field forces to nitrogen ions (N^+), they are implanted to the surfaces of samples which are electrically negative polarized.

KEYWORDS: Plasma, Ion, Implantation, PIII

SCIENTIFIC BASES OF NEW METHODS OF INFLUENCE ON GASCONDENSATE LAYERS

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At the present time a significant part of the largest deposits of dry gas in Russia are at the falling production stage. In the next decades, the main reserve are added raw material resources base will be accounted for by the deposit containing in gas condensate being most valuable raw materials for petrochemical industry. In size of design condensate recovery factor (CRF) almost 50 % condensate reserves it is connected with objects, for which CRF statement within the range of from 0,6 to 0,7, still for 25 % is below than 0,6. Design factor of extraction sharply decreases in accordance with growth of the content gas condensate. At the content of condensate in gas within the range of from 400 / м^3 and above CRF not exceed 0,6 1. At development of Vuktyl'skij NGCF on natural mode during 20 years CRF accounted for 30%. Such discrepancy of modern design and field values of the CRF is caused apparently by insufficient mechanisms level of scrutiny of filtration of gas condensate mixes in deposit conditions.

Developing of gas condensate fields possibly significant decrease of efficiency of operational wells. Depending on termobar conditions in gas condensate layer one of two modes of filtration is implemented: single-phase, in the case of finding of hydrocarbon mix in beyond stall area of phase diagram of condition, and two-phase, in the case of finding of mix in two-phase area of phase diagram. At the same time gas and liquid phases have various hydrodynamic mobility, therefore at development of gas condensate fields it is necessary to deal with production constantly varying their composition. Process of loss of liquid phase in porous skeleton of the layer at decrease of deposit pressure it is accepted to name retrograde condensation. In the case of occurrence of similar condensate in porous layer space decrease of the fluid charge or even total stoppage of filtration takes place. In such a manner, it is possible to say about formation of gas condensate fuse.

Theoretical researches of filtration of mix of hydrocarbon conducted at present in porous Wednesdays if there is phase transitions showed that arising oscillations of the flowrate the wells are described oscillatory system of oscillatory type. Second by necessary condition of occurrence of such system is finding of gas condensate system in retrograde area on phase diagram, when at mix pressure decline liquid loss takes place. Properties of oscillatory system unambiguously are defined by boundary conditions for pressure (area on pressure on phase diagram of mix is defined) and molar share of easy hydrocarbon at the inlet (Particular point on phase diagram of mix is defined). Presence of areas with zero phase permeability is the base of implementation of feedback of oscillatory system. Depending on properties of oscillatory system and sustained oscillations - occurrence of self-sustained oscillations are possible both fading, Here is system power supply by energy (layer), and energy supply does not take place arbitrarily, and is implemented through actuator actuated by system itself. The actuator acts as feedback between oscillatory system and energy source (layer), supplying supply of energy in necessary moment of the period of oscillations. In such a manner, substantially the concept of hydrodynamic effect is expanded. It is not necessarily wave impact, and any impact (pressure, composition, temperature) of wave type enabling to use layer energy, i.e. to form such control system of oscillatory system of oscillatory type which would supply movement and gas and liquid phases.

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THERMOPHYSICAL PROPERTIES AND CO_2 SOLUBILITY IN IONIC LIQUIDS

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The growing concern of climate change and global warming has in turn given rise to a thriving research field dedicated to finding solutions. One particular area which has received considerable attention is the lowering of carbon dioxide emissions from large-scale sources, that is, fossil fuel power. This article deals with the ionic liquids used as a new medium for CO_2 capture and calculation of their thermophysical properties in a wide range of temperatures and pressures.

We present in this work, the CO_2 solubility in 1-butyl-3-methylimidazolium bis (trifluoromethylsulfonyl)imide [BMIM][NTf_2] or 1-hexyl-3-methylimidazolium bis (trifluoromethylsulfonyl)imide [HMIM][NTf_2] at T = (273.15 to 413.15) K, and pressures up to p = 4.5 MPa are presented. The measurements were carried out using the isochoric method as a function of temperature ranging from T = (413.15 to 273.15) K in decrements of 20 K at selected four different pressure steps ranging from around 4.5 MPa to around 0.5 MPa. The temperature dependency of Henry's law constant was calculated and the average deviation of the Henry's law constant is always better than ±1%. Thermodynamic properties of solution such as the free energy of solvation, the enthalpy of solvation, the entropy of solvation, and the heat capacity of solvation were calculated to evaluate the solute-solvent molecular interactions.

Also, the (p,ρ,T) properties of ionic liquids at T = (273.15 to 413.15) K and pressures at p =(0.101 to 140) MPa were investigated using a new, modernized high pressure and high temperature Anton-Paar DMA HPM vibrating tube densimeter. The thermophysical properties [isothermal compressibility $\kappa_T(p,T)$/MPa^{-1}, isobaric thermal expansibility $\alpha_p(p,T)$/K^{-1}, thermal pressure coefficient $\gamma(p,T)$/MPa·K^{-1}, internal pressure $p_{int}(p,T)$/MPa, specific heat capacities $c_p(p,T)$/J·kg^{-1}·K^{-1} and $c_v(p,T)$/J·kg^{-1}·K^{-1}, speed of sound $u(p,T)$/m·s^{-1}, isentropic expansibilities $\kappa_s(p,T)$] were calculated at high pressures and temperatures, in which the density of ionic liquids were measured. The required heat capacities $c_p(p_0,T)$/J·kg^{-1}·K^{-1} at ambient pressure for these calculations obtained using a Pyris 1 differential scanning calorimeter.

DENSITY MEASUREMENTS OF N.BUTANOL+ ETHYLBENZENE IN THE TEMPERATURE RANGE FROM 290 K TO 560 K AT PRESSURES UP TO 60 MPa

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Density measurements of n.butanol+ ethylbenzene have been carried out in a temperature range from 290 K to 560 K at pressures up to 60 MPa using a density apparatus with a dual path length cell.

For experimental investigation the hydrostatic weighting method has been chosen modified variant of the experimental installation has been assembled. The measurement has been carried out with a maximum error of 0.08 % in the whole state parameter region under study.

A detailed analysis of the concentration dependence of p-V-T data of studied systems has shown, that concentration dependence of the density deviates from the additive it line and changes with temperature and pressure.

The analysis of the given experimental shows that for all the substances investigated the equation of state proposed by Naziyev and Hasanov is suitable:

$$\rho^4 = A + B \cdot p^{0.5} + C \cdot p\,, \tag{1}$$

Where p is the pressure, MPa; ρ is the density of substance, g/cm^3; A, B, C are the temperature (T, K) dependent coefficients. The A, B, C coefficients are calculated for each isotherm by the least squares method and are described analytically as

$$A = \sum_{i=0}^{5} a_i T^i\,,\ B = \sum_{i=0}^{6} b_i T^i\,,\ C = \sum_{i=0}^{6} b_i T^i \tag{2}$$

The equation (1) with account of (2) describes all the experimental data with an average error of 0.05-0.1%. The coefficients a_i, b_i and c_i have the concentration dependences.

The generalization of the experimental data is of great interest in vien of information storage in the form of equation and prediction of properties of the object investigated. The proposed method of a comparative calculation attention of investigators by its simplicity and universality. This method allows to predict the properties of the third solution with the help of the two ones and also to extrapolate the properties of the system.

A NEW VISCOSITY-SURFACE CORRELATION FOR PROPANE

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The exact knowledge of thermophysical properties of fluids with industrial importance is needed for a more accurate basic design of compressors, gas turbines, and gas pipelines. Transport properties of propane, in contrast to the thermodynamic properties, are not sufficiently well known, particularly in the near-critical region. REFPROP 9.1 of Lemmon et al. (2013), the current NIST standard data base, recommends the correlation of Vogel et al. (1998) to calculate viscosity values. This viscosity-surface correlation is characterized by uncertainties of ±(2.5-4)% in their range of validity. It was based on an outdated equation of state of Younglove and Ely from 1987, whereas REFPROP 9.1 recommends the reference equation of state of Lemmon et al. (2009) for calculating thermodynamic properties of propane.

Recently, Seibt et al. (2011) performed new very accurate viscosity measurements including the near-critical region by using a vibrating-wire viscometer combined with a single-sinker densimeter. The uncertainty of these data was conservatively estimated to be ±(0.25-0.4)%, increasing with temperature and in the near-critical region. Consequently, they are considered to be primary data. In addition, viscosity measurements by Wilhelm et al. (2001) were re-evaluated (2011) and have to be considered as primary data, too.

Based on the new reference equation of state and on the improved data situation in the dense-gas region, a new viscosity-surface correlation for propane was generated using the structure-optimisation method by Setzmann and Wagner (1989). The bank of terms comprises expressions for different regions: the limit of zero density, the higher-density fluid region, and the near-critical range. The structure of the expressions for the region near to the critical point was based on the work of Herrmann (2015). Calculated values using the new viscosity-surface correlation were compared with the primary data sets, which were used in the development of the correlation. In addition, the correlated values were compared with values resulting from the earlier viscosity-surface correlations of Vogel et al. (1998) and of Scalabrin et al. (2006).

SYNTHESIS AND INVESTIGATION OF THE NEW AROMATIC 1,2-AMINOTHIOLS AND THEIR DERIVATIVES

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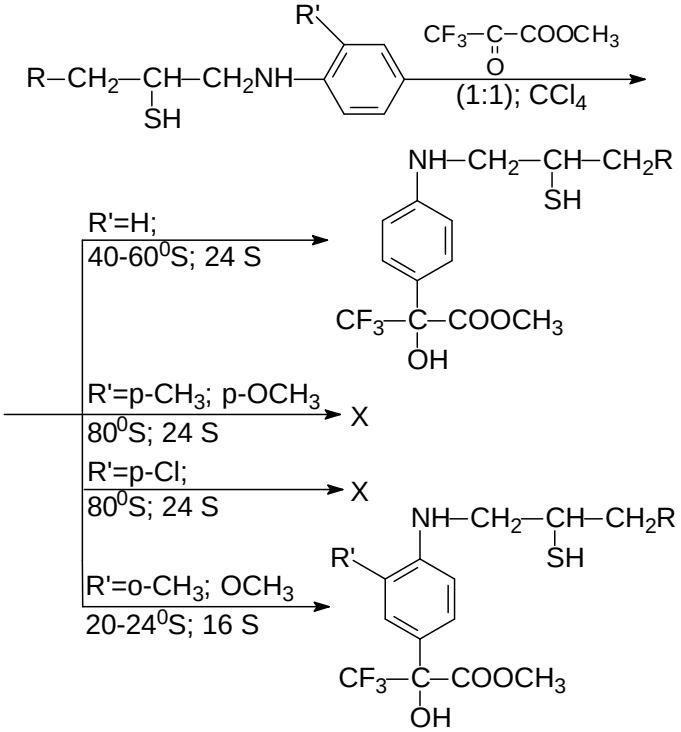
Increase of fuel oils and lubricants stability towards oxidation during the long time preservation and exploitation – one of the actual problems of modern chemmotology. The only way of lubricants and oils stabilization is the addition of the antioxidative additives. The different substituted aromatic 1,2-aminothios have been synthesized and the relationship between their structure and antioxidative properties was investigated. In generally the obtained compounds can be presented as:

$R\text{-}CH_2\text{-}CH(SH)\text{-}CH_2\text{-}NH\text{-}C_6H_4(R^I)$, R – H; CF_3CH_2O; R^I -H; CH_3; OCH_3

1, 2- Aminothiols have been obtained by the interaction of thiirans with different substituted aromatic amines in the following conditions: thiiran : amine = 1:2; reaction time 12 hours; temperature 90-100^{0}C. The reaction was carried out in the sealed tube. The yield was 50-84%. On the basis of aminothiols the new perfluor-containing 1,2-aminopropanthiols have been synthesized. It should be noted that up to date the interaction between 1,2-aminopropanthiols and methyltrifluor pyruvate wasn't studied. The presence of two active groups (NH and SH) into the 1,2-aminopropanethioles molecule allow to assumed that not only C-alkylation but also S-alkylation and cyclization under the influence of strong electrophilic reagent methyltrifluorpyruvate will be able to realized. The results of investigation have been shown that the interaction between 1,2-aminothios and methyltrifluor pyruvate can be realized only in the direction of C-alkylation of aromatic ring in para-position towards NH – group:



Structures of the synthesized compounds have been confirmed by IR- and NMR spectroscopy analysis; purity – by elemental analysis and thin-layer chromatography. Antioxydative properties of the synthesized compounds have been studied by chemiluminescent analysis in petrolatum oil at 200 ^{0}C by means of equipment elaborated in the Institute of Chemistry of Additives of NASA (analog of CHK chemiluminescent installation, elaborated in the Institute of Chemical Physics of National Academy of USSA). It was found that synthesized perfluor-containing 1,2-aminopropanthiols are effective antioxidants for petrolatum oil.

EFFECT OF ADDITION Sn IN TITANIUM ALLOYS

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The main reasons for these studies are increasing of mechanical properties, durability and to expand the application fields. Since 50's years of last century a number of studies and experiments were carried out in the field. Many research investigations are devoted to the influence of the tin (Sn) to titanium alloys. In this paper, the results of the addition tin in Ti-12Mo-xSn (x=2,4,6) group of titanium alloys have been analyzed. There are various studies on the effect of Sn in titanium alloys. As an example, in [1,2] were shown (Ti-Zr) 1.5Mo- xSn (x=2,3,4) group (50Ti-50Zr is base) and Ti-7.5Nb-4Mo-xSn (x=0,1,2,3,4) group alloys.

Surveys exhibit a shape memory effect and superelastic property by changing amount of tin in the (Ti-Zr)-1.5Mo-xSn (x=2,3,4) alloys. In this group of alloys, the most stable superelastic property is observed in (Ti-Zr)-1.5Mo-3Sn. In this alloys the superelastic recovery strain showed a strong dependence on heat treatment temperature after cold working. by the increasing temperature during termal treatment the superelastic recovery strain were increased. The (Ti–Zr)–1.5Mo–3Sn alloy heat treated at 1073 K exhibited excellent superelastic properties with a large recovery strain as large as 7% [1].

During the studies of Ti-7.5Nb-4Mo-xSn (x=0,1,2,3,4) were found that Sn is a strong stabilizer of the beta phase, which is effective in suppressing the formation alpha double prime and omega phases in the alloys. Furthermore, the addition of tin has a significant effect on the mechanical properties of alloys. With the increase of Sn addition, the yield stress of the alloys is increasing, but their elastic modulus, the fracture strength and the ductility is decreasing [2].

Researches on Ti-12Mo-xSn (x=2,4,6) group alloys shows that, addition of Sn is stabilizing beta phase in alloys. As in the previous studies Sn have great impact to the mechanical properties of alloys. Research shows, that the increases amount of Sn and determine the thermal and mechanical enamels, the results are very different from the results of the initial Ti12Mo In studied alloys increasing weight percentage of Sn increases yield point, but young's modulus and elongation is decreased. (Fig. 1).

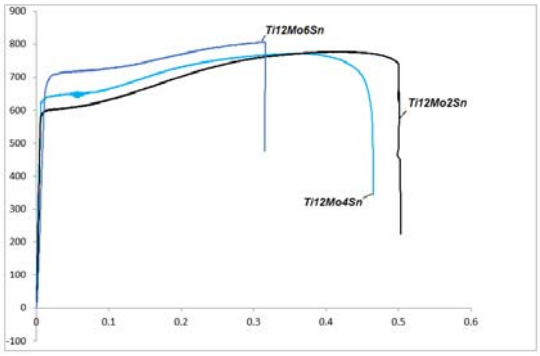

Fig 1. Tensile test results.

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DAMP ASBESTOS-CEMENT WASTE – AS THE ADDITIVE-ADDITIVE TO CLINKER FOR PRODUCTION OF PORTLANDTSEMENT

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Results of researches whenever possible receiving a portlandtsement from clinker with the thermoactivated additive additive as which damp asbestos-cement waste acts are given in work, the way of preliminary thermoactivation of damp asbestos-cement waste by their giving on a layer of the hot clinker leaving the furnace for clinker roasting is described. It is noted that the cement received by a clinker grinding with the thermoactivated asbestos-cement additive additive on physicomechanical properties conforms to requirements of GOST 10178-85 and Öz DSt (State standard of Uzbekistan) 913-98 of all-construction cements and of cements for production of asbestos-cement products. Are developed the standard of the organization (Ts) on the asbestos-cement waste thermoactivated as an additive additive to clinker and the technological instruction (TI) on carrying out process of thermoactivation of asbestos-cement withdrawal for industrial development of the developed technology.

PROSPECTS TO IMPROVE EFFICIENCY WITH REDUCING AGRICULTURAL MACHINES' METAL CAPACITIES

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In this research with using academic V.P.Goryachkin's plow's tractive force's rational formula; plow's metal capacity's efficiency, agricultural machines' effective complex's and increasing productivity of theoretical basis, also theoretical initial conditions of disc plow's force characteristics' and tractive resistance's research's prerequisites were defined. At the same time deformation of the soil with agricultural machines and dynamics of deeply emollient, settlement system of aggregate, dynamic system of plowing were explored. According to rational formula of tractive force's, which was used and proposed agricultural mechanics' fundamentals by academic V.P. Goryachkin:

$$R = fG + kab + \varepsilon abv^2, \tag{1}$$

interpretation of the formula give an opportunity to plow trunk which is used in efficiency.

If we use rational formula (1) of plow's traction, plow's efficiency changes depending on plow trunk's number *n*:

$$\mu = \frac{kabn}{Gf + kabn + \varepsilon abv^2 n} \tag{2}$$

here *n* is number of trunks.

If we mark plow's metal capacity with "*q*" and if we take into consideration $q = \frac{G}{bn}$, we get for efficiency:

$$\mu = \frac{ka}{qf + ka + \varepsilon av^2} \tag{3}$$

We see from the formula (3) that, if "*q*" metal capacity increases "μ" efficiency reduces. Three-bodied plows have minimum material capacity, but if the number of trunks increase, for example eight-bodied plow's material capacity increasing by 1.6 compared with the three-bodied and thus if plow's trunks are more than 3, for each trunk material capacity increases to 13%.

DENSITY AND SURFACE TENSION OF ALLOY URANIUM – CHROMIUM IN LIQUID PHASE

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Method of maximum pressure in gas bubble in two-capillary modification are measured density and surface tension of liquid alloy 94,2 % mas. uranium - 5,8 % mas. chromium in the interval of temperatures $T_{m.p.}$ - 1900K. As method of research method of maximum pressure in gas bubble is chosen. To advantages of method well developed theory, constant updating of the surface of formed bubble during experiment relates, from given one experiment density and surface tension of under study corium receive. However at traditional execution of this method with one capillary tube a series of methodical difficulties arises. First, accuracy of measurement of surface tension is limited of accuracy of registration of the capillary tube immersing depth to corium. Secondly, it is necessary to correct for curvature of the meniscus in the crucible which is defined by boundary angle of coating with the crucible material corium and surface tension of under study substance which can change during experiment In given work two-capillary outline of method of maximum pressure in gas bubble for the first time offered in [1] is realised. Application of two capillary tubes of various diameters immersed to corium, eliminates necessity of the account of curvature of the meniscus in the crucible, and immersing depth enters amendment, size of which is small as compared with measured sizes.

At research of density of high-temperature and chemically active substances because of complexity of filling of pycnometer and difficulties connected with the control of the level of corium in dilatometer, method of maximum pressure in gas bubble becomes to competitive that two the most common methods of density research.

Experimental installation and the technique of execution of measurements are described. Confidential error of received data is appreciated. Experimental data of density and surface tension of alloy uranium - chromium are received for the first time. In investigated temperatures interval properties of corium decrease linear with growth of temperature.

$$\rho \cdot 10^3 = 19{,}11 - 2{,}2215\ T$$
$$\sigma = 2548{,}8 - 0{,}5960\ T,$$

where ρ - density in kg/m^3, σ - surface tension in mN / m, T - temperature in K.

Confidential error measuring ρ and σ are appreciated equal ±28 kg/m^3 and ±52 мN/m. Reliability of experimental data received on given technique on this experimental installation, is recognised in modern reviews and reference books by results of research of density and surface tension of uranium up to temperatures 2100K [2,3].

It is shown that within the limits of accuracy of experimental data of density of uranium and chromium molar volume of alloy uranium-chromium is described by the equation of the type additivity $u_{alloy} = u_1 \chi + u_2 (1-\chi)$, where u_{alloy}, u_1, u_2 - molar volumes of alloy and his components, χ there is a molar concentration of the component.

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EXPERIMENTAL ANALYSIS OF E-GLASS / EPOXY COMPOSITE LEAF SPRINGS

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In this study, experimental analysis were carried out to investigate static response of flat polymeric composite leaf springs for light commercial vehicles. As reinforcement material 600 gr/m^2 by weight, 0/90^0 orientation angles of E-glass and as resin material epoxy were used. Leaf springs were produced by vacuum assisted resin transfer molding method (VARTM) with specially designed mold. After curing process at 80 ^{0}C during 8h, specimens were cut by water jet. Composite leaf springs had approximately 53% fiber volume fraction and 28mm thickness at center.

Tests were conducted by a novel design leaf spring test machine and a novel design link mechanism for flat leaf springs, which have 2014/05721 and 2014/05719 corresponding patent application number to Turkish Patent Institute. Experiments were repeated with three specimens for reliability and conducted according to Society of American Engineers standard of SAE J1528.

Experimental results show that E-glass/epoxy composite spring characteristic and static load carrying capacity are approximately 100 N/mm and 21kN respectively. Results were discussed in detail at the end of the study.

KEYWORDS: Composite leaf spring, vacuum assistant resin transfer method (VARTM), mechanical properties.

THERMAL PROPERTIES OF BSCCO GLASSES DOPED WITH PbO AND Se

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In this study, PbO and Se element were added to the glass ceramic BSCCO system and thermal properties were investigated. For determination of crystallization kinetics under non-isothermal conditions, BSCCO glass samples were first heated at the rates 5, 10, 15 and 20 K min-1 to 850 K. It is known that the start of crystallization temperature associates with the nucleation process, and the peak temperature is related to the growth process. Kinetics parameters were determined for different heat treatment applied samples by using Johnson –Mehl –Avrami –Kolmogorov (JMAK) equations. The values of peak crystallization temperature and glass transition, activation energy have been calculated by using Kissinger, Takhor and Augis Bennett equation.

It is observed that the Tg and Tp values increase with increasing heating rate. PbO together with Se doped glass transition temperature for the samples (Tg) of between 733 ± 0.5 and 749 ± 0.5 K, crystallization to start the temperature (Tc) of 739 ± 0.5 to 759 ± 0.5 K, the temperature of the top point of the crystallization peak (Tp) is 746 ± were calculated between 0.5 and 766 ± 0.5 K. Crystallization activation energies calculated according to Kissinger, Takhor, Augis-Bennett equation were calculated .The activation energy was seen to have risen with the increasing PbO and Se contribution.

THERMODYNAMIC AND KINETIC APPROACH FOR SIMULATION OF FORMATION OF SUBMICRON PARTICLES AT COAL COMBUSTION

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According to [1], the presence of fine particles in air poses a serious threat to public health. These considerations are reflected in the US National Ambient Air Quality Standards (NAAQS) that limit the concentration of $PM_{2.5}$-class particles (i.e., the particles with diameters smaller than 2.5 μm). The emission of submicron particles in the process of coal combustion is one of the sources of such air contamination. The danger comes not only from the particles themselves but also from various hazardous substances (e.g., certain toxic microelements present in coals [2]) that may condense at the particle surfaces. The bulk condensation of vapors of compounds originating from the mineral part of coals in the process of combustion (solid-vapor-particulate pathway [3]) is considered to be a probable mechanism of submicron particle formation. In order to capture the mentioned particles efficiently, one should determine the parameters (such as the concentration of particles and their size distribution) of condensation aerosols formed in the process of combustion. These parameters may be obtained via numerical modeling of the bulk condensation process.

The products of combustion of coals are essentially a multicomponent reactive system. So it is reasonable to apply a complex (thermodynamic and kinetic) approach [4] to simulation of submicron particles formation in this case. In accordance with this approach, the compositions of the gas and condensed phases and the order of condensation of various substances with the reduction in temperature of the combustion products along the processing route are determined first using the methods of chemical thermodynamics. The thermodynamic analysis results are then used at the second stage to determine the desired condensation aerosol parameters by solving the kinetic equation of bulk condensation [5].

The products of combustion of 15 types of power-station coal from different deposits located in Russia and several other countries were the objects under study. The composition of all these coals varies greatly. Their ash content varies from 5.75 to 48.0%, sulfur content varies from 0.3 to 6.5%, potassium content varies from 0.4 to 3.5%, and sodium content varies from 0.2 to 1.9%.

The compositions of coal combustion products were calculated as functions of temperature with the use of the upgraded TETRAN software that was developed under the supervision of one of the authors of the present paper (E.V. Samujlov) and implements the technique for calculating the composition and properties of multiphase reactive systems [6]. A total of 194 compounds formed from 14 atoms were included into the calculations. The calculations were performed for a four-phase system (a gas phase and three condensed ones).

Based on the results of thermodynamic analysis obtained in the first stage, a closed model of the submicron particles formation in the coal combustion products was provided:

1. The formation of condensable components (potassium sulfate) in the gas phase in the approximation of the thermodynamic equilibrium;
2. The formation of condensation aerosol of potassium sulfate considering the kinetics of the process.

On the basis of the computer implementation of the proposed model, a numerical simulation of the bulk condensation of potassium sulfate in the flow of combustion products at their cooling was realized.

According to obtained results, with decreasing of potassium content in the coal the number density of particles increases and their average size decreases. The calculated values of the average size coincide with the experimental data presented in [7], with accepted value of the condensation coefficient of 0.1. The particle size distribution is lognormal. Moreover, dispersion of the distribution increases with decreasing of potassium content in the coal.

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EFFECT OF TEMPERATURE ON METALLIC NANO-HOLE STRUCTURES

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A large amount of research on plasmonics has been devoted to noble metal nanostructures, which to control electromagnetic energy flow on nanometer length scales. The interesting thing about metals is that they have free conduction electrons and their collective oscillations on the surface of metals create quantized particles called surface plasmons. In the presence of photons surface plasmons couple with photons to create new particles called surface plasmon polaritons (SPPs). The study of SPPs is called plasmonics. Metallic nanostructures have applications in biophotonics and sensing. Recently there is an interest in studying SPPs in metallic nano-hole structures experimentally and theoretically [1, 2]. They provide simple way to excite SPPs at perpendicular incidence without varying the angle of the incident beam. It is found that these structures transmit more radiation than that of incident light due to the presence of SPPs in these structures. We have investigated theoretically and experimentally the transmission of light in metallic nano-hole structures in the presence of SPPs. The transmission spectrum is measured for several samples having different radii and periodicities. We found that the spectrum has several peaks. The effective dielectric constant of this structure are calculated by using the transmission line theory [3]. Using effective dielectric constant the SPPs are calculated using the transfer matrix method and it is found that the SPP energies are quantized. A theory of the transmission of light has also been developed using the quantum density matrix method. The transmission expression is compared with experimental results of three samples and a good agreement is found between the theory and these experiments. We found that the location of the transmission peaks in can be modified by changing the periodicity and radius of the nano-holes. This can be achieved by applying an external laser or pressure pulse on the structure. These results can be used to make nanosensors and nanoswitches for medical and engineering applications.

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THE ENHANCED EFFECTS OF ELECTRIC FIELD AND PRESSURE ON THE THERMOPHYSICAL PROPERTIES OF POROUS MATERIALS

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Up to now, the structure and chemical composition of porous zeolite materials have been studied adequately, but there is insufficient knowledge about the physical properties associated with transport phenomena. This situation in particular is related to the electrical and thermo-electric properties. The study of electrical conductivity, thermal electromotive force, dielectric permittivity, dielectric loss, and other parameters are important for the solution of a number of fundamental and applied problems of advanced porous materials. This is true when it comes to determining the activation energy, concentra-tion and mobility of charge carriers, and the relaxation time. Electrical properties of natural zeolite, in practice have not been studied up to now. This is due to a number of objective difficulties namely; formation in nature in the form of small (0.1-0.01 mm to 1 μm) crystals, filling its cavities and channels by water molecules, the difference in the cation composition, the presence of phase boundaries and the presence of impurities [1]. It is necessary to identify the factors affecting the dc conductivity to improve the micro-electro-optic applications of aluminosilicate materials [2]. Therefore, we study the bulk electri-cal conductivity of natural zeolites to understand the thermophysical properties of the porous materials which is required to ensure proper optimization of gas discharge electronic device (GDED). Transport mechanisms were interpreted in details for GDED with zeolite cathode. It was shown that electronic conduction also contributes to ionic conduction which occurs in rare earth cations located in zeolites' inner structure, which occurs due to possible electron multiplication in pores and gas discharge gap. Thus, the main aim of our study was to show how pressure-driven new mixed electronic and ionic transport mechanisms of aluminosilicate materials occur when zeolite plates are used as a cathode in GDED. Consequently, our important experimental result is a required stage for understanding the zeoli-te electrical conduction mechanisms in mode of enhanced electric field.

The electrical characterizations of nanoporous zeolite and transport mechanisms were studied for the first time in a wide operating temperature range (28-800 K), gas pressure (10^{-2}-760 Torr) and elec-tric field strength (60-200 kV/cm) at room temperature. The influence of temperature, gas pressure and electric field on the dc conductivity was described. The resistivity decreased from 2.34×10^{10} to 2.17×10^{8} Ω.m whiles the temperature increased from 28 to 800 K which is associated with the ionic mobility. The existence of water in the channels and pores is the decisive parameter in the ionic transport and it de-pends strongly on the electric field and gas pressure. When a high voltage was applied to gas discharge gap and porous structure, ionization phenomena increased. In this stage, electronic conduction also contributed to zeolite dc conduction. Therefore, understanding of the ionic and electronic transport mechanisms and thermophysical properties of the porous materials are essential in enhancing applica-tions in microdischarge devices with nanoporous zeolite cathodes [3].

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DIELECTRIC-METAL (VAPOUR-LIQUID) PHASE TRANSITION IN VAPORS OF METALS, SEMICONDUCTORS AND IONIC LIQUIDS

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The unified thermodynamic model that allows to calculate the parameters of the critical point and binodal for insulator-metal (vapor-liquid) phase transition in the vapor of various metals, semiconductors and ionic salts (alkali halides) is suggested. The model is based on the assumption that the transition is appeared in a dense atomic gas (gas near the critical point) due to special kind of attraction between the atoms caused by the appearance of the conduction electrons and conduction band. For liquid and solid metallic states this attraction is well known – it is a cohesion (cohesive energy). For atomic hydrogen [1], alkali metal vapors [2] and the gas of excitons [3] cohesion can be calculated analytically for all atomic densities. For most other metals and other substances (such as semiconductors, inert gases, halides et al) having many-electron valence shell, cohesion can be calculated only numerically using the Hartree-Fock method and the density functional theory. For such substances, we used the scaling dependences for energy coupling, generalizing the results of numerous numerical computations and describes a simple and universal expression for various types of binding energy [4] (Universal Bind Energy Relation, UBER). Universal expression for the cohesive energy is defined through evaporation energy, normal density and isothermal elastic modulus of the metal at normal density.

Isotherms for all substances, considered as in [1, 2], when the temperature decreases show the appearance of the van der Waals loops, which clearly indicates the presence of the first order vapour-liquid phase transition. Analyzing the isotherms we can immediately estimate the critical temperature, density and pressure. Calculations are performed for the alkali and alkaline earth metals, Boron group and transition metals, and noble metals, semiconductors (Ge, Si, C, Se, S). We applied our model to the calculation of the critical parameters of the vapor-liquid transition in halides also.

The calculated critical point parameters are in reasonable good agreement with the experimental data for the alkali metals and with estimates of the critical point parameters for most metals made by other authors. The model allows to calculate analytically the vapor-liquid phase transition binodal for all considered substances and to obtain the density of the liquid and the gas phases near the critical point. The liquid phase is a metallic one because it contains conduction electrons. Transitions in liquid metal state precedes the formation of a new, unusual substance – Likal'ter gaseous metal. The analogy of this phase transition in metal and semiconductor vapors is discussed.

Thus, in this work we propose a new method for calculation the parameters of the critical points and binodal of the vapor-liquid transition (insulator-metal) in the metal vapors, semiconductors and halides. All transitions are of the same nature, as described by an unified thermodynamic model, which is based on a single hypothesis about the dominant role of quantum collective interatomic bonding energy – cohesion for condensed matter, and in the gas near the critical point.

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PECULIARITIES OF BEHAVIOR OF LOW RANK COAL-BIOMASS MIXTURES DURING HEATING IN INERT AND OXIDIZING ATMOSPHERE

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Interest to the co-firing of different kinds of coal and different types of biomass is caused by tendency to wider usage of renewable hydrocarbon raw materials in energy purpose and to enhance the consumer characteristics of low-grade fossil solid fuels. One of the purposes of combustion studies of coal-biomass mixtures is to clarify the possibility of predicting the behavior of such mixtures on the base of the characteristics of their components. In the scientific literature there is no common opinion on this subject [1].

In this paper as initial raw materials there were considered coal slack, straw and their mixtures with different mass fractions between components. The coal slack has little content of volatile matters (about 18% by mass) and high ash content (about 47%) in its composition. On the contrary straw has moderate ash content (about 8%) and high content of volatile matters (72%). Investigations were carried out with the help of the analyzer SDT Q600, which allowed applying the methods of thermogravimetric analysis (TGA) and differential scanning calorimetry (DSC). The experiments were carried out in inert (nitrogen) and air atmosphere. The heating rate was equal to 20ºC/min. On the basis of the experimental TG, DTG and DSC curves, measured in nitrogen and in air for straw and coal slack, the corresponding weighted average curves for mixtures of straw and coal slack at different mass ratios between the original components were calculated. Comparison of the calculated and measured DTG curves in nitrogen showed, that when mass fractions of coal slack and straw in a mixture are approximately equal, in the temperature range, corresponding to yield of volatile products as a result of thermal decomposition of straw, there is observed a noticeable increase in the measured rate of mass loss in comparison with the calculated value. In the end it leads to a reduction of mass of solid residue by 10%. Increasing the mass fraction of any component in the mixture results in a reduction of this effect.

Comparison of the calculated weighted average DTG curves with experimental DTG curves in air showed that for all mixtures of straw and coal slack in the temperature range corresponding to oxidation of straw, the experimental values of the rate of mass loss is less than the calculated values. On the contrary, in the temperature range, corresponding to oxidation of coal slack, the experimental values of mass loss rate exceed the calculated values. In both cases the difference between the experimental and calculated values increases with increasing mass fraction of the coal slack in the mixture. The experimental values of heat release are higher than the calculated values practically in the whole temperature range. From a comparison of the TG and DSC curves one can conclude that an addition of straw contributes to a more complete burning-out of the coal slack.

Application of TGA and DSC to investigations of mixtures of coal slack and straw with different mass ratio between the mentioned components made it possible to detect the conditions at which non-additivity of mixture properties as respects to the rates of thermal decomposition and oxidation, as well as to the heat release during burning takes place.

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PHOTOCHROMISM OF THE THIN SOLID SPIROPYRAN FILMS OBTAINED BY THERMAL VACUUM DEPOSITION

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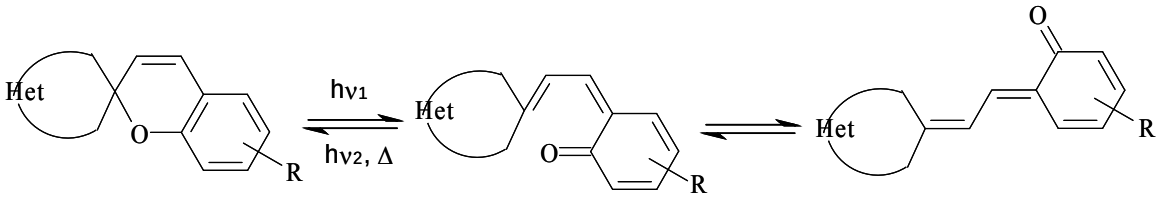
Spiropyrans are among the most important classes of photochromic compounds due to high quantum efficiency of their photoinduced rearrangements by the reversible photochemical broken of the Cspiro-O bond in the 2H-chromene ring [1].



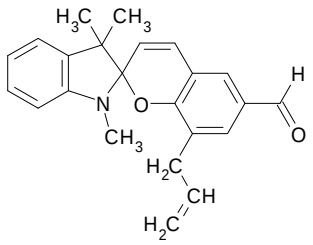
spiropyran *cis-cis*-isomere *trans-trans*-isomere

It must be pointed out that spiropyrans may show their photochromic properties in solution and in polymeric films [1]. For practical applications (recording and storage of optical information, 3–D memory etc.) is very important to use spiropyrans possessing photochromic properties in the solid phase.

New spiropyrans both of indoline and benzoxazine series containing formyl group in [2H]-chromene fragment have been synthesized. Photochromic properties of this compounds thin solid films have been investigated.

Thin solid films of spiropyrans were obtained during vacuum thermal deposition of target compounds onto quarts or glass plates. The VUP-4 apparatus was used for vacuum deposition (remaining pressure ~ $1{,}5 \cdot 10^{-5}$ Torr, temperature of evaporation ~250– 400 °C). Control of the film homogeneity had been realized with the polarity interference microscope MPI – 5 (PZO Warzawa, Poland) by scanning two coordinate axis and observing interference signals. Electronic absorption spectra of the spiropyran thin solid films were taken using "Specord UV VIS" spectrophotometer supplied special rotating mirror. Documator DDB–2 (Germany) unit was used for irradiation.

1,3,3-Trimethyl-6′-formyl-8′-allyl-indoline-2,2′-[2H]chromene **IV** containing free formyl group in 8′-position was synthesized. This spiropyran shows photochromic properties in thin solid films obtained during vacuum thermal deposition onto cooling glass or quartz plates. After irradiation by UV light λ_{max} 365 nm photoinduced form of spiropyran **1** (λ_{max} 567 nm) was generated (Fig.1). The back reaction of the spiropyran **VI** photoinduced form of can run thermally or by visible light irradiation (Fig.2).



1

Among three spiropyrans of benzoxazinone series containing formyl group in 6′ (**2**) or 8′ (**3**, **4**) position only compound **3** shows photochromic properties in thin solid films obtained by vacuum thermal deposition (λ_{max} of photoinduced form 595 nm). However, their light sensitivity is very low.

We have y studied photochromic properties in solid state of two spiropyrans **5** and **6** containing *ortho*–located formyl and hydroxy groups. Absorption spectra of these compounds are represented at Fig. 3. Long–wave maximums of photoinduced forms are at λ_{max} 520 nm for compound **5** and 550 nm for **6** correspondently.

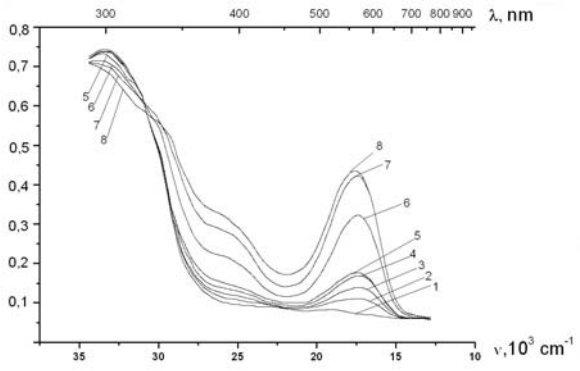


Fig.1 Changing of absorption spectra of thin solid film of spiropyran 1 depended UV irradiation time: 1,2,3,4,5 - 0, 60,120,300, 600 sec irradiation (λ_{max} 365 nm) correspondingly; 6,7,8 – following 60, 300, 600 sec irradiation (λ_{max} 313 nm) correspondingly

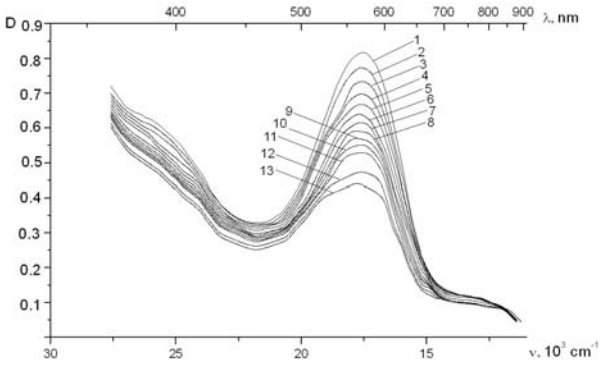
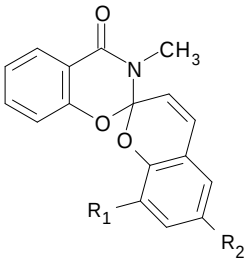
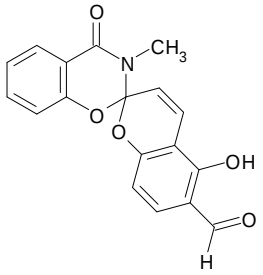


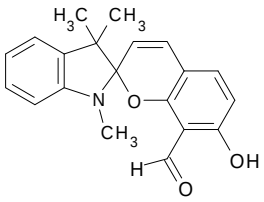
Fig. 2. Changing of absorption spectra of thin solid film of the spiropyran 1 photoinuced form: 1-11 – 0, 180, 360, 540, 720, 900, 1080, 1260, 1440, 1620, 1800 sec after irradiation by UV light (λmax 365 nm); 11, 12 - following 60, 180 sec irradiation by visible light (λ_{max} 578 nm), 13 - following 180 sec irradiation by visible light (λ_{max} 546 nm)



2: R1 = OCH_3, R2 = CHO;
3: R1 = CHO, R2 = CH_2Ph;
4: R1 = CHO, R2 = *iso*-C_3H_7

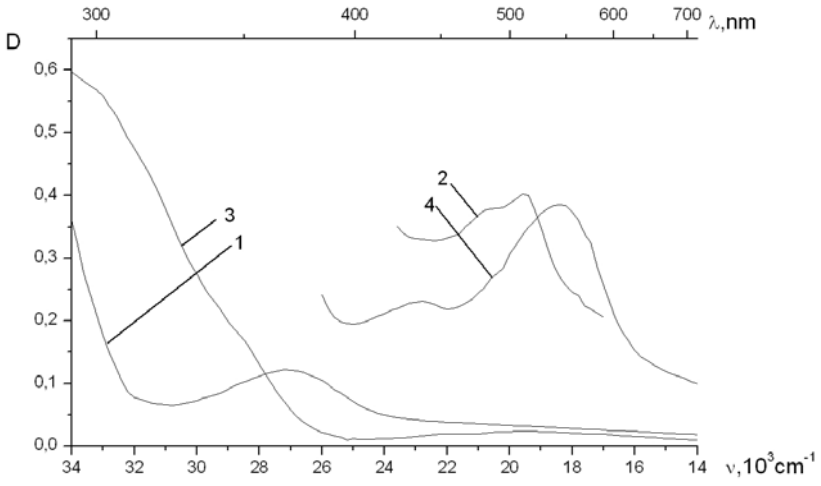


5



+6

Fig.3. Absoption spectra of thin solid films of spiropyrans 5 and 6 before (curves 1,3) and after (curves 2 and 4) irradiation by UV light (λ_{max} 365 nm) correspondently



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CLASSIFICATION OF GEOTHERMAL AND MINERAL WATERS OF AZERBAIJAN

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The surface heat of the Earth is applied in industry, agriculture, communal, medicine in around the world due to exhaustion of energy reserves. In energy production and consumption the main advantage of the use from geothermal energy resources is that, application of them does not require huge amount of financial resources. Possessing the characters of accumulator of underground heat energy of geothermal waters and high heat-energy capacity characterize the thermal water as crucial energy resource between alternative energy reserves. Thermal water holds crucial position in human life. Mineral water has the specific role in types of ground waters. Mineral waters are the natural waters with holding varied biological active mineral components and specific physical-chemical ingredients which are beneficial to human body.

There are mineral water resources in almost all world countries. Also Azerbaijan is rich with mineral waters. The main water resources locate in Istisu, Shusha, Naftalan, Sirab, Vaykhir and other regions. There are more than 1,000 mineral water springs in our Republic. Most of them locate in mountainous regions. Azerbaijan's physical-geography has shrap changing relief structure. That is why, 90% of natural mineral water springs or 905 out of them locate in mountainous and rest one or 98 mineral water springs is in plain regions. The main ingredients of the water are more active in for the "weight". Mineral waters are selected from common ones. There are mixed gases, salts and microelements in their ingredients. Waters have varied physical and chemical characters, qualities in according to the quantities and types of materials in inside. Physical characters of mineral waters include their temperature, colour, smell, limpidity. Temperature of any type of ground waters reflects the thermal regime of surface of Earth. Temperatures of waters in different parts of the world are varied. The temperature of Azerbaijan mineral waters is from 4 ºC to 65 ºC. This belongs to only natural water extractions. However, 95 ºC water is extracted with drilling methods from deep layers in Azerbaijan. In our republic the highest temperature waters are in Donuzuten (64 ºC Masalli) and Istisu (62 ºC Kalbajar). In according to the temperature characters waters with 35-36 ºC are more expensive. The same temperature fit with human body. Their role in medicine is more important. These waters include Khaltan (Shabran district), Ilisu (Qakh) (36 ºC - 42 °C) and others.

ACCESSING THE ACCURACY OF PREDICTED SUBSTANCE PROPERTIES

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Substance properties are crucial for research as well as process development. In many cases experimental data are not available and measurement is time consuming and expensive. Predictive methods, such as group contribution methods, quantum chemistry or other molecular modelling approaches, allow for quick estimates of the missing data. However, if the values obtained from such methods are used it is important to know about their reliability and accuracy. Most methods are published along with some error metrics. Nevertheless, these values are often not useful for a reliable evaluation of the actual accuracy.

The major problems are transferability and assessment of total uncertainty. Limited (or usually unknown) transferability is caused by pure internal validation of the models with missing external validation. In such cases a test for transferability becomes challenging if the whole data base is not available. Even more difficult is the quantification

of the total uncertainty of the model. It has to be kept in mind that uncertainty is not only caused by the scatter of the model but also by the uncertainty of the underlying experimental data.

Total uncertainty of a prediction method can be excessed by different approaches. A mathematically rather demanding approach is a parameter fitting based on maximum likelihood methods. This would not only allow for finding optimized parameters, but also for estimating the distance between estimated and actual values (not only experimental values). A rather straight forward approach is based on error propagation. Assuming statistical independence of experimental uncertainty and deviation of prediction from measurement, an estimation of the combined uncertainty is possible. However, statistical independence has to be checked, since the parameters of the model are fitted to the erroneous experimental data and thus uncertainty induced by the parameters may show a bias concerning experimental uncertainty.

In this work approaches for accessing the actual accuracy of prediction methods are presented and discussed. It will be shown that the uncertainty of predictions can be significantly higher than expected based on the conventional error metrics. To account for this problem an error metric combining both, experimental and statistical uncertainty, will be proposed. Its applicability will be demonstrated on a number of examples from the field of property prediction.

THERMOPHYSICAL PROPERTIES OF IONIC LIQUIDS WITH BF_4 ANION

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Ionic liquids (ILs) are a salt in the liquid state, which are very popular substances using in the industry during the last two-three decades. They have been suggested as potentially "green" replacements for conventional organic solvents since they are nonvolatile (negligible vapor pressure), nonflammable, thermal stable, and recyclable. ILs are also claimed to be useful as heat transfer fluids in solar heating and absorption refrigerating systems, mass spectrometry, supports for the immobilization of enzymes, in separation technologies, as liquid crystals, templates for the synthesis of mesoporous, nano-materials and ordered films etc. Such wide range applications of them require high quality thermophysical properties, like as density, gas solubility, surface tensions, viscosity, diffusion coefficients, thermal and electrical conductivities.

This work is a continuation of our investigations in the field of (p,ρ,T) properties of ILs. The new accuracy (p,ρ,T) data of ILs 1-butyl-3-methylimidazolium tetrafluoroborate [BMIM][BF_4], 1-hexyl-3-methylimidazolium tetrafluoroborate [HMIM][BF_4] and 1-methyl-3-octylimidazolium tetrafluoroborate [OMIM][BF_4] at the wide range of temperature and pressure [T=(273.15 to 413.15) K and pressures up to p=140 MPa] are reported with an estimated experimental relative combined standard uncertainty of $\Delta\rho/\rho$= ±(0.01 to 0.08) % in density, which were investigated using a Anton-Paar DMA HPM vibration-tube densimeter. The density measurements at ambient pressure were carried out using the Anton-Paar DSA 5000 density and sound of speed measurements. The heat capacities at ambient pressure and various temperatures were measured using the differential scanning calorimeter Pyris 1.

An empiric equation of state for fitting of the (p,ρ,T) data of ionic liquids with BF_4 anion has been developed as a function of pressure and temperature. This equation together with the heat capacity values was used for the calculation of the thermophysical properties of IL, such as isothermal compressibility $\kappa_T(p,T)$/MPa^{-1}, isobaric thermal expansibility $\alpha_p(p,T)$/K^{-1}, thermal pressure coefficient $\gamma(p,T)$/MPa·K^{-1}, internal pressure $p_{int}(p,T)$/MPa, specific heat capacities $c_p(p,T)$/J·kg^{-1}·K^{-1} and $c_v(p,T)$/J·kg^{-1}·K^{-1}, speed of sound $u(p,T)$/m·s^{-1}, isentropic expansibilities $\kappa_s(p,T)$ at high pressures and temperatures, in which the density of ionic liquids with BF_4 were measured.

USING POSSIBILITIES OF THE GREATER CAUCASUS THERMAL WATERS IN THE POWER ENGINEERING AND OTHER FIELDS OF AZERBAIJAN

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Traditional energy sources (oil, natural gas and coal) countries reduce the rate to ensure its energy security and diversification of the energy sources. In this case, it is important to pay attention to the development of renewable energy sources (RES), including the use of thermal waters in order to achieve any success in sustainable energy economy. World experience shows, that developing of RES stimulates the creation of new jobs to the development of regions and gives impetus to the development of economic gain additional RES.

Only about 1% of the RES include to the global electric power production. Obe of the RES is using of heat energy from thermal water soruces.There are many thermal electric heating systems in the Central American country, in Europe, in Philippines, Iceland etc. Icelanders using of thermal waters can be an example model for the other countries [1]. Thermal energy sources are using in the steam turbine, where hot water vapor generate the electricity in the turbines.

Thermal water, not depending on the time of year and day, also from other factors is inexhaustible. The advantage of using thermal water does not require the use of a large financial investment in energy production and consumption. Thermal energy compare with fossil fuels needed lower production costs up to 80 percent compared and no additional fuel necessary to generate electricity. The capacity of thermal power stations was 5000 MW in 1990 years, up to 6000 MW in 2000 years, but it was increased up to 10500 MW in 2008 year.

Attending of enough of high temperature (t= 30 - 97 ºC) thermal waters in the territory of Great Caucasus side of the Republic of Azerbaijan make possible to use of them as the production of energy. Such prognoses can help for suppling of electricity in the Great Caucasus, Absheron peninsula, and Capsian Sea coast – Guba regions. At the present time, there are no thermal electric power stations, but the wide range activities are doing in this field. Various energy generators are testing in the Azerbaijan side of the Great Caucasus region [3].

Prognosis of the exploitation stocks of thermal waters of the great Caucasus is about 43654 m^3 per day [4]. Dependence from exiting pressure and temperature of thermap waters in the Azerbaijan side of the Great Caucasus region they can be use in heating and energy sections.

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FATIGUE STRENGTH AND STRUCTURAL RESEARCH OF SINTERED STEEL DISTALOY AE

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High temperature sintered Fe-Cu-Ni steels have been quite popular in Japan and Europe for their balanced strength-toughness performance. Excluding the nonconforming forging data from the evaluation, the scatter bands of plane bending and axial loading overlap with a statistical superiority of the bending results.

The basic mechanical properties are a long term structured accumulation of results obtained under semi-industrial conditions. There is no other single source offering a similar wealth of information. The drawbacks are that the data are related almost exclusively to a single powder manufacturer and that the cooling rates from the sintering heat must not necessarily match those of industrial furnaces. This may cause deviations from the values presented here, if the material considered tends to transform at least partially into bainite or martensite.

For the higher strength range samples were manufactured from the widely used Distaloy family of steels containing 4 % Ni, 1.5 % Cu and 0.5 % Mo which are diffusion bonded to pure iron to prevent segregations and maintain highest compressibilities. All powders were blended with 0.5 fine graphite and in most cases with additions, which were expected to change the pore morphology. As additions powder boron were used. Further the standard grade, Distaloy AE, based on water atomised iron was made from a coarse powder > 45 µm and a fine fraction < 45 µm and compared with the same alloy based on sponge iron. The specimens were compacted with 600 MPa in the R & D department of Höganäs AB, Sweden, were the sintering took place in semi-industrial equipment at 1120 ºC in a non-decarburizing protective atmosphere. The cooling rate between 800 and 500 ºC was 1.0 ºC/s. Plane bending fatigue tests were performed with 60 specimens in six stress levels per S-N curve, which permits to evaluate the data statistically and to determine a rather reliable endurance limit for a failure of survival probability of 50 %.

In a fracture are visible pore, which have got the extended form during deformation of sintered steel. The part pores has revealed at destruction. As a whole character of a break viscous, a plenty large and fine hole is visible.
In order to improve the mechanical characteristics of sintered materials, it is increased necessary, the density to. In order to avoid an increase of the density through atrophy or a swelling preserving the sinters, but to simultaneously reach higher mechanical characteristics, is used in this work Distaloy AE as a basis powder.

Application of an electronic microscope has allowed revealing laws of a microstructure of fracture which it is accepted to allocate special area fractography. The small cyclic weariness is in most cases connected to action of high stress, therefore features of a structure, characteristic for fracture of a cyclic overload are inherent in fractures.

Fractures considered by us are characterized by presence of appreciable traces of plastic deformation, is especial on a site of final destruction. The microfractography analysis has shown in the centers of fractures and near to them presence rough microfatigue strip, that testifies to action significant on size of repeated stress.

GENERALIZED PRINCIPLE OF CONGRUENCE IN CRITICALITY OF PURE COMPONENTS AND MIXTURES

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The classical principle of thermodynamic congruence originated with van der Waals (vdW) who applied it to express the properties of binary mixtures in terms of the simple vdW-EOS for pure components by the well-known *one-fluid model*. The hypothesis about the existence of a wide vdW-like class of so-called *global fluid asymmetry* (GFA) between the liquidlike $(l;\rho_l \geq \rho_c)$ and gaslike $(g;\rho_g < \rho_c)$ equilibrium states (including the orthobaric ones) was formulated and extended recently by authors to the range of near-critical universal behavior of real fluids and mixtures. Particularly, the consistency of the independently predicted in the framework of the fluctuation thermodynamics' (FT) model *critical exponents* and *amplitudes* with those well-founded by the scaling theory of critical phenomena was established and confirmed *for l-states*. To extend the FT/GFA-methodology for the much more complicated (possibly, heterophase) behavior of *near-critical g-states* the generalized principle of congruence is proposed in this work as the essential addition to the fundamental principle of scaling isomorphism. The *universal for any real fluids* extension is formulated in terms of the *effective non-singular finite-range pair potential* and the generalized Ornstein-Zernike (OZ)-formalism of the *total and direct correlation functions' integrals*. It seems that such approach is promising if one wishes to have a global fluid theory based on the specified microscopic interactions, rather than a crossover theory, limited to the non-analytic behavior close to the actual critical point and to the mean-field behavior far away from it. The crossover theory ignores the realistic features of a pair potential and *its substance-dependent cutoff radius* while the mean-field antipode of the scaling theory adopts an existence of the artificial infinite-range interactions. The proposed generalized principle of FT/OZ-congruence omits any signs and arguments of analyticity due to the GFA-hypothesis but provides the well-defined prediction of criticality, separately, in the regions of its *g*- and *l*-states.

INVESTIGATION OF MECHANICAL PROPERTIES AND NUMERICAL SIMULATION OF FRICTION STIR WELDED 7075 ALUMINUM ALLOYS

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Friction stir welding which developed in 1991 for aluminum alloys has been continued to progress nowadays. In this study, microstructure evolutions and effect of heat transfer mechanism on friction stir welded 7075 aluminum alloys were investigated. For this purpose, friction stir welding of 7075 aluminum alloys carried out with combination different rotational speed and welding speed. Temperature distribution around the welding region was measured during the welding by using the non-contact infrared thermometer and K-type thermocouple. Mechanical properties of welded plates were examined from the point of tensile strength, microstructure and hardness test.

Plates joined by FSW were modeled as three-dimensional solid for the finite element analyses. Simulation of the welding processes was carried out by using ANSYS software. APDL (ANSYS Parametric Design Language) codes were developed for the transient nonlinear finite element analyses. The thermal analysis was modeled by taking into consideration the heat transfer from the pin and shoulder to the plate.

Finally, mechanical properties of 7075 aluminum alloy plates joined by the FSW were discussed in terms of stress and microstructure. Then these results were compared with the numerical results.

DETERMINATION OF POLLUTION SOURCES AND ECOTOXICOLOGICAL EFFECTS OF WATER ENVIRONMENTS IN ARDAHAN, TURKEY

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The aim of this study was to determine the effects of water pollution on the water environments in Ardahan, Turkey. Kura River, which is a trans-boundary river that runs into the Caspian Sea, Lake Çıldır and Lake Aktaş were exmined whether the pollution sources are of anthropogenic or natural origin. Although monitoring the quality of the Kura River is of international importance, there has been no study on its water and sediment quality within the borders of Turkey. The ecotoxicological studies on Lake Çıldır and Aktaş were performed between 2013-2015 by our team. The water and sediment quality of Kura River's were determined and the ecological risk threshold by evaluating annual changes in water quality were established. The Chemical Oxygen Demand (COD) of Aktaş Lake was144 mg/L which was the highest between all water environments. The amounts of heavy metals (Cu, Pb, Zn, Ag, Ni, Mn, Hg, Cd, Al, Fe, As) were measured and Cd and As were at the highest level in all water environments in Ardahan. The heavy metal enrichment using multiple elements analysis (ICP-MS) was found in samples of alluvial soils formed on the river flood plains. The detailed physico-chemical analysis of samples taken from the Kura River revealed that, in particular, anthropogenic pollution occured between 2012-2015 in water environments. The most possible pollution sources of heavy metal enrichment could be usage of fossil fuels for heating and agricultural activities.

INVESTIGATION OF GEOTHERMAL WATERS OF SOUTH AZERBAIJAN AND WEST TURKEY

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Azerbaijan and Turkey possesses rich water (geothermal, mineral and river water) resources. Various thermal water resources of these countries has temperatures up to ~140 °C. Mainly, these resources potentially use for bottled water production, medicinal purposes, for spas and health clinics that utilize the waters to treat arthritis, dysfunction of the nervous system and skin diseases. But they can be also used for: thermal heat, for warming soil, hotbeds and hothouses with the aim of early and rapid growth of vegetables and fruits (40-50 °C). In this filed, Turkey have more knowledge and there are many alternative energy installations already installed in the country. There are some installed energy equipments in Azerbaijan also and this work developing speedily.

In the presented work, we will inform the thermophysical properties of geothermal waters of south Azerbaijan (Yardimli region) and west Turkey (Chesme and Hitit Ayash Thermal). The thermal waters of tehse regions have high exiting temperature, high mineralization, which make them good candidates for using in domestic and medicine purpose. For example, the Hitit Ayash Thermal Health center has all possibilities for the medical therapie of patients. Various medical and touristic centres have the Yardimli thermal waters. To use the thermal water resources in medicine, alternative heating source or domestic use, the investigation of the chemical and thermophysical properties of a wide range of parameters must be investigated can. In this work, the thermopysical properties of investigated thermal waters were studied in the wide range of temperature and pressure.

The first investigations were the analysis of chemical compounds using a IRIS Intrepid II Optical Emission Spectrometer and DX 100 ion chromatography. The (p,ρ,T) behaviour at T=(274.15 to 413.15) K and p=(0.101 to 100) MPa using the DMA HPM vibrating tube densimeter; density measurements at T=(278.15 to 363.15) K and p=0.101 MPa using the DMA 5000 vibrating tube densimeter; vapor pressure measurements at T=(274.15 to 413.15) K using the two different static method installations and viscosity measurements at T=(278.15 to 343.15) K using a SVM 3000 Stabinger Viscometer will discussed in this presentation.

The thermal water samples were filtered and degassed slowly using the vacuum system. To stop vaporisation of pure water, the vacuum procedure was very slow (the groove of the flask valve, which held the sample, was very slightly opened). These investigations have been examined for the first time.

An empiric equation of state for fitting of the (p,ρ,T) data of these thermal water samples has been developed as a function of pressure and temperature. The molecular weight of thermal waters was analysed. The fitting of properties of thermal water resources are discussing. The equation of state is used for the calculation of the thermophysical properties of IL, such as isothermal compressibility, isobaric thermal expansibility, thermal pressure coefficient, internal pressure, isobaric and isochoric heat capacities, speed of sound and isentropic expansibility.

THERMAL CONDUCTIVITY AND VISCOSITY OF Ag-WATER NANOFLUIDS

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It has been almost two decades since research started on nanofluids, potential heat transfer fluids of next generation. Although many studies have been published on the subject, there are still inconsistent and contradictory results between the reports. In this study, thermal conductivity and viscosity of Ag – deionized water nanofluids with different particle concentrations (0.25 to 1% weight) were studied experimentally, and the results were compared with the effective thermal conductivity and effective viscosity models from the literature. Thermal conductivity measurements were performed by 3-ω method at 20 ºC, room temperature. Results show that there is no anomalous thermal conductivity enhancement for the samples. For viscosity measurements, experiments were carried out by Brookfield DV3T model rheometer for the temperature range of 20-50 ºC. The results of the rheological measurements indicate that, nanofluid samples show a Newtonian fluid behavior and Einstein model, one of the classical effective viscosity model, fails to predict the viscosity of nanofluid samples.

A METHOD FOR PREDICTING THERMAL PROPERTIES OF POLYMERIC NITROGEN AT EXTREME CONDITIONS

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Difficulties of experimental investigation of thermal properties of materials under extreme pressures and high temperatures results in to an increase in the role of theoretical methods for predicting the behaviour of highly compressed substances. In this paper we discuss the equation of state of polymeric phase of solid nitrogen at extremely high pressures and temperatures, based on results of Monte Carlo computer simulations [1]. A method for predicting thermodynamic properties of substances at extreme parameters of state based on combination of theoretical equations of state and results of computer simulation as well as *ab initio* quantum mechanical calculations data was developed. It was applied in thermodynamic properties calculations of the polymeric *cubic gauche* phase of nitrogen and uses the equation of state, which combines the modified Mie-Grueneisen model and anharmonic corrections to the Helmholtz free energy of a solid [2].

We discuss the effect of negative thermal expansion of polymeric nitrogen found earlier [1]. This effect is manifested both in the polymeric crystalline *cubic gauche* phase and in amorphous polymeric nitrogen state. It plays an important role in explaining the specific features of thermodynamic behaviour of the polymer phase and in the configuration of the phase diagram of nitrogen at high pressures. Theoretically predicted PVT-data are in good agreement with the existing limited experimental data [3].

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MOLECULAR DYNAMICS STUDY OF HIGHLY COMPRESSED DIATOMIC SOLIDS NEAR THE MELTING LINE

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Maximum of the melting temperature first predicted in *ab initio* simulations of highly compressed molecular hydrogen [1] has been extensively discussed in the literature during the last years. Despite serious difficulties in thermophysical measurements at megabar pressures and elevated temperatures, a lot of efforts have been made by experimentalists to prove the existence of such a maximum. Finally the turnover in the melting line of hydrogen has been confirmed [2]. A similar behaviour of the melting line was observed in nitrogen in the pressure range 50-80 GPa [3]. There are different points of view on what the physics is behind this effect, in particular, specific changes in the intermolecular interaction during melting have been assumed as its reason [1,4]. However, similar maxima of melting temperature observed in other molecular systems, particularly in carbon and water, gave some grounds to suppose that the origin of the turnover effect may have a more general reason.

The study of transitions between disordered phases and crystalline phases having different symmetry is a serious problem for molecular dynamics (MD) simulation technique. Nevertheless in this work MD computer simulation was applied to study relative stability of molecular liquid and solid phases of nitrogen and hydrogen at high pressures. The pressure dependence of melting temperature of solid nitrogen and hydrogen was determined at high pressures using the combination of several methods: single-box (single-phase and two-phase in the box) and two-box, and the results of these two types of MD simulations were compared. Conditions, corresponding to maximum melting temperature of hydrogen at extreme pressures were found and possible explanations [5] of the turnover of the melting line discussed. Molecules forming the solid were considered as non-rigid strongly bound pairs of atoms. Intermolecular interaction was represented by the sum atom-atom and quadrupolar forces and the influence of the quadrupole interaction on the stability of different phases examined. It was also found that quadrupolar forces have only a weak influence on the structure, energy and pressure, but significantly affect the stability of the crystalline structures and the shape of the melting line on the phase diagram.

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INVESTIGATION OF BENDING PERFORMANCES OF FOAM CORE SANDWICH COMPOSITES

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Laminated composite materials have superior in plane mechanical properties such as stiffness and strength. To overcome their low bending stiffness problem without significant weight increase, sandwich composites can be preferred. Sandwich composites have been used popularly in marine, wind turbines, space and aircraft vehicles. Sandwich composites are composed of the core, which is lighter but thicker and has lower strength, and the face-sheets, which are rigid and stronger. Sandwich composites' rigidity depends on the core material thickness. Rigidity increases with increasing core thickness. However this increase could not be possible every time and everywhere due design limits. It is aimed in this study to investigate the bending performance of sandwich composites with some improvements.

Sandwich composites were manufactured using PVC foam core and multidirectionally placed unidirectional glass fiber mats by vacuum infusion method. Four different types of sandwich composites were manufactured. First type of specimen, which has unperforated core with 20 mm thickness, is selected as the reference material. The other specimens have perforated cores with 10 mm, 15 mm and 20 mm thicknesses. The holes have predetermined diameters punched with determined intervals. During infusion process epoxy filled in the holes of the perforated cores and after curing they behave like columns. Bending tests are performed according to ASTM C393 standard for all types of the specimens and the results are compared.

From experimental results it is concluded that epoxy columns increase the bending loading capacity and rigidity of the investigated sandwich composites. It is also seen that there is the possibility of acquiring similar bending performance with thinner sandwich composites.

KEYWORDS: sandwich composite, bending, glass fiber, epoxy, PVC foam.

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DEVELOPMENT OF RENEWABLE ENERGY SOURCES STORAGE SYSTEM

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The renewable energy systems including solar and wind power plants are widespread now. The main problem of using renewable energy sources (RES) systems is storage of electric power for providing secure consumers supply. It is necessary to have a reservation system which store energy in the period of its redundant production and spend energy when it necessary for secure consumer supply. Hydrogen technologies are considered to be the most promising direction in energy storage. Today researches in USA, Japan, European countries are concentrated their efforts in this direction. In Russia such researches are carried out in the Joint Institute for High Temperatures of the Russian Academy of Sciences (JIHT RAS), Moscow and in Research and Design institute "Rostovteploelectroproect (ROSTEP), Rostov.

Hydrogen application solves the problems of wide-scale power sector development based on renewable energy sources: sun, wind, hydraulic. At the time of manufacture of excessive amounts of the electric power on RES installations production of hydrogen in electrolyze installation and further his accumulation is carried out. Then accumulated hydrogen is used for generation of electric and thermal energy. One of the most promising directions of accumulated hydrogen use for electric and thermal energy production is gas piston installations.

Untill now, gas piston installations running on pure hydrogen are not designed. It is connected with detonation combustion of fuel with high hydrogen content at it use as fuel in the internal-combustion engine. Basic opportunity of modification gas piston installations for work on hydrogen fuel is demonstrated during complex of researches performed in JIHT RAS. Concept "work on hydrogen" includes use of hydrogen with some additives, for example, with using of combustion products recycle, or methane additives. The condition of use of gas mixes based on hydrogen as fuel for internal-combustion engine is that with the use of "additives" loss of capacity with reference to use of pure hydrogen should not exceed 15 %.

A result of feasibility study of the demonstration sun-wind installation with hydrogen storage is present. It is planned that this installation may be constructed in the place not having today centralized supply by electric and thermal energy. This installation can include sun-wind power plant with the system of storage and reserving of electric power, the system of production and hydrogen storage and gas piston power plant using hydrogen as a fuel. Parameters of designing installation are following:
- total installed power - 1800 kW, including:
- photo-electric sun installation - 1000 kW
- wind electric installation - 600 kW
- gas piston installation - 200 kW.

It is shown that the construction of given installation is the project of high investment attractiveness.

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DISTRIBUTED POWER SYSTEM ON LOCAL FUEL-ENERGY RESOURCES

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The technical and economical comparison of various technologies of distributed power system is presented in this report. Ranking of various technologies of distributed power system from the standpoint of financial and economic efficiency is considered. The problems connected with the local fuel resource using for distributed energy are considered.

There are two technologies are necessary for development of distributed power system on local fuels. The first one is production of fuel from biomass which can replace hydrocarbon fuel in existing power plants. The second problem is production of energy gas from the biomass which can be used in power plants as a fuel for combined heat and power production. As a rule, for these purposes gas turbine and gas piston installation are considered. Today replacement of hydrocarbon fuels including coal in energy installations to local energy resources is a problem, decision of which is one of the most important tasks of power distributed system development. But wood has smaller heating value in comparison with coal, smaller specific gravity, the wood should be stored dry otherwise at the expense of absorption of moisture from atmospheric air wood humidity is increased considerably. The coal is hydrophobic, i.e. does not absorb moisture at storage. Fuel transmitted on pipelines does not change its properties at transport and storage.

Torrefaction is technology of low temperature pyrolysis at temperatures 250-280 ºC, that can provide hydrophobic properties of processing biomass fuels, increasing of heating value (by 20-25%), and decreasing of bulk weight (by 25-30%). Studying and optimization of the torrefaction process are carrying out in many science centers.

The second direction of biomass using for energetic purposes is development of technology for conversion of biomass into fuel gas with increased heating value. At present, there are two processes for energetic gas productions from biomass notably pyrolysis and gasification. The main disadvantage of existing biomass technologies is the presence of liquid phase in gaseous reaction products. This liquid phase consists from high molecular hydrocarbons and its presence can lead to formation of carbon deposits inside energy producing installations. Thereby existing processes of biomass thermal conversion such as pyrolysis and gasification cannot be used for distributed energy.

Technology, which is meeting the modern requirements for distributed energy is developed in JIHT RAS. The main advantage of the technology is production of energy gas free of liquid phase. The technology has a high degree of energy conversion of processed biomass into gas fuel energy. In developed JIHT RAS technologies this ratio is 0,75 - 0,80. Amount of produced gas is about 1,4 nm^3 by 1 kg of the raw material, and heating value of the produced gas is about 11,5 MJ /m^3. The technology allows carrying out an effective processing of local fuel-energy resources with production of dry energy gas with enhanced heating value, which can be used effectively as a fuel for distributed energy systems.

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Poster Presentations

RELIABILITY OF CONSTRUCTION OF LINEARLY EXTENDED FACILITIES

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Leading organizational and technological indicators are very important in assessing the reliability of design decisions on organizing the construction of linearly extended facilities. The resulting fluctuations and deviations from the values of various parameters defined or planned by their values, the trends of these deviations give the greatest opportunity to assess the reliability of the implementation of the approved design decisions.

To assess the reliability of the realization of the plan, one can use the following deviations of indicators or parameters from the desired values:

- by volumes of redistribution of examined types of resources between the set of activities and facilities;
- by volumes of attracting additional resources;
- by sizes of change of deadlines of the set of activities and construction of facilities;
- by sizes of change of the duration of carrying out the set of activities and construction of facilities;
- by volumes of reprioritizing of coherence and order of the execution of the set of activities and construction of facilities.

The main idea of achieving high reliability of the implementation of the planned structure is to form specific tasks and systems in the field of technology and construction of facilities, the execution of which is possible with a fairly large margin of time and major resources. By creating a reserve of time and resources, one can achieve remarkable improvements in the reliability of the execution of any program.

On the basis of these reasonings, one can suggest an overall strategy of building design solutions. It involves building the plan to construct linearly extended facilities with the maximum possible saturation of the work with resources and the shortest construction schedule, as well as the presence of certain features of added resources from reserve options when necessary. All constructions must be carried out within the allocated resources and the appointed schedule of constructions when achieving certain reserves in time resources.

DEVELOPMENT OF COMPOSITE POLYMERIC MATERIALS FILLED WITH POWDER FILLERS USED FOR PARTS OF COTTON PROCESSING MACHINES

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The article presents the results of research of creating the optimal composition of the composite polymeric materials (CPM) with the non-activated and mechanically activated additives, which are intended for use in parts of rubbing pairs of working bodies of cotton proceeding machines. Developed new compositions of CPM increase strength, durability, wearproof properties, improve thermo- and electrical properties and decrease the friction coefficient or materails.

THERMOPHYSICAL PROPERTIES OF GEOTHERMAL WATERS OF NORTH-WEST AZERBAIJAN REGIONS

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Azerbaijan possesses rich geothermal energy and mineral water resources. Some of these thermal water groups are located in the nord-west regions of Azerbaijan in Gabala (Gamarvand, Yengije) and Gakh (Moksu, Ilisu and Ilisu-Beshbulag). Gamarvan villiage of Gabala region is rich in water springs, rivers and waterfalls. The thermal water deposit 600 meters north of the village with 39 °C comes from under the ground. The thermal water resources of Gakh region are springing around the village of Ilisu and 1,400 to 1,600 m above sea level. To use the geothermal energy resources as an alternative energy source requires the investigation of the thermophysical properties of a wide range of parameters. In many cases, the temperature of the geothermal water remains high, but pressure quickly becomes equal to ambient pressure. If, we will use the geothermal resources for power generation directly at the source, they can be generating the energy.

In this work, we present the chemical and thermophysical properties of geothermal water resources of the nord-west regions of Azerbaijan using the various installations (Spectrometer, Chromatography, Densimeter, Viscometer, DSC calorimeter etc.). The samples were filtered and degassed slowly using the vacuum system. To stop vaporisation of pure water, the vacuum procedure was very slow (the groove of the flask valve, which held the sample, was very slightly opened). These investigations have been examined for the first time.

An empiric equation of state for fitting of the (p,ρ,T) data of these water samples has been developed as a function of pressure and temperature. The molecular weight of geothermal waters was analysed. The fitting of properties of water resources are discussing. The equation of state is used for the calculation of the thermophysical properties of IL, such as isothermal compressibility, isobaric thermal expansibility, thermal pressure coefficient, internal pressure, isobaric and isochoric heat capacities, speed of sound and isentropic expansibility.

THERMOPHYSICAL PROPERTIES DATA OF THE GEOTHERMAL SYSTEMS

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Geothermal fluids play a significant role in nature as geothermal systems. The thermodynamic data on geothermal brines, which can be considered as mixtures of aqueous solutions of NaCl, KCl, $CaCl_2$, $MgCl_2$, K_2CO_3 *etc.*, are needed for geothermal energy utilization devices. The underground water (geothermal fluids) are the largest reservoir of aqueous electrolyte solutions. The volumetric (density and derived partial and apparent molar volume properties), caloric (heat capacity and enthalpy), and transport properties (viscosity and thermal conductivity) data of the geothermal fluids are important in geothermal exploration and energy production, for example, to establish optimal operations for the productions of geothermal brine fields. Also accurate thermophysical properties data of the geothermal brines are prerequisite for chemical and reservoir modeling of geothermal brine systems (multiphase underground flows) and fundamental importance for the understanding of various physic-chemical processes occurring in the natural environment (quantify the natural processes occurring below the surface). To understand and control those processes which used geothermal fluids, it is necessary to know their thermodynamic and transport properties, particularly density and viscosity as a function of temperature.

THERMOPHYSICAL PROPERTIES OF 1-BUTANOL AND DIESEL MIXTURES

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Alternative energy sources such as solar, wind energy, bio-diesel and biogas are becoming very important in many countries, because the amount of traditional fuel is decreasing. Various possibilities are analysing for the increasing of power received from alternative energy resources. Various organic or biological compounds were tested during the last years for the using as additive in traditional fuels. Normal alcohols (methanol, ethanol, 1-butanol etc.) are also important fluids for this purpose. 1-butanol has been proposed as an alternative to conventional gasoline, diesel fuels and using of them dramatically increased during the last years.

Current fuel injection systems of compression-diesel engines reach pressures up to 200 MPa for transport systems. In a near future, injection systems can be designed for higher pressures up to 400 MPa. Number of injections at such high pressures per cycle can be expanding, the time of one injection process can be reduced and it is wished for to have exact control of injection rate shaping. That is why it is so important to have reliable knowledge of thermophysical properties of the fuel under high pressures, such as density, vapor pressure, viscosity, speed of sound, heat capacity etc. would allow modelling, understanding, and optimizing the processes in an internal combustion engine.

A new method for the analysis of thermophysical properties of substances at high pressures and over wide range of temperature was developed by our research group. This work is an application of that method to 1-butanol + diesel mixture. The (p,ρ,T) properties at T = (263.15 to 468.15) K, pressures up to p = 200 MPa, vapor pressure at T = (274.15 to 468.15) K, heat capacity at T = (253.15 to 468.15) K and ambient and saturated pressures were measured experimentally. An equation of state for fitting of the (p,ρ,T) data has been developed as a function of pressure, temperature and concentration. The various thermophysical properties (density, vapor pressure, speed of sound, specific heat capacities at constant pressure and volume), also isothermal compressibility, isobaric thermal expansibility, thermal pressure coefficient, internal pressure and isothermal exponent were calculated at high pressures up to 200 MPa and temperatures, in which the (p,ρ,T) properties were studied experimentally.

The excess molar volumes V_m^E of 1-butanol + diesel mixture were calculated using the experimental values of investigated solutions. The molecular mass of diesel, which is necessary for these calculations, was used as the recommendations of various literatures.

INVESTIGATION OF THE INFLUENCE OF PROCESSING TIME TO PHYSICAL AND MECHANICAL PROPERTIES OF GYPSUM BINDER

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In the paper, the processing of sulfate mineral raw materials by heat treatment in thermal units has been shown. That the increase in the duration of heat treatment, dehydration occurs dihydrate crystals have been shown. It is accompanied by the removal of water molecules, which causes a decoupling of Ca^{+2} and SO_4^{-2} with H_2O molecules and mixing calcium sulfate chains (-Ca- SO_4 -Ca- SO_4 -Ca) to 0.317 nm.

EFFECT OF TEMPLATE SOURCE ON SYNTHESIS PROCESS OF SILICOALUMINOPHOSPHATE CATALYSTS

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Silicoaluminophosphate molecular sieves (SAPOs) have considerable potential as acidic catalysts which can play different key roles such as membrane or adsorbent in sorption reactions and catalyst in petrochemical reactions, especially in methanol-to-olefin (MTO) process. SAPO-34 is the best catalyst known among silicoaluminophosphates because of its remarkable pore structure and hydrothermal stability, it shows an exceptional selectivity for light olefins and the complete conversion of methanol in MTO process. Our main aim was to synthesize SAPO-34 silicoaluminophosphate via hydrothermal method with using of different structure directing agents and to investigate influence of these templates to the activity and stability of catalyst.

In order to synthesize stable SAPO-34 catalyst, different single and mixed templates such as triethyamine (TEA), tetraethylammoniumhydroxide (TEAOH)/TEA, TEAOH/morpholine (further abbreviated as S1, S2 and S3) were used as structure directing agents. Required components for synthesizing of zeolite were mixed for 25 h, then transferred into stainless-steel autoclaves and heated at 200 ºC. Crystallization time for these samples are 24 h. After heating catalysts washed with distilled water several times, then dried at 120 ºC and at the end calcined at 550 ºC. XRD analysis proved presence of according peaks of pure SAPO-34 phase in the case when mixed template (TEAOH/morpholine) was used. When only TEA and mixed TEAOH/TEA templates were used some diffraction peaks of SAPO-5 were observed, too. Catalytic tests were conducted at 450 ºC-, and 0.125 MPa-, for 5 h on stream using $CH_3OH:N_2$=60:40 feed with a contact time of 2.05 $mg_{cat}\cdot min\cdot ml^{-1}$ with respect to methanol.

C_2-C_4 low olefins were main products of reaction and the yield of light olefins over S1, S2 and S3 was 55.8%, 75% and 78% respectively. It was revealed that using a single structure directing agent in SAPO-34 synthesis, results in rapid coke formation and the coke cover acidic sites and block the pores of SAPO-34 which finally leads to catalyst deactivation. That's why S1 deactivates fast and it prevents for obtaining of lower olefins. Compared with using a single template, a mixed template leads to the particle size reduction. Besides, the catalytic stability of SAPO-34 was found to be affected by the preparation parameters during synthesis which are closely related with crystal size and the silicon contents during synthesis. The crystal size and elemental composition of prepared samples were described in Table.

Table: Crystal size and elemental composition of prepared samples

Sample №	Elemental composition (wt.%)				Crystallite size,nm
	Si	Al	P	O	
S1	8.,6	20.5	21.6	49.3	>100
S2	7	21	16	56	45
S3	6	15	16	63	33

The reduction of silicon content during synthesis of gel led to the formation of only pure SAPO-34phase. Thus, S3 sample because of its small crystal size (33 nm) and a low amount of silicon content (6 wt.%) shows best behaviour in MTO reaction and deactivates a little bit slowly in compare to samples S1 and S2.

STATE AND PROSPECT OF PRODUCTION OF CEMENT WITH USE OF NONCONVENTIONAL RAW MATERIALS – VOLCANIC ROCKS OF UZBEKISTAN

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Results of researches on development and industrial development of the production technology of portlandtsement clinker with use as a ferruterous mineralizer and an alyumosilikate component of nonconventional raw materials – volcanic rocks of Uzbekistan are given: diabase-porfirits, diabase-spillits, diabase-piroksenits, andesite-porfirits, basalts, gabbro and rocks of tufoalevrolite structure. High reactionary ability of new raw mixes at the expense of the high maintenance of a phase from glass as a part of volcanic rocks and rather low temperature of their melting is established (1100-1320 ºC). Thanks to formation of silicate fusion of quite low viscosity and high fluidity at a low-temperature stage, reaction of a formation of clinker when roasting new raw mixes comes to the end at 1380-1420 ºC that on 30-70 ºC temperatures of roasting of clinker from raw mixes of traditional structure are lower. Lack of intermediate phases, full digestion of free oxide of calcium with good crystallization of brick minerals provides their high hydraulic activity and high durability of cements from them - from 53,2 to 60,3 MRA. This technology is introduced as at a dry and wet way of production of clinker on JSC Kuvasaysement and JSC Kizilkumsement. Now a preparatory work on development of the developed technology on JSC Akhangaransement is carried out.

SURFACE TENSION OF HIGH-PURITY MERCURY AT POSITIVE TEMPERATURES

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The results of the detailed measurements of the temperature dependence of surface tension of high-purity mercury in range of 297-623 K held within the sessile drop method have been presented. The mercury surface tension polytherm has been shown to be satisfactorily described by the linear equation with negative temperature coefficient of – 0.196 mN/(m·deg) at studied temperatures.

Mercury ant its alloys possess unique thermal and physic-chemical characteristics attracting huge theoretical and practical attention when facing numerous needs [1,2]. The analysis of the reference data on surface tension (ST, σ) of mercury reveals that the values range in a broad limits from 400 to 515 mN/m [3-10] much exceeding the inaccuracies of determination of ST (several percents) declared by the authors. That is why the studies of thermophysical properties of mercury availing contemporary experimental equipment and measuring techniques remain to be still actual ones.

The measurements of the temperature dependence of surface tension were held within the sessile drop method at temperatures from 297 to 623 K in conditions of high static vacuum and in a strict compliance with the conditions of the thermodynamical equilibrium between a surface of the studied mercury drop and its saturated vapor. The mercury used in experiments was of purity 99,9997% of the base element (label R-O).

The measuring unit was exposed to the thermal (at 630 K) and vacuum (10^{-4} Pa) treatments for several hours prior to mercury leading in. Here has to be mentioned that to determine the temperature dependence of surface

tension of mercury we have applied for the first time a new original modern automated software [12] availing to obtain an enormous stack of statistical data (more than a thousand of experimental points).

Table: Recommended values and experimental data on surface tension of mercury at 297 K

Reference	σ, mN/m
Nizhenko V.I., Floka L.I., 1976, [4]	479,4
Keene B.J., 1993, [5]	484,8
Popel S.I., 1994, [6]	470,7
Shapiev S.T., Ibragimov Kh.I., 1999, [7]	473,0 (expt)
Kirillov P.L., Deniskina N.B., 2000, [8]	479,4
Alchagirov A.B. et al., 2001, [9]	479,4
Mills K.C., Su Y.C. 2006, [10]	474,6
Present paper	469,2 (expt)

The processing of the obtained data with the least squares method reveals that the temperature dependence of the surface tension, σ(T), of mercury at temperatures from 297 to 623 Kelvins can be satisfactorily described by the equation $\sigma(T) = 469{,}2 - 0{,}196(T - 297)$.

The comparison of our experimental results on surface tension of mercury at 297 Kelvins with the most reliable recommended data σ(T) [4-11] demonstrates a good agreement, see the Table.

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THERMODYNAMIC PROPERTIES OF CHLOROBENZENE OVER A TEMPERATURE RANGE FROM THE TRIPLE POINT TO 700 K WITH PRESSURES UP TO 100 MPa

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The accurate knowledge of thermophysical properties of chlorobenzene is a precursor to modeling petroleum based fuels. In addition, chlorobenzene plays an important role in the production of synthetic fibres, rubbers, plastics, and so on. The use of chlorobenzene in industry has made it one of the most important substances for which the development of accurate equation of state is needed.

Equations of state for pure fluid properties are often expressed as fundamental equations explicit in the Helmholtz energy, with the density and temperature as independent variables

$$\frac{\alpha(\rho,T)}{RT}=\frac{\alpha^0(\rho,T)+\alpha^r(\rho,T)}{RT}=\alpha^0(\delta,T)+\alpha^r(\delta,T) \qquad (1)$$

where $a(\rho, T)$ is the Helmholtz free energy; $\alpha 0(\delta, \tau)$ is the reduced Helmholtz energy in the ideal-gas state; $\alpha^r(\delta, \tau)$ is the residual part of the reduced Helmholtz energy; $\delta = \rho/\rho_r$ is the reduced density; $\tau = T_r/T$ is the inverse reduced temperature; and ρ_r, T_r is reducing parameters (often use critical properties, for chlorobenzene T_c=632,35 K и ρ_c=3,24 mol/l).

The ideal-gas reduced Helmholtz energy, in dimensionless form, can be represented by

$$\alpha^0(\delta,\tau)=\frac{h_0^0\tau}{RT_c}-\frac{s_0^0}{R}-1+\ln\frac{\delta\tau_0}{\delta_0\tau}-\frac{\tau}{R}\int_{\tau_0}^{\tau}\frac{c_p^0}{\tau^2}\mathrm{d}\tau+\frac{1}{R}\int_{\tau_0}^{\tau}\frac{c_p^0}{\tau}\mathrm{d}\tau \qquad (2)$$

where $\delta_0 = \rho_0/\rho_c$ and $\tau_0 = T_c/T_0$. T_0 and p_0 are arbitrary constants, and ρ_0 is the ideal gas density at T_0 and p_0 ($\rho_0 = p_0/(T_0R)$). h_0^0 is the ideal-gas enthalpy at the reference state, and s_0^0 is the ideal-gas entropy at the reference state.

The calculation of thermodynamic properties from the ideal gas Helmholtz energy requires an equation for the ideal gas heat capacity

$$C_p^0=\sum_{i=0}^{3}c_iT^i \text{ , cal/(mol*K)} \qquad (3)$$

To describe the residual part of the reduced Helmholtz energy, an optimized functional form has been used:

$$\alpha^r(\delta,\tau)=\sum_{k=1}^{6}N_k\delta^{d_k}\tau^{t_k}+\sum_{k=7}^{14}N_k\delta^{d_k}\tau^{t_k}\exp\left(-\delta^{l_k}\right) \qquad (4)$$

The uncertainties of properties of chlorobenzene calculated using the equation (1) (with the exception of the critical region $0.98 \le \tau \le 1.05$ and $0.7 \le \delta \le 1.3$) are as follows: density of the liquid phase: 0.3 %; saturated liquid density: 0.1 – 0.5 %; saturated vapor pressure: 0.4 – 1.0 %; heat capacity and speed of sound: 0.5 – 1.3 %.

EXERGY ANALYSIS OF CANOLA-BASED BIODIESEL PRODUCTION IN BELARUS

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The main indicator during manufacturing of a new source of energy is its energy efficiency, which is a correlation between the energy and exergy in the received products. In the current work, detailed exergy analysis of the production of canola-based biodiesel was performed on the basis of classical model of the environment suggested by Shargut, considering all manufacturing stages from sowing of canola seeds to receiving of final biodiesel ready for sale. The typical spring canola (*Brassica napus L.*), cultivated on soddy–podzolic and loamy sandy soils at the usual weather conditions in the central part of Belarus, was used in the exergy analysis. Agrochemical characteristics of soil were considered as: 1.6 – 1.7 % of humus, 128 – 189 mg·kg^{-1} of P2O5 and 172 – 210 mg·kg^{-1} of K_2O, pH = 6.5 – 6.8.

Biodiesel is composed of methyl or ethyl fatty acids esters (FAE) obtained primarily by transesterification of plant oils. To perform the exergy analysis, the whole process of production of FAE (Fig. 1) was divided into five parts: (i) cultivation of canola; (ii) drying of canola seeds; (iii) receiving cold-pressed canola oil; (iv) transesterification of the canola oil into FAE; (v) processing of glycerin fraction (main by-product of transesterification). Values of standard chemical exergies Ex_i^o for the majority of substances involved in the current exergy study were taken from approved reference data, while characteristics of such complex materials as canola plant, seed, straw and oil were obtained from our own calorimetric measurements of specific heats of combustion and heat capacities of the substances.

The total exergy costs of methyl and ethyl FAE transesterification were estimated to be respectively 30.97 and 33.28 GJ·ha^{-1}·yr^{-1}, and 32.8 and 35.1 GJ·ha^{-1}·yr^{-1} considering exergy of glycerin fraction processing. The output of chemical exergy with the target products (esters, glycerin and potassium dihydrogen phosphate) is equal to 27.82 GJ and 29.19 GJ. As it follows from the calculations, the exergy costs for ethyl FAE production are 7 % higher than that for methyl esters. This means that additional exergy costs for ethyl esters, caused by the necessity of running of oil transesterification with ethanol at higher temperatures, are not entirely compensated by the higher heat combustion values of ethanol and ethyl esters. The Grassmann diagram were constructed as the summarized scheme of the exergy costs for the process of methyl FAE production to illustrate the amounts and places where exergy is lost, and all the rearrangements between technological components that occur during the whole manufacturing process. As it comes from our study, the major exergy expenses in this case are for mineral fertilizers and plant protection chemicals due to their artificial nature and thus high standard chemical exergies. Preparation of dried canola seeds and their pressing requires only 7.8% of exergy, while transesterification of the produced oil in FAE consumes 25.2% of exergy. Some insignificant losses of 883.3 MJ of exergy appears with the side products (scourage, oil waste fraction) and comprises about 3% of the total expenses. The exergy costs for the transportation needs introduce the smallest part of exergy balance and do not exceed 1%. And as it follows from the analysis, significant part of chemical exergy in the canola straw can be further minimized by converting into solid fuel. Besides, processing of glycerin fraction wastes can provide valuable pure glycerin and potassium phosphates that can be used as mineral fertilizers. Therefore the performed exergetical calculations of FAE production testify to the high exergetical effectiveness of biodiesel production from canola, especially when major by-products and wastes are further processed into valuable matter.

SURFACE TENSION AND ELECTRON WORK FUNCTION OF SODIUM-CESIUM-RUBIDIUM SYSTEM

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The measurements of the surface tension (ST) and electron work function (EWF) of several Na-Cs-Rb alloys (possessing concentrations along one of the radial sections with constant ratio of sodium to cesium amounts within the initial binary alloys and converging to the rubidium corner of the concentration triangle) have been reported previously.

In this research the results of the further experimental investigation of temperature and concentration dependences of ST and EWF of ternary Na-Cs-Rb alloys have been presented. The compositions of alloys were chosen along the radial sections again converging to the rubidium corner but this time in such a manner to provide the uniform cover of the area of the concentration triangle of concentrations by the experimental points. The surface tension has been measured using the known sessile drop method while EWF have been determined by the Fawler method of isothermal curves [1] applying the single-sealed measuring cell [2]. Both methods were adapted to the peculiarities of the alkali metals.

The images of the drops were fixed with help of the digital USB-camera "TS-5" when measuring ST of ternary alloys. The software allowed us to detect and register the images from the videocamera in an automated regime and to perform the digital processing of the profile of the drop as well to calculate the values of ST [3].

The measurements of EWF by means of photoelectric Fawler method were held by lighting of the surface of the alloys through the quartz window with a monochromatic light of various wavelengths.

The experiments were performed in a temperature range from the liquidus line up to 400 K while those of EWF were held from the room temperatures up to 330 K on the samples not worse than purity of about 99.995 % of the base element in conditions of the high static vacuum 10^{-7} Pa. The exposure of alloys to a certain temperature aimed on the homogenization of the alloys lasted at least 20-30 minute prior to measurements of ST and EWF. The error in determining of ST was 1% and 1.5% in case of EWF.

The ST and EWF polytherms of the studied ternary alloys can be described by the linear dependencies with both positive and negative temperature coefficients. The isotherms of the surface tension can be represented by the smooth curves decreasing with the increasing rubidium content in ternary alloys with predominating sodium concentration. At greater cesium content in the alloy the additions of rubidium result in increasing ST of ternary alloys.

The EWF isotherms can be represented by the smooth decreasing curves or, in other words, by the increasing with the concentration of rubidium ones in melts in respect to the ratio of the concentrations of sodium and cesium in ternary alloys.

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STEEL-SMELTING SLAGS - AS COMPLEX RAW MATERIALS FOR PRODUCTION OF PORTLANDTSEMENTNY CLINKER

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Work is devoted to development of technology of receiving cement clinker with use of the recycled steel-smelting slags as ferriferous and alyumosilikat complex raw materials for formation of raw mix. It is established that use of the recycled steel-smelting slags is reduced a limestone consumption in raw mix that in turn, reduces emission of carbon dioxide in the atmosphere and the ecological situation around metallurgical and cement productions improves. When roasting raw mixes of new structure speed process of dissociation of $CaSO_3$ with allocation of CaO_{free} is considerably accelerated, and binding of the last in brick minerals and its full assimilation happens at 1350-1420°C. Hydraulic activity of cement on the basis of skilled clinkers makes 41,8 – 43,2 MPa that corresponds to brand of 400 cement. By production of clinker the economy of natural raw materials makes 10-20% of raw furnace charges of new structure, fuel on clinker roasting - to 20%, increase of productivity of the rotating furnaces – to 10%. By roasting of the three-component raw mixes including limestone, the loess and the recycled steel-smelting slag possibly production of standard clinker for cement of all-construction appointment and sulfate-resistant cement.

CRYSTALLIZATION IN THE AMORPHOUS STRUCTURED $Tl_{50}Nl_{25}CU_{25}$ ALLOY

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Chilling metallic alloy from liquid state at an extreme speed (10^6K/sec) sometimes leads to the formation of amorphous structure. This paper studied kinetics of crystallization of amorphous structured alloy obtained as a result of rapid cooling (10^6 K/sec) of the $Ti_{50}Ni_{25}Cu_{25}$ alloy. The presence of amorphous state was initially confirmed by electronic microscope (TEM), X-ray analysis (XRD) and microstructure research.

We have researched the process of crystallization of the amorphous structured $Ti_{50}Ni_{25}Cu_{25}$ alloy via different methods, but conducted crystallization kinetics in the device that studies the change of electric resistance depending on temperature developed for researching thin films. The presented paper widely studied kinetics features of temperature dependence of electrical resistance. Temperature dependence of electrical resistance (after being chilled at an extreme speed in liquid state) and its change depending on the thickness of the sample have also been studied. In addition, the analysis of crystallization parameters among kinetic equations has been researched in the research and the activation energy of the crystallization process evaluated.

The crystallization parameters of isothermic storage at temperatures 420, 430 and 440 ºC of amorphous layers of $Ti_{50}Ni_{25}Cu_{25}$ alloy obtained through chilling from liquid state at 106 K / sec speed have been set. The incubation period (pre- crystallization time) gets reduced from 6 minutes at 420 ºC to 1 minute at 440 ºC. The of the time of formation of the first 50% of the crystal phase is less than the time of formation of the remaining 50%, which is explained by more rapid emergence and spending of seeds (crystal centers).

When thinning from 45 mkm to 5 mkm, the crystallization process of the amorphous layers of $Ti_{50}Ni_{25}Cu_{25}$ alloy obtained obtained through chilling from liquid state was observed to speed up significantly; it proves the significance of the role of the surface in crystallization processes in solid state.

INVESTIGATION OF DENSITY OF THE KURA RIVER

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Kura river (total length is 1515 km) starting in north-eastern Turkey, it flows through Turkey to Georgia, then to Azerbaijan, where it receives the Aras River as a right tributary, and enters the Caspian Sea. Pollution of the river from the territory of the neighbouring states creates an environmental tension. Mineralisation of the water of the Kura river raises till 800-1200 mg in the connecting part of Araz and Kura rivers is 35-50 per cent more compared to its medium current. Density of polluted water of Kura river is max. 9 times more than sanitary norms. More than 350 million m^3 of the chemically and biologically polluted water annually injects the Kura river pool. From this point of view, it is important to conduct, from the security of the population point of view, a general monitoring over the dangerous substances in the transborder rivers.

During our last research activities, we have investigated the thermophysical properties (density, vapor pressure, viscosity, speed of sound, chemical compounds analysis) of 14 Kura river water sample in Azerbaijan side from west to east over the parameter range of interest. In this presentation, we will inform the the thermophysical properties of four new water samples of Kura River in Turkey side from its source at Ardahan region, which are carry out at DMA HPM high pressure – high temperature vibration tube densimeter. The density and speed of sound measurements at ambient pressure are carry out using the DSA 5000M density and speed of sound measurement installation. The chemical compounds analysis using the IRIS Intrepid II Optical Emission Spectrometer and DX 100 ion chromatography are also presented. These investigations have been examined for the first time. The comprehensive and accurate thermodynamic equation of state over a well specified range of parameters which are of interest in ecological research are constructed, which are used to calculate thermophysical properties of these samples. Using the (p,ρ,T) data, the comprehensive and accurate thermodynamic equation of state over a well specified range of parameters which are of interest in ecological research was constructed, which is used to calculate thermophysical properties of these samples.

INVESTIGATION OF THE THERMAL STABILITY AND MECHANICAL PROPERTIES COATINGS ON BASE MODIFIED EPOXY OLIGOMER

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For protection against from corrosion of equipment in the chemical, petrochemical industry and in engineering, various widely used corrosion resistant polymer coating. However, developments in the production and study of corrosion-resistant coatings, filled with a variety of siliceous fillers to protect metal surfaces from aggressive and abrasive environment is currently insufficient. In the paper the process of heating in temperature 20-500 ºC in composition on base modified epoxy resin with furfirol alcohol stilling with variety fillers as bentonite, kaolin, waste of gold extraction is shown. The objects of study are organic coatings based on bottoms of furfuryl alcohol with an epoxy oligomer ED-20, gossipol resin (HS), an amine hardener - polyethylene polyamine (PEPA), filled with a variety of silica filler - bentonite, kaolin, waste of gold extraction (OZIF).

ECOLOGICAL AND ECONOMIC ASPECTS OF PRODUCTION OF THE LOW-MAIN CLINKERS AND CEMENTS WITH COMPOSITE ADDITIVES ON THEIR BASIS

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This article presents the results of research on the development of environmentally and economically viable technologies of production of clinker and cement through the formation of a low-carbon raw material mixture using local raw materials. SUMMARY technology is to reduce the saturation coefficient (CN) raw mixture clinker synthesis at relatively low firing temperatures (1350-1380 ºC) and the subsequent modification when grinding cement composition tuffite phosfoanhydrite additive. The cement clinker from low basic with SR = 0.88 for activity not inferior without addition cement clinker from the highly basic traditional composition, and the addition of up to 20% of the additive composition of the thermally activated tuffite phosphogypsum and greatly increases its strength, which provides up to 20% savings clinker component additional cement.

KEYWORDS: low carbon raw mixture saturation coefficient, low-temperature synthesis, mineralization, low basic clinker, belite structure, phase composition, microstructure, savings in raw materials and fuel, environmental and economic benefits.

FINELY MILLED RAW MATERIALS AND TECHNO GENIC WASTES-AS INGREDIENTS OF ADDITIVES FOR PRODUCTION STICKY COMPOSITE MATERIALS

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The paper provides information on the development of design dismembratora, provides a fine mineral ingredient at the nanoscale. The principle of operation is dismembratora shock-raskalivayuschee-grinding action of the workers in the milled object. It is noted that the use of the obtained nano-dispersed materials in the production of building materials (cement, chemically bonded bricks, concrete, etc.) greatly increases efficiency, improves performance properties building materials and products. Comparative data on the effect of recycled steel slag on the properties of Portland cement. Found that using nano-grinding dismembratora increases the strength of cement compositions by 22-40% compared with cements, slags containing these conventional dispersion.

KEYWORDS: Cement, cement compositions, slags, nano-dispersed materials, mineral ingredient building materials

MODELING OF SATURATION THERMODYNAMIC AND THERMOPYSICAL PROPERTIES OF REFRIGERANTS BY USING CUBIC AND B-SPLINE CURVE FITTING

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In order to analyse a refrigeration system as a thermodynamic or heat transfer system, a complete thermodynamic and thermophysical property sets should be available in computer environment. Saturation thermophysical properties such as thermal conductivity, viscosity, surface tension, and thermodynamic properties of saturated, liquid and vapor phases are needed in a complete system analysis. One single equation representing saturation curve and thermodynamic properties around saturation curve may not have enough accuracy, specially around critical region. One way of representing data is through spline functions, but spline functions requires many coefficients to represent data, therefore they are not very suitable for hand type of calculations. Modern calculation environment utilises computers, and if coeffcients are given in a computer programs, it is not that important number of variables representing data, and when error analysis are carried out, it is shown that much smaller error can be obtained by using spline type of function definition. In this study, B-Spline and cubic spline computer models are prepared to represent refrigerant saturation thermodynamic and thermophysical properties. Two class developed in java programming language, on efor cubic spline interpolation and the second one is for B-spline interpolation and error analysis are carried out. As a result, it is shown that in both cases error level is very small and these type of functions can be used as general saturation property representation. Program has capability of calculating the following properties: buble point vapor pressure, dew point vapor pressure as a function of temperature, buble point vapor temperature, dew point vapor teperature as a function of pressure, saturated liquid heat capacity, saturated vapor heat capacity, saturated liquid density, saturated vapor density, saturated liquid viscosity, saturated vapor viscosity, saturated liquid thermal conductivity, saturated vapor thermal conductivity, saturated liquid-vapor interphase surface tension, saturated liquid enthalpy, saturate vapor enthalpy, saturated liquid entropy, saturated vapor entropy, saturated liquid speed of sound, saturated vapor speed of sound. The programs can be calsulate these properties fort he refrigerants R12, R22, R23, R32, R123, R124, R125, R134a, R152a, R245fa, R404A, R407C, R410A, R507A, R717, R718, R744, R50, R170, R290, R600, R600a, R1150, R1270, R702, R702p, R704, R728, R732, R740.

Program codes are availabale from adress www.turhancoban.com

NEW COMPOSITE MATERIALS WITH IMPROVED PROPERTIES FOR DESIGNING FINISHING OF BUILDINGS

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This article presents results of studies pioneered developed compositions gypsum binders and technology of obtaining of water-resistant and biostable powder composite materials with improved properties of finishing purposes. It was found that purposeful change of their structure and composition of the material in bound zone which is passing a few tenths of a micron from the joint of dough of gypsum binder with filler, by introducing mechanically activated alloying mineral ingredients is the most effective way to significantly enhance the contact area and improve the properties of the artificial stone.

HIGH-TEMPERATURE THERMOPHYSICAL PROPERTIES OF THERMOELECTRIC CERAMICS BASED ON CALCIUM COBALTITE WITH CARBON NANOTUBES ADDITION

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Efficiency of thermoelectric devices is evaluated by a dimensionless figure-of-merit $ZT=(S^2\cdot\sigma T)/\lambda$, where S is the thermopower, σ the electrical conductivity, λ the thermal conductivity and T the working temperature. The main task for thermoelectrics is to maximize the thermoelectric figure-of-merit. This can be achieved by electric conductivity increasing and thermal conductivity reducing. Misfit-layered cobaltite $Ca_3Co_4O_9$ exhibits high values of thermoelectric power factor $P=S^2\cdot\sigma$ and ZT [1]. Nanostructures addition is another factor which increases ZT. Authors [2] have shown that the introduction of nanographite leads to reduce of thermal conductivity of a material with simultaneous increase of electrical conductivity. Furthermore, the introduction of carbon nanographite in ceramics can prevent recrystallization.

The results of thermophysical properties investigation of calcium cobaltite ceramics with incorporated carbon nanotubes in the range from room temperature to 900 °C are presented in the paper. Ceramics $Ca_3Co_4O_{9+\delta}$ was received in the Byelorussian State Technological University by citrate gel method followed by milling and compression in the presence of carbon nanotubes. The concentration of nanotubes was 0.1, 0.5 and 2.0 wt.%. Measurement of thermophysical properties were carried out on the device LFA457 MicroFlash (NETZSCH, Germany) by laser flash method.

It has been shown that carbon nanotubes, even in a small amount (0.1 wt.%), increase the thermal diffusivity and the thermal conductivity of a material and significantly reduce the specific heat. The increase of the thermal diffusivity and conductivity is about 200% at room temperature. But at temperature above 400 °C we observe decreasing of the parameters to 15%. Moreover, the increase of nanotubes concentration virtually does not effect on the thermal performance of the modified ceramics. It is of interest that the thermal conductivity and thermal diffusivity of calcium cobaltite is constant in the entire range of temperatures and the specific heat is constant at temperatures ranging from about 100 to 700 °C. It is connected apparently with the recovery of samples due to the deoxygenation from their volume in the environment. The character of the electric conductivity changes from semiconducting to metallic [3]. In semiconducting thermoelectrics heat transfer is carried out by phonons, electrons (holes), and radiation heat transfer can occur at high temperatures. At moderate temperatures, the thermal diffusivity and the thermal conductivity decrease in inverse proportion to the temperature. That is observed in samples with nanotubes and was not observed for ceramic base. Thus, the introduction of nanotubes in calcium cobaltites does not reduce the thermal conductivity, as might have been expected. The reasons for this behavior of the thermal conductivity are considered.

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EQUATION OF STATE FOR MIXTURE OF BENZENE WITH CHLOROBENZENE (C_6H_6 – C_6H_5Cl)

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The system C_6H_6 – C_6H_5Cl represents undoubted industrial interest. This mixture is used in refrigeration, heat pumps, foam-blowing, and other applications. Mixture equations are required to evaluate the performance of possible working fluids. The mixture model presented here is based on corresponding states theory and uses reducing parameters that are dependent on the mole fractions of the mixture constituents and critical points of the pure fluids to modify absolute values of the mixture density and temperature.

The proposed approach allows the thermodynamic properties of the mixture to be based largely on the contributions from the pure fluids. Without additional mixing functions, the model is similar to that for an ideal mixture, and only the excess values, or the departures from ideality, are required to accurately model the properties of the mixture. The model uses the Helmholtz energy as the basis for all calculations. The Helmholtz energy of the mixture is calculated as the sum of an ideal gas contribution, a real fluid contribution, and a contribution from mixing. The Helmholtz energy from the contributions of the ideal gas and the real fluid behavior is determined at the reduced density and temperature of the mixture by the use of accurate pure fluid equations of state for the benzene and chlorobenzene. The equation for the mixture Helmholtz energy used in this work is

$$\alpha(\delta,\tau,x) = \alpha^0(\rho,T,x) + \alpha^r(\delta,\tau,x) \tag{1}$$

where $\alpha(\delta,\tau,x)$ is the mixture Helmholtz energy; $\alpha_0(\rho,T,x)$ is the reduced Helmholtz energy in the ideal-gas state; $\alpha^r(\delta,\tau,x)$ is the residual part of the reduced Helmholtz energy; $\delta = \rho/\rho_r(x)$; $\tau = T_r(x)/T$.
The reducing parameters $\rho_r(x)$, $T_r(x)$ can be defined by the following relations

$$\frac{1}{\rho_r(x)} = \sum_{i=1}^{N} x_i^2 \frac{1}{\rho_{c,i}} + \sum_{i=1}^{N-1}\sum_{j=i+1}^{N} 2x_i x_j \beta_{v,ij}\gamma_{v,ij} \frac{x_i + x_j}{\beta_{v,ij}^2 x_i + x_j} \frac{1}{8}\left(\frac{1}{\rho_{c,i}^{1/3}} + \frac{1}{\rho_{c,j}^{1/3}}\right)^3 \tag{2}$$

$$T_r(x) = \sum_{i=1}^{N} x_i^2 T_{c,i} + \sum_{i=1}^{N-1}\sum_{j=i+1}^{N} 2x_i x_j \beta_{T,ij}\gamma_{T,ij} \frac{x_i + x_j}{\beta_{T,ij}^2 x_i + x_j} \left(T_{c,i} \cdot T_{c,j}\right)^{0.5} \tag{3}$$

where $T_{c,i}$ and $\rho_{c,i}$ is the critical properties of component i; x_i is the mole fraction of component i; β_v,, γ_v, β_T, γ_T is the binary interaction coefficients.
The ideal part can be defined by the following relation

$$\alpha^0(\rho,T,x) = \sum_{i=1}^{N} x_i \left[\alpha_{0i}^0(\rho,T) + \ln x_i\right] \tag{4}$$

where $\alpha_{0i}0(\rho,T)$ in the ideal part of Helmholtz energy of component i.

The excess part can be defined by the following relation

$$\alpha^r(\delta,\tau,x) = \sum_{i=1}^{N} x_i \alpha_{oi}^r(\delta,\tau) + \sum_{i=1}^{N-1}\sum_{j=i+1}^{N} x_i x_j F_{ij} \alpha_{ij}^r(\delta,\tau) \tag{5}$$

where $\alpha_{0i}^r(\delta,\tau)$ is the excess part of Helmholtz energy of component i; $\alpha_{ij}^r(\delta,\tau)$ is the excess function

$$\alpha_{ij}^r(\delta,\tau) = \sum_{k=1}^{K_{pol,ij}} N_{ij,k}\delta^{d_{ij,k}}\tau^{t_{ij,k}} + \sum_{k=K_{pol,ij}+1}^{K_{pol,ij}+K_{\exp,ij}} N_{ij,k}\delta^{d_{ij,k}}\tau^{t_{ij,k}} \exp\left(-\delta^{l_{ij,k}}\right) \tag{6}$$

Determination of the binary interaction coefficients in Eq. 2, Eq. 3 and coefficients of Eq. 6 took place simultaneously using nonlinear optimization. The uncertainties of properties calculated using proposed model are as follows: vapor-liquid equlibrium (VLE) data: 1.26 %; saturated liquid density: 0.25 %; heat capacity: 0.65 %.

DEVELOPMENT OF NEW SYNTHETIC CAST IRON FOR OIL INDUSTRY

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This paper discusses the possibility of using synthetic cast iron for manufacturing the "fitting" instead of corundum (Al_2O_3 powder). The union is made by special technology. In our opinion, the synthetic cast iron with a high density meets the requirements of corundum. Lifetime of the fitting made of synthetic cast iron is at the level of corundum, but several times cheaper. This paper includes researches on cost reduction of parts such as "fitting." They are intended for pumping formation fluid from oil wells under high pressure - 100 ÷ 150 atm.

The service life of these components is within 20-30 hours. The fitting is made by special technology of Al_2O_3 powder (corundum) by sintering. The hardness of the working surface of the fitting is equal to 85-87 HRA. We propose to prepare it by using cheap waste of metal, i.e., solid white iron of bimetal type, while retaining the hardness of the working surface and performance properties.

The main advantage of bimetal is its lower cost compared to the same monometallic product made from only one cladding layer (corundum). When pouring bimetal, the cladding layer is welded over the entire surface to the basis, mutually filling the surface irregularities. The quality of adhesion of the cladding layer (white cast iron), with the main (gray cast iron) is determined by a test on cut; the resistance to shear along the interface of the layer - base must not be below a shear strength of gray cast iron.

The results of industrial tests of these fittings from bimetal showed that the service life is 20 to 25 hours. Thus, we can assume that the fitting of wear resistant bimetal can replace the corundum fitting. According to the results of the work, one can make following conclusion: the technology of pouring fitting of wear resistant cast iron bimetal has been developed. In the meantime, the hardness of the working surface is maintained at the same level equal to 85 Rockwell HRA.

BEHAVIOUR OF FRICTION WELDED THIN-WALLED STEEL TUBES UNDER TORSION

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The aim of this study is to experimentally investigate the weldability of thin walled steel tubes having different material properties by friction welding technique and to examine the mechanical behavior of friction welded joints under torsional loading.

In this experimental study, both thin walled steel tubes having different material properties were successfully welded. The torsional load carrying capacity of friction welded tubes was determined by performing static torsion tests. Furthermore the fatigue behavior of the welded tubes was investigated by conducting bi-directional torsional fatigue tests at different torque levels.

The torsional load carrying capacity of friction welded thin walled steel tubes without any damage was 4.447,55 Nm in 90 % confidence interval. After conducting 13 bi-directional torsional fatigue tests, the fatigue strength of friction welded steel tubes was detected as 876.46 Nm.

KEYWORDS: Friction Welding, Mechanical Behavior, Torsion Test.

ON OPTIMALITY EQUATION FOR THE LINEAR HYPERBOLIC EQUATION OF SECOND ORDER WITH NUMEROUS NON-LOCAL BOUNDARY

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With the known variants of the method increments it cannot be generalized maximum principle of Pontryagin for the processes described by hyperbolic equations in the non-local boundary conditions. In this work by constructing a fundamental solution for a hyperbolic equation of second order with non-local boundary conditions, when the right side of the equation, as well as the boundary conditions depend on some vector-control functions or vectors, a necessary and sufficient conditions of optimality.

Let's assume that $G = G_1 \cdot G_2;\ G = (0, h_k),\ k = 1,2; W_p^{(1,1)},\ 1 \le p \le \infty$ the space of all $u \in L_p(G)$ in the sense of having the Sobolev generalized derivatives $D_1^j \cdot D_2^j \in L_p(G),\ (i = 0,1;\ j = 0,1)$ where $D_k = \dfrac{\partial}{\partial x_k},\ k = 1,2$.

This space of Banach is ok $\|u\|_{W_p^{(1,1)}(G)} \sum_{i,j=0}^{1} \left\| D_1^i D_2^j u \right\|_{L_p(G)}$

Let's consider the problem of minimizing the linear functional

$$S(v) = \sum_{k=1}^{u} A_k u(\overline{x}_1^k, \overline{x}_2^k) \tag{1}$$

On solutions $u \in W_p^{(2,1)}(G)$, for a hyperbolic equation of the second order

$$\begin{aligned} &(Lu)(x) \equiv D_1 D_2 u(x) + a(x) D_1 u(x) + b_2(x) D_2 u(x) + c(x) u(x) = \\ &= \varphi(x, v(x)), \qquad x = (x_1, x_2) \in G \end{aligned} \tag{2}$$

satisfying the following conditions nonlocal

$$\begin{aligned} &(L_{1,0}u)(x_1) \equiv D_1 u(x_1, 0) + \sum_{j=1}^{n} \left[\alpha_j^{(1)}(x_1) u(x_1, x_2^j) + \alpha_j^{(2)}(x_1) D_1 u(x_1, x_2^j) \right] = \\ &= \varphi_{1,0}(x_1, v_{1,0}(x_1)),\ x_1 \in G_1 = (0, h_1); \\ &(L_{0,1}u)(x_2) \equiv D_2 u(0, x_1) + \sum_{j=1}^{n} \left[\beta_j^{(1)}(x_2) u(x_1^j, x) + \beta_j^{(2)}(x_2) D_2 u(x_1^j, x_2) \right] = \\ &= \varphi_{0,1}(x_2, v_{0,1}(x_2)),\ x_2 \in G_2 = (0, h_2); \\ &L_0 u \equiv u(0,0) + \sum_{i,j=1}^{n} \gamma_{i,j} u(x_1^i, x_2^j) \varphi_0(v_0) \end{aligned} \tag{3}$$

where $(x_1^i, x_2^j) \in \overline{G},\ (\overline{x}_1^k, \overline{x}_2^k) \in \overline{G}$ fixed point constants, A_k constants.

Let function $a(x), b(x), c(x)$ measurable in all of its variables of G and functions exist $a_0 \in L_p(G_2), b_0 \in L_p(G_1)$ such that, $|a(x)| \le a_0(\__2), |b(x)| \le b_0(x_1)$ and $c \in L_p(G)$. In addition, we assume that fulfilled the conditions.

$$\alpha_j^{(1)} \in L_p(G_1), \alpha_j^{(2)} \in L_\infty(G_1),\ \beta_j^{(1)} \in L_p(G_2)$$

$$\beta_j^{(2)} \in L_p(G_2), \gamma_{i,j} \in R,\ i, j = 1,2,...,n$$

$\varphi(x,v),\ \varphi_{1,0}(x_1, v_{1,0}),\ \varphi_{0,1}(x_2, v_{0,1}), \varphi_0(v_0)$ - certain specified functions, respectively $G \times R^{r_0}, G_1 \times R^{r_{1,0}}, G_0 \times R^{r_{0,1}}, R^{r_0}$. $v(x) = (v^1(x), v^2(x), ..., v^r),\ v_{1,0}(x_1) = (v_{1,0}^1(x_1), v_{1,0}^2(x_1), ..., v_{1,0}^{r_{1,0}}),$ $v_{0,1}(x_2) = (v_{0,1}^1(x_2), v_{0,1}^2(x_2), ..., v_{0,1}^{r_{0,1}}),$ - con-

trol functions, a $v_0 = \left(v_0^1, v_0^2, ..., v_0^{r_0}\right)$ - the control vector. The four vectors $v = \left(v(x), v_{1,0}(x_1), v_{0,1}(x_2), v_0\right),$ is said to be admissible if $v(x), v_{1,0}(x_1), v_{0,1}(x_2)$ bounded measurable functions with values from a given set

$$V \subset R^r, V_{1,0} \subset R^{1,0}, V_{0,1} \subset R^{0,1}, \left(v(x) \in V, v_{1,0}(x_1) \in V_{1,0}, v_{0,1}(x_2) \in V_{0,1}\right);\ v_0 \in V_0 \subset R^{r_0}.$$

Let's assume that $\varphi(x,v),\ \varphi_{1,0}\left(x_1, v_{1,0}\right),\ \varphi_{0,1}\left(x_2, v_{0,1}(x_2)\right)$ on $G \times R^{r_0}, G_1 \times R^{r_{1,0}}, G_0 \times R^{r_{0,1}}$ satisfy the Caratheodory conditions and any $l > 0$ there are functions $g^l \in L_p(G), g_{1,0}^l \in L_p(G_1), g_{0,1}^l \in L_p(G_2)$ such that $\left|\varphi(x,v)\right| \le g^l(x), \left|\varphi_{1,0}\left(x_1, v_{1,0}\right)\right| \le g_{1,0}^l(x_1),$

$\left|\varphi_{0,1}\left(x_2, v_{0,1}\right)\right| \le g_{0,1}^l(x_2)$ almost for all $x \in G$ and in all $\|v\| \le l,\ \left\|v_{1,0}\right\| \le l,\ \left\|v_{0,1}\right\| \le l,$ besides that $\varphi_0(v_0)$ are constant for R^{r_0}. When the conditions imposed sense the problem of minimizing the functional (1) is not the solution $u \in W_p^{(1,1)}(G)$ assignment (2), (3) the relevant control

$$\left(v, v_{1,0}, v_{0,1}, v_0\right) \in V^{\partial} \times V_{1,0}^{\partial} \times V_{0,1}^{\partial} \times V_0^{\partial}\left(,(x_1) \in ,(x_2) \in\right); \in \subset R^{r_0}.$$

Let's Consider the corresponding increment of the functional (1) which has the form

$$\Delta S(v) = S(v + \Delta v) - S(v) = \sum_{k=1}^{n} A_k \Delta u\left(\overset{-k}{x_1}, \overset{-k}{x_2}\right) \tag{4}$$

Using the representation function [1] present increment of the function to the form

$$\begin{aligned} \Delta S(v) = {} & \sum_{k=1}^{n} A_k \Delta u(0,0,) + \int_{G_1} A_k \sum_{k=1}^{n} \theta\left(\overset{-k}{x_1} - \xi_1\right) D_1 \Delta u(\xi_1, 0)\, d\xi_1 + \int_{G_2} A_k \sum_{k=1}^{n} \theta\left(\overset{-k}{x_2} - \xi_2\right) D_1 \Delta u(0, \xi_2)\, d\xi_2 + \\ & + \iint_G A_k \theta\left(\overset{-k}{x_1} - \xi_1\right) \theta\left(\overset{-k}{x_2} - \xi_2\right) D_1 D_1 \Delta u(\xi_1, \xi_2)\, d\xi_1 d\xi_2 \end{aligned} \tag{5}$$

It is obvious that $\Delta u \in W_p^{(1,1)}(G)$ is the solution of the corresponding problem in the variations that the linearity of the problem (2), (3) coincides with it when

$$\begin{aligned} \varphi &= \varphi\left(x, v(x) + \Delta v(x)\right) - \varphi\left(x, v(x)\right) \\ \varphi_{1,0} &= \varphi_{1,0}\left(x_1, v_{1,0}(x_1) + \Delta v(x_1)\right) - \varphi_{1,0}\left(x_1, v_{1,0}(x_1)\right) \\ \varphi_{0,1} &= \varphi_{0,1}\left(x_2, v_{0,1}(x_2) + \Delta v(x_2)\right) - \varphi_{0,1}\left(x_2, v_{1,0}(x_2)\right) \\ \varphi_0 &= \varphi_0\left(v_0 + \Delta v\right) - \varphi_0\left(v_0\right) \end{aligned}$$

Let's take the limited functionality

$f = \left(f, f_{1,0}, f_{0,1}, f_0\right)$ из $H_q = H_p^*$ $\qquad \left(H_p = L_p(G) \times L_p(G_1) \times L_p(G_2) \times R\right)$.

Then, by definition, takes a place

$$\begin{aligned} \hat{f}(\hat{L}\tilde{u}) = {} & \iint_G f(\xi)(L\tilde{u})(\xi)d\xi + \int_{G_1} f_{1,0}(\xi_1)(L_{1,0}\tilde{u})(\xi_1)d\xi_1 + \\ & + \int_{G_2} f_{0,1}(\xi_2)(L_{0,1}\tilde{u})(\xi_2)d\xi_2 + f_0 L_0 \tilde{u} = \iint_G f(\xi)[\varphi(\xi, v(\xi) + \Delta v(\xi)) - \varphi(\xi, v(\xi)]d\xi + \\ & + \int_{G_1} f_{1,0}(\xi_1)[\varphi_{1,0}(\xi_1, v_{1,0}(\xi_1) + \Delta v_{1,0}(\xi_1)) - \varphi_{1,0}(\xi_1, v_{1,0}(\xi_1)]d\xi_1 + \\ & + \int_{G_2} f_{0,1}(\xi_2)[\varphi_{0,1}(\xi_2, v_{0,1}(\xi_2) + \Delta v_{0,1}(\xi_2)) - \varphi_{0,1}(\xi_2, v_{0,1}(\xi_2)]d\xi_2 + \\ & + f_0[\varphi_0(v_0) + \Delta v_0) - \varphi_0(v_0)], \qquad \tilde{u} = \Delta u. \end{aligned}$$

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TERMOIZ OF A BORGIDRID AND TETRAHYDROALUMINATE OF STRONTIUM

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In this presentation process of thermal decomposition of a borgidrid of an itetragidroalyuminat of strontium ispol-zovanyy by method a tenzimetriya with membrane zero manometer are discussing. Application of a tenzimetriya as the main experimental method is caused by features of work with such strongly hygroscopic and easily oxi-dized substances as alyumogidrida and also slowness of the studied processes. The Tenzimetrichesky method differs in that time of establishment of balance in the course of decomposition of hydrides is almost not limited to anything that does it preferable when studying of very slowly proceeding processes.

From literature it is known that process of thermal decomposition of borgidrid and tetragidro-aluminates of the IIA elements of groups proceeds in three stages according to the following scheme:

$$M(AlH_4)_{n(тв)} = \frac{1}{3}M_3(AlH_6)_{n(тв)} + Al_{(T)} + H_{2(газ)} \quad (1)$$

with formation of geksagidroalyuminat according to the scheme

$$M(AlH_6)_{n(T)} = MH_{n(T)} + Al_{(T)} + H_{2(г)} \quad (2)$$

and the following step corresponds to a termoliz of binary hydride

$$MH_{n(T)} = M_{(ж)} + \frac{n}{2}H_{2(г)} \quad (3)$$

For borogidrid of the IIA elements of groups [95, 104] the following scheme of a termoliz is offered

$$M(BH_4)_{n(T)} = MH_{n(T)} + nB_{(T)} + \frac{3}{2}nH_{2(г)} \quad (4)$$

at a certain temperature in parallel with the scheme (3.4.) goes termoliz binary hydride

$$MH_{(T)} = M_{(ж)} + \frac{1}{2}H_{2(г)} \quad (5)$$

In this work as one of the main experimental methods of research of process of thermal decomposition of a bor-gidrid and tetrahydroaluminate of strontium the static method (tenzimetriya) with membrane zero manometer is used. Application of a tenzimetriya as the main experimental method is caused by features of work with such strongly hygroscopic, easily oxidized substances as alyumogidrida and also slowness of the studied processes.

KEYWORDS: Zero manometer, tetrahydroaluminate of an iborgidrid of strontium, tenzimetriya, thermochemical cycle of Borna-Haber.

TECHNIQUE AND EXPERIMENTAL VACUUM-PUMPING SETUP FOR STUDING REFLECTIVITY AND RADIATIVE PROPERTIES OF MATERIALS AT HIGH TEMPERATURES

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The optimality of technological process at action of laser radiation depends significantly on thermophysical properties of a surface. Experimental data relating to the beginning of melting and total melting of a surface layer allow optimize the laser action on the material. Now melting of materials is determined from behavior of surface reflectivity [1,2]. However the reflectivity depends variously on surface roughness and temperature. This does not allow determine the beginning of melting and total melting of a surface. In this connection it was suggested to study evolution of the melting process from dynamics of spatial distribution of probe radiation scattered by anisotropic rough surface. Since action of laser radiation on materials can be performed in various technological conditions, the experimental study is performed in air atmosphere, inert gases, and vacuum. In the experiment, oxidation of the metals is investigated at heating and melting processes.

In present work the experimental setup is intended for study of melting of anisotropic rough surfaces at heating in the vacuum up to 10^{-5} mm Hg, inert gases and air atmosphere. Samples are heated thermally with a flat heating unit. The unit consists of Al_2O_3 plates 3×3 cm each having thickness 2 mm. The plates have linear groves. Platinum wire having diameter 0.5 mm is located in the grooves and allow obtain temperature up to 1500 °C. The heating unite is located in high-temperature isolation material Oxidal-1800. The samples and heater are located in water-cooled chamber made from stainless steel. Vacuum is provided by vacuum and diffusion pumps. The setup also includes laser with the wavelength of 660 nm, optical system for measuring reflectivity, LightWaySystems camera recording spatial distribution of the scattered laser light, a thermal radiation gauge, and the platinum-platinum/rhodium thermocouples. The described systems are controlled by a computer.

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METHOD OF DECREASE OF ELASTIC COUNTERACT TO THE QUALITY OF POWDER MATERIALS, PRESSED IN CLOSED PRESS- CASTS

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Repulsion pressure is proportional to pressing pressure after elastic counteract factor takes pressing pressure within matrix and during extraction of pressing from matrix of press- cast and depends on internal friction and Poisson factor. It is known from pressing practice of powder materials that, if pressing pressure is higher, then

lateral pressure affecting the wall of matrix and fricting it will be higher also. In connection with that, due to emerging of elastic counteract effect in the pressings, probability of occurrence of cracks in the pressings during extraction from matrix is higher [1].

In this article, method of pressing of powder materials in closed press-casts prepared by us, is offered, which enables realization of relaxation of tension created in pressings in the pressing processes within matrix up to extraction level. This method enables obtaining of foliated, qualitative pressings, without cracks, with the relative density up to 0.98%. Construction of press-cast (picture 1) if necessary, enables possibility of pressing of matrix to circle and extraction from circle. In first level of pressing, 1- matrix pressed to 2-circle with less tension. Tension is necessary in joint of matrix with circle for provision of full seating of circle in appropriate contact surface with all external surface of matrix. After the matrix is pressed to circle, lower poisson-3 is installed; further, indicated elements of press-cast are allocated on working desk of press and powder materials are added to matrix (picture 1, level II). Then, upper poisson-4 is installed to matrix and pressing level is executed. Densification of powder material is executed in accordance with required pressure. During pressing process of powder material, in result of affection of lateral pressure, matrix is tensed toward pressing direction in perpendicular flatness and this causes increase of tension in matrix-circle joint. Value of extension of matrix and tension in connection with it, depends on value of pressing pressure.

Next level of pressing process consists of extraction of circle-2 from matrix-1 by aid of two carves 5 and 6 (Figure, level IV). In result of extraction of circle and matrix, tension, occurred in pressing during pressing process will be decreased significantly. And this, in its turn, creates condition for decreasing of further affection in the process of extraction operation. Final level of pressing ends with extraction of pressing (Figure, level V) and dismissal it from press-cast.

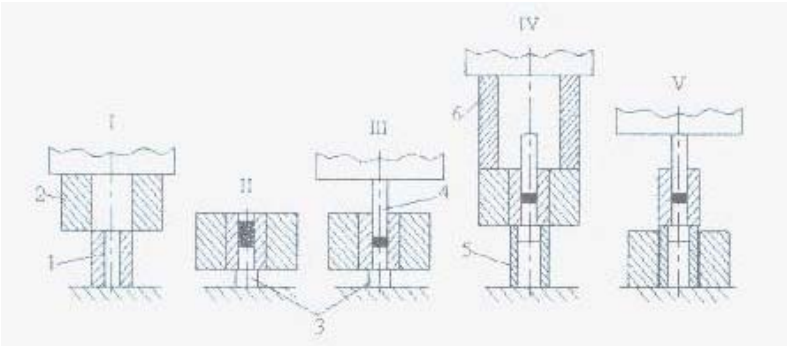

Figure. Level of pressing operations of powder materials in contact surfaced press-cast of mutual cylinder of matrix and circle: I – pressing of matrix to circle; II – pouring of powders to matrix ov; III – pressing; IV – extraction of circle from matrix;V – extraction of pressing;1 – matrix; 2 – circle; 3 – lower poisson, 4 – upper poisson; 5,6 – carves.

Suggested method of pressing of powder materials in closed press-casts creates condition for execution of tension in pressing up to extraction level of relaxation and this residual porosity provides obtaining of 5-3% qualitative non-boiled materials. Applied pressing method does not require any significant change in universal pressing equipment, increases working period of working surfaces of matrix and poisons, decreases isothermal holding period in sintering process, and most of them are wasted to process of elimination of porosities, enables avoiding of re-pressing of boiled briquettes, as well as, limits exploitation of lubricators and superficial active matters, applied to material. Thus, method of pressing of applied powder materials in closed press-casts is considered as efficient and economically purposeful.

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CARRYING CAPACITY OF REINFORCED CIRCULAR TREE LAYER FIBERED COMPOSITE PLATE CLAMPED ON EXTERNAL CONTOURS AND LYING ON NON-COMPRESSIBLE FOUNDATION

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The problem mentioned on the title for the composite plate subjected uniformly distributed loads with different intensity over rigid insert and annular parts, is investigated in the paper. The statically allowable fields of bending moments and the corresponding fields of the rate of deflections are determined too.

We consider the plastic bend of a circular plate occupying the area of $0 \le r \le b$, $-h/2 \le z \le h/2$, $0 \le \varphi \le 2\pi$ in dimensionless cylindrical coordinate system r, φ, z where z axis is down-directed. We think that the central part $0 \le r \le a$ $(a < b)$ of the plate is not deformed i.e. circle $r = a$ is articulate one. The plate is situated on incompressible foundation and subject to influence by positive load with p_1 intensity evenly distributed along deformed circular part $a \le r \le b$. The thickness of the plate h is constant one. The central layer of the plate with different yield loads $k\sigma_0$ and σ_0 $(0 < k \le 1)$ on tension and compression is reinforced by fibers in two orthogonal directions coinciding with the axes of capital bending moments. The materials of the fibers and coatings are also considered ideally stiff-plastic ones. The amount of the fibers is variant in each direction. The coatings are sufficiently thick layers, material which is homogeneous, isotropic, ideally plastic one with yield points Q_0 and $Q^-_0 = vQ_0$ $(0 \le v \le 1)$ while tension and compression, respectively. Composite yield conditions are deduced in [1].

The plate is situated on incompressible medium, therefore incompressibility condition is fulfilled

$$\int_0^b w(r)rdr = 0, \tag{1}$$

where: w is deflection rate of the plate in positive direction. Equilibrium equation of the plate has the following appearance

$$(rm_1)' - m_2 = -2(p - q)a^2 + 2(u - q)r^2, \; a < r < b, \tag{2}$$

where the stroke implies derivative for r and u is dimensionless intensity of medium reaction. The equation (2) is ordinary differential equation with two unknown quantities m_1 and m_2. The second equation between these values of form $f(m_1, m_2) = 0$ is the condition of plastic flow [1] and boundary conditions are:

$$w = 0, \; dw/dr = 0 \text{ or } m_1 = m^+_{01} \text{ when } r = a \text{ and } r = b, \tag{3}$$

as well as continuity conditions between the zones of different plastic regimes.

The rates of curvature change in radial and peripheral directions χ_1 and χ_2 are expressed through the derivatives of deflection rate w:

$$\chi_1 = -w'', \; \chi_2 = -(w'/r) \tag{4}$$

and under associated plastic flow rule in capital directions are associated with yield equations

$$\chi_1 = \lambda \, \partial f / \partial m_i \; (i = 1, 2) \tag{5}$$

Solution of the assigned task allows definition of statistically acceptable fields of bending moments, bearing capacity of composite plate and kinematically acceptable fields of deflection rates. Character of dependences of limiting load coefficient and resistance of medium from properties of materials formed plates has been developed.

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EFFECT OF ANNEALING ON THE THERMOPHYSICAL PROPERTIES OF HFO_2 GAS SENSORS

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Gas sensors are applied in many fields of industry, automobiles, domestic living and environmental monitoring for analyzing the chemical composition of the ambient atmosphere, to protect from harmful and hazardous gases as well as dangerous solvent vapors [1]. According to the working principle, several kinds of gas sensors can be found, like pellistors, quartz-micro-balances (QMB), optical systems, electrochemical sensors as well as metal oxide semiconducting gas sensors because of high stability, easy production and long lasting [2]. The principle of semiconducting metal oxide gas sensors is described in reversibly change their surface electronic resistance in the presence of hazardous gases. Therefore, to improve the reliability, stability and sensitivity of the metal oxide gas sensors, the different factors may affect the gas sensing of sample, such as the morphology, producing methods, surface defects and doped with different metals [3]. During the production of materials, annealing temperature is one of the key factors which significantly affect the structure, optical and electrical properties of the sensing materials. It was concluded that the final annealing temperature influences the concentration of the reactive sites for oxygen ionosorption [4-5]. The effects of thermal annealing on the electrical properties for gas sensing materials is important to increase the gas sensing properties.

In this study, HfO_2/p-Si samples are fabricated by Atomic Layer Deposition method with the thickness of 3.3 nm and investigated their gas sensing properties for different annealing temperatures. The sensing properties of samples are affected by the annealing temperature due to the change of the grain size of the material. When the annealing temperature increased, Increase in sensitivity is observed. Our results demonstrated that the annealing temperature is a very important parameter to determining the sensitivity of HfO_2 based gas sensors.

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THERMODYNAMICS OF THE PROCESS OF GENERATION HYDROCARBONS FROM WATER AND CARBON DIOXIDE

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One of the major environmental problems of the present is to reduce CO_2 emissions by replacing the processes forming CO_2 more modern, as well as the involvement of carbon dioxide in the new chemical synthesis. Independently of problem of the greenhouse effect, carbon dioxide should be considered as an important source of raw materials in the future. Oil, gas and coal are rapidly being depleted. Currently, only 10% of oil is used for processing chemical and petrochemical products. In order to combat greenhouse effect required use in industry new forms of energy and CO_2 should be involved to chemical processing.

In this paper we consider the possibility of producing hydrocarbons from carbon dioxide and water without additional hydrogen feed. In order to establish the temperature range of the process involving reactions (1-8) we carried out the relevant thermodynamic calculations.

The magnitude and sign of the isobaric-isothermal potential allows to solve not only qualitatively the issue of the possible direction of the reaction, but also quantitatively calculate the equilibrium composition of the system, and hence the degree of conversion of the reactants under the given conditions.

Table. The values of the isobaric-isothermal potential reactions (1-8), ΔZ (kcal/mol)

№	Reaction	Value, ΔZ_n*	Temperature, K			
			600	700	800	900
1.	$H_2O + Me^0 \rightarrow MeO + H_2$	ΔZ_1	-7,506	-8,75	-10,02	-11,31
2.	$CO_2 + H_2 \rightarrow CO + H_2O$	ΔZ_2	3,932	3,057	2,219	1,415
3.	$MeO + CO \rightarrow CO_2 + Me^0$	ΔZ_3	3,574	5,742	7,798	9,898
4.	$CO + 3H_2 \rightarrow CH_4 + H_2O$	ΔZ_4	-17,286	-11,437	-5,516	0,479
5.	$2CO + 5H_2 \rightarrow C_2H_6 + 2H_2O$	ΔZ_5	-17,622	-5,876	5,988	21,938
6.	$CO_2 + 4H_2 \rightarrow CH_4 + 2H_2O$	ΔZ_6	-13,354	-8,38	-3,297	1,894
7.	$CO + H_2O = CO_2 + H_2$	ΔZ_7	-3,932	-3,057	-2,219	-1,4150
8.	$11Me^0 + 3CO_2 + 5H_2O \rightarrow CH_4 + C_2H_6 + 11MeO$	ΔZ_8	-105,678	-104,357	-103,058	-101,781

The decomposition reaction of water on the catalyst surface can occur already at 600 K and with increasing temperature the probability of formation reaction is increases. The fourth, fifth and sixth reaction occur spontaneously when the temperature drops, but as the temperature increases the reaction rate decreases as the value of ΔZ increases. The probability of reaction (7) also decreases with increasing temperature in the temperature range 600-900 K. Reaction 8 represents the summary production of hydrocarbons from the reaction of CO_2 and H_2O. Due to the presence of hydrogen gas generated by the decomposition of water at the surface of the catalyst, the occurrence of the reaction at a temperature of 600 K.

The results of thermodynamic calculations show that in the temperature range 600-900 K carbon dioxide under the influence of water can be reduced with the formation of low molecular weight hydrocarbons (CH_4, C_2H_6), with high total yields.

ACKNOWLEDGEMENT: This work was supported by the State Oil Company of Azerbaijan Republic (SOCAR) and the Science Development Fund under the President of Azerbaijan Republic - Grant № EİF-2011-1 (3) - 82/63/4.

THE HEAT AND MOISTURE OF THE CONCRETE HARDENS AT LOW TEMPERATURES

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In the study of the stress state of concrete structures in the process of hardening concrete, it is necessary to define the temperature fields arising from exothermy concrete and external temperature effects. The hydration reaction of cement is accompanied by transition pore moisture in the bound state, leading to significant changes in humidity. Especially important is the inclusion of exothermy in the curing of concrete at naturally low ambient temperatures, as is the case when concreting in winter conditions.

A mathematical model based on the application of the equations of heat conduction and of moisture transport distributed volumetric heat sources and flow of water, the intensity of which depends on the temperature.

Considering that at low temperatures the hardening of the concrete, and hence heat and moisture transport is almost completely stopped, the solution of the problem in the adiabatic conditions a function of the volumetric heat source $\omega(t)$ in the form:

$$\omega(t) = \frac{BT_\infty (T_\infty - T_0)}{T_\infty + T_0 \left[\exp\left(BT_\infty t\right) - 1\right]}, \qquad T_\infty = T_0 + \frac{Q_g N}{c\rho}. \tag{1}$$

where B is the parameter of heat release rate of cement; N is the cement content in concrete; T_0 is the initial temperature of the process; T_∞ is the temperature of the concrete at the end of the heat dissipation; Q_g is the amount of heat released by a unit mass of cement during the hydration.

The heat equation and moisture transport in concrete mixtures with an initial temperature T_0 and the humidity was solved with the boundary conditions of the free warm-wet interface with the external environment with T_v set temperature and moisture W_v.

For concrete mix cement grade 300 with initial temperature T_0 = 15 ˚C and moisture W_0 = 0.0655 (in relative units by weight) when hydrated in adiabatic conditions, the temperature of the concrete increases with time from the initial to the limit T_∞ = 48,96 ^{0}C. Of humidity, due to the binding of water is reduced from the initial to 0,056 (14.5%). The calculation was carried out by time up to 700 hours, when the process of hydration and hardening of concrete, was mostly completed.

The dynamics of development of the fields of temperature and humidity in a concrete wall of thickness $2l$, cooled by external air with a constant temperature $T_v < T_0$ and humidity W_0. The calculations were conducted with the following numerical values: l = 1m; T_v = 3 ^{0}C; ρ = 2300 kg/m^3; λ_T =1.7 kcal/m·h· grad; c = 0,23 kcal/kg· grad; a_T =0,003m^3/h; α_{HT}=20 kcal/m^2·h·grad.

The calculation results indicate that the concrete is initially rapidly heats up from exothermy to C, then cooled slowly losing accumulated heat. Over time, the temperature in a concrete mass tends to quasi-stationary regime in the absence of exothermy. The most intensive process temperature change occurs at the points most remote from the boundaries.

Humidity value, calculated based on the flow of moisture, significantly different from the calculated without regard to runoff. This indicates that accounting for the flow of moisture during hydration needed to determine field moisture in concrete structures. The most significant changes in the moisture of the concrete occurs at the points most remote from the boundaries. Therefore, humidity strain of concrete (swelling or shrinkage) is inherent in massive concrete structures.

STUDY OF THE SPIROPYRAN THERMALLY INDUSED VALENCE ISOMERIZATION BY ^{1}H NMR SPECTROSCOPY

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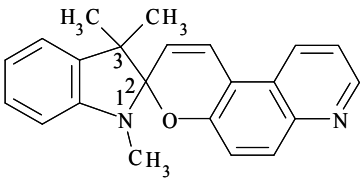
The process of thermoinduced isomerization for the spiropirans **1,2** has been studied by the dynamic NMR method. Diastereotopic *hem*-dimethyl groups at position 3 are object of study. It was found out experimentally that in the NMR 1H spectrums the point of coalescence signals of *hem*-dimethyl groups is achieved when the studied compounds are heated.

This gives the opportunity to determine the amount of the conversion free energy (ΔG≠) of the spiropyrans closed form. Parameters is carried out using the



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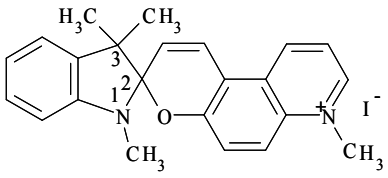

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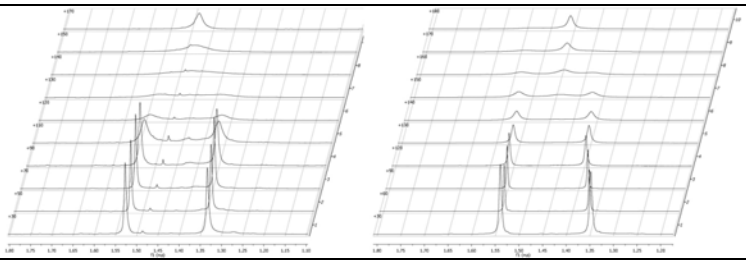
temperature dependence data in the NMR spectra of the exchanging diastereotopic groups. Two singlet signals nonequivalent methyl groups in the 3-position are shown in the spectra in the absence of exchange. These signals are broadened with the temperature increasing (increasing the rate of exchange) and the point of coalescence reached. The full coalescence occurs at 170 ^{0}C (1.48 ppm) (compound **1**).This indicates the full identity of the methyl groups at observed temperature. Behavior of *hem*-dimethyl groups in compound **2** is similar. The difference is another point of coalescence. It is observed at higher temperature (180 ^{0}C).

Expression Kcoal = π • Δν/√2 gives the rate constants at the coalescence temperature for the exchange between the two positions with equal population density and the free energy conversion of the closed spiropyran form ΔG ≠ calculated according to the Eyring equation:

$$\Delta G^{\neq} = 4{,}576T(10{,}32 + \lg T - \lg k)$$

The calculations are shown in Table 1



a b

Fig 1. The dynamics of the methyl group signals in the 1H NMR spectra (CD_5NO_2) of compounds 1 at 1 (a) and 2 (b) at temperatures 30-170 °C (a) and 30-180 °C (b) accordingly.

Table 1 . The results of NMR studies of the dynamics of compounds **1** and **2**.

Compound	*Hem*-dimethyl groups		Δν. Hz	K, sec^{-1}	T_{coal}	$\Delta G^{\neq}$, kj/mol
	ν_1	ν_2				
1	798	918	120	267	443	21.37
2	810	924	114	253	453	21.92

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DETERMINATION MELTING ENTHALPIES OF EUTECTIC COMPOSITIONS IN THE TERNARY SYSTEM $LiVO_3$-$NaVO_3$-KVO_3

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In work we identified specific melting enthalpy of eutectic compositions in the ternary system $LiVO_3$-$NaVO_3$-KVO_3 and two-components systems, which are elements of faceting, with microcalorimetry heat flux [1].

Using peak areas of differential curves, according to the formula (1) calculate the specific melting enthalpy of eutectic compositions [2]:

$$\Delta_m H_E = \Delta_m H_m \cdot \frac{S_E}{S_m} \cdot \frac{T_E}{T_m}, \text{ kJ/kg}, \quad (1)$$

It is also theoretically calculated specific melting enthalpy ternary system $LiVO_3$-$NaVO_3$-KVO_3 and two-components systems by the formulas (2) and (3) [2, 3]:

$$\Delta_m H_E = \Delta_m H_m \cdot (1 + 0.00025 \cdot \Delta T) \cdot \frac{S_E}{S_m}, \quad (2)$$

$$\frac{\Delta H_E}{T_E} = 25.1 \pm 4.2, \quad (3)$$

In Eq., S_E и S_m – peak areas of differential curves corresponding to the melting temperatures of the eutectic composition and the model; $\Delta_m H_m$ и $\Delta_m H_E$ – the specific melting enthalpy of the model, which is close to the melting temperature of eutectic composition, and the specific melting enthalpy of eutectic, kJ/kg; T_E и T_m – melting temperatures of the eutectic composition and the model, K.

The obtained results were compared with experimental (table).

Table: Properties of nonvariant points

Melting temperature, K	Composition, mass %			Specific melting enthalpy, kJ/kg		
	$LiVO_3$	$NaVO_3$	KVO_3	Experiment	By the formula [2]	By the formula [3]
639	32.9	-	67.1	249±12	263±13	167±8
767	-	15.3	84.7	323±16	323±13	151±7
663	26.4	5.6	68	186±9	191±9	165±8

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PROPERTIES OF HEAVY OIL – WATER EMULSIONS

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Using of heavy oil – water emulsions (HOW) as a boiler fuel allows to reduce harmful emissions and to utilizee waste oil. The emulsion components are evenly distributed in HOW, so the water is an effective component. The most expedient way of preparation of HOW is to produce it from oil residues using additives and various dispersing devices.

The rheological behavior of boiler heavy oils (HO), HOW, bioadditives (BA), HO+ BA mixtures and HOW+BA mixtures are investigated. Amount of BA in mixtures was 0.5 - 10 % mass. Viscosity of HO was 13 and 37 Pa·s (20 °C). HOW prepared from HO, heavy oil deposits and scourage had a different dispersion composition. Substandard vegetable (canola) oil and their methyl esters (FAME) were used as BA. Investigated HOW were kinetically resistant to water separation for a long time. Mixtures were produced by addition BA to HO and HOW with mechanical stirring. The rheological characteristics of HO and BA were studied on a rotational viscometer DV-III+Ultra (Brookfield), of HOW and all mixtures – on REOTEST-2 PV-type. The dynamic viscosity was measured at temperatures 20, 30, 40, 50, 60, 70, 80 °C and shear rate 0,03–145 s^{-1}. Accuracy of temperature was ±0,1 °C.

HOW and HOW+BA mixture are pseudoplastic liquids in temperature interval from 20 to 50 °C. Flowing of HOW becomes Newtonian after 60°C from 1% content of BA. It was found that the addition of 1-3% BA in HO and HOW reduces its viscosity to 5-60% in dependence on the temperature, shear rate, quantity of BA and etc. The higher the dynamic viscosity of of the initial sample at low temperatures, the lower it when BA administered. Reduced viscosity also depends on the degree of dispersion HOW. When adding 1,2 and 3% BA to the coarse-dispersion HOW viscosity reduction is 1,6, 1,5 and 1,1 times higher than to the HOW with 90% content of drops with size of the dispersed phase up to 10 microns. Viscosity reduction of HOW+BA mixture is higher than viscosity reduction of HO+BA mixture because of distribution of BA in the interphase layer of HOW. With increasing temperature the HOW solubility in the hydrocarbon phase is increased. Viscosity reduction of HOW + BA mixture with increasing amounts of BA from 1 % occurs primarily due to lowering the viscosity of the hydrocarbon component. FAME viscosity is 6 times less than the viscosity of canola oil at 50 °C. HOW viscosity reduction when it's added is differs approximately in 1,5 times.

50 samples of heavy industrial fuel oil of Republic of Belarus are investigated. Approximately half of the sample contained waste in its composition. It was determined experimentally that the sulfur content is 0,5–2,5 % (by gravimetry after combustion in a bomb containing oxygen under pressure and/or by energy-dispersive X-ray fluorescence spectrometry), density is 870–1010 kg/m^3 (hydrometer), the water content is 0,03–70 % (distillation with benzene), kinematic viscosity at 80 °C is 20–450 mm^2/c (glass capillary viscometer), gross calorific value is 13-45 MJ/kg (isoperibolic bomb calorimeter).

Ranges of viscosity, density and the calorific value of samples studied depending on the nature of the feedstock and the dispersion composition were identified and analyzed. Equations for calculating the gross and net calorific values, based on the values of the density and water content, were developed. The received relations were checked according to the literature data. The proposed equations allow to predict the values of the calorific values for liquid petroleum fuel oils with an error of no more than 0,4 MJ / kg at 95% probability.

COMBINATION OF CERAMIC RESEARCH OF THE MECHANISM OF CONTACT MATERIALS

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The strength of the ceramic mechanics essentially depends on the volume of funds. Large-scale means of dangerous defects is high probability, their average strength is low. According to the theory, Weybull, volumes V_1 and V_2 relative firmness of the two examples is a follow:

$$\frac{\sigma_1^{'}}{\sigma_2}=\left(\frac{V_2}{V_1}\right)^{\frac{1}{m}}, \tag{1}$$

where, *m*- body is a constant characterizing the material, if *m*-high, then one body material. This condition must be seen in the specific design of the welding. The elasticity of the porous ceramic is low and depends on the exponential low of elasticity. Most of the data represented by the formula Reskewis:

$$\sigma=\sigma_0\exp(-h\Pi), \tag{2}$$

here *h*-stable, 4÷7 change. *P*-volume temperature range.

Leading to the destruction of means of asserting the two changes that have increased the amount of funds, *R* stress and the shape factor of the body depends on the *S*-confirming the critical temperature suited to its difference.

$$\Delta T_{kp}=R\cdot S, \tag{3}$$

In some cases, dependence of the material properties *R* is considered as a *S* factor in resistance which, in many cases, have complex relationships. It is often difficult to quantify. Therefore, *R* used by the relative stability of slow heating, thermo relative heating and cooling uses ceramic thermo physic dependency ratio can be solved by following formula:

$$R=\frac{\lambda(1-\nu)\sigma_b}{\alpha c\rho E}, \tag{4}$$

here, *v*- is the Poisson's ratio, C-specific heat, *ρ*-holder compression, E-Yung modulus.

Oxide materials are very often used as a conductive material. For such purposes, in accordance with their importance for the transmission rate depends on the temperature of the thermal gradients. The thermal conductivity of the following basic equation:

$$\frac{dQ}{dt}=-\lambda S\frac{dT}{d\chi}, \tag{5}$$

here: *dQ –t* to the direction, *S*- it passes-surface and heat. λ – coefficient of thermal conductivity.

The main role is played by the extremely low load conditions with the aim point. Status sliding metal impressed experts. But despite this resilience of physical processes. Calculation of work gliding accurate method difficult. In simple cases, the sliding speed is calculated by the following equations:

$$\varepsilon=\varepsilon_0\exp\left[-\frac{Q}{RT}\right], \tag{6}$$

here: *Q* –active energy slip, *R*-slip-stability gas, ε_0 –ratio.

The analysis shows that the surface is not only parallel to the dislocation interaction. Dislocations at an angle perpendicular to the power.

$$F = -\frac{Gb^2}{4\pi l}, \quad (7)$$

here, *F*- podem free surface, *l*- the distance from the surface, *b* -Byurgers of the vector, *G*- a change material to module.

Normal temperature at a high temperature (1100÷1300 K) oxide material is treated in a fragile and low-voltage distributing heat. According to the theory Griffiths at the end of the crack length σ_{min} is approved voltage average score:

$$\sigma_{\min} = 2\sigma_{or}\sqrt{\frac{l}{r}}, \quad (8)$$

here: *l* - is half the length, r - radius of the crack.

Causes micro-cracks structures and physical properties of heterogeneous and diverse etaps. Vryed do oxide materials characterized by melting metals such as merging the high modes. Intomogeneus temperature is regarded as the mechanical connection.

During welding, a high temperature due to pressure non-metalic elements only metal elements be deformed in this case, less than the thickness of the metal element. Relatively thin metal mechanical properties of the formation differ. This case is contact strength and tensile and flexural strength and elastic types occurs during charging types. Such compounds are called non-uniform mechanical combination.

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PRICES OF FOREIGN FORCES DURING DETERMINATION OF ELEMENTARY PRESSING POWDER PARTICLES

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While pressing the powder particles to establish an assessment of the elementary work of the external force on the molded funds can be considered as deformable body. Then the main work dA_e, *dh* of the external forces during a change of location of the ponder is carried out by operation of the press:

$$dA_e = Pdh, \quad (1)$$

During consideration of price *P* compression forces press molded funds segment in *N* particles of cohesive forces can be found as the sum of the projection:

$$P = \sum_{i=1}^{n_s}\sum_{i=1}^{k_a}\sigma_{ki}S_{ki}\cos\varphi_i(1+f_i\varphi_{\tau}) \quad (2)$$

go for the average number of expression (2) can be written in the following manner:

$$P = \sigma_k S_{kc} n_s K_a^{'}(1+f_i\varphi_{\tau})\cos\varphi_i \quad (3)$$

Taking into account (3) the expression (4) can be written as follows:

$$dA_e = \sigma_k S_{kc} n_s K_a^{'}(1+f_i\varphi_{\tau})\cos\varphi dh \quad (4)$$

Internal forces dA_i work in the integrity of pressing against the force of resistance to sliding push particles consumed.

$$dA_i = \sum_{i=1}^{n_z}\sum_{i=1}^{n_s}\sum_{i=1}^{K_a^{'}} \sigma_{ki} S_{ki}(d\delta_{ki} + 2 f_i du_i) \tag{5}$$

Turning to the mean expression (5) can be written as follows:

$$dA_i = \sigma_k n_z n_s S_{kc} K_a^{'} d\delta_k (1 + f_i \varphi) \tag{6}$$

In this way during the consideration of the number of briquettes and the ratio $n_s = \frac{S_H \vartheta}{\Phi a_{c_p}^2}$ of the average particle, particles interact with the normal ratio: the ratio between the positions of the particles $d\delta_k$ -can be expressed as follows:

$$d\delta_k = -\frac{\Phi_0 \cdot a_{ort}}{\Phi(1 + f_i \varphi_\tau)\cdot \cos\varphi} \cdot \frac{dh}{h}; \tag{7}$$

here: Φ_0 - the volume of the particle shape, Φ - is flat shape of the particle size of the particles, a_{ort} -middle static – during consideration the height, h - of briquette-normal contact, φ - angle of mutual influence between the particles change places-approximation particle, $\varphi = 2\frac{du_c}{d\delta_k}$ -is a relative factor at this time consider can write well.

This expression against the relative ratio can be obtained by solving an expression.

$$(1 + \Psi\varphi_\tau)(1 + f_i\varphi_\tau)\cos^2\varphi = (1 + f_i\Psi) \tag{8}$$

The expression ψ of a quantity,

$$\Psi = \frac{(tg^2\varphi - f_i\varphi_\tau)}{\varphi_\tau(1 + f_i\varphi_\tau) - f_i(1 + tg^2\varphi)} \tag{9}$$

If that solve the majority of the particles are moving vertically with respect to the movement parallel to the working punch, then the following conditions will be available for contact connections:

$$\varphi = \tau \approx \frac{\pi}{2}\cos\tau \approx \sin\varphi \quad \varphi_\tau \approx tg\varphi \tag{10}$$

Taking into account (10) the expression (9) is as follows:

$$\Psi = 2\frac{du_c}{d\delta_k} \approx tg\varphi \tag{11}$$

The maximum inner strength job evaluation expressions (10) and (11) correspond to each other.

At the same time the relation (11) shows that the conditions for the normal movement of particles occur mainly due to its weakening. Thus ψ the function is available in the form of the following inequality:

$$tg\varphi \le \Psi = \frac{(tg^2\varphi - f_i\varphi_\tau)}{\varphi_\tau(1 + f_i\varphi_\tau) - f_i(1 + tg^2\varphi)} \tag{12}$$

φ_T estimate of the number corresponds to the following, interval differential equation:

$$\frac{\sqrt{1 + 4f_i^2(1 + tg^2\varphi) - 1}}{2f_i} \le \varphi_\tau \le tg\varphi \tag{13}$$

Describing the mechanism of deformation of the equation

$$d\left(\frac{a_k}{\vartheta^2}\right) = \overline{U}_1 \frac{d\vartheta}{\vartheta} \tag{14}$$

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EXPERIMENTAL STUDY OF CORRELATION BETWEEN METAL SURFACE ROUGHNESS AND INTENSITY OF PROBE RADIATION SCATTERED BY THE ROUGHNESS AT MELTING

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Experimentale data of melting of metal surface layer allow to determine boundaries of applicability of theoretical models describing variation of thermophysical properties at the early stage and subsequent stages of influence of intensive radiation. Melting of the layer under action of intensive radiation is usually studied from surface reflectivity with the probe radiation [1-4]. However spatial structure of roughness and optical constants influencing on the reflectivity are different dependence on temperature [5]. In this connection investigation of informativity of spatial distribution of the probe intensity scattered by surface roughness at melting is relevant.

Correlation between degree of isotropy of spatial distribution of probe radiation intensity diffusive scattered by the surface roughness and degree of isotropy of spatial distribution of the surface roughness was determined experimentally. Correlation was evaluated as ratio between degree of isotropic distribution of the radiation intensity and degree of isotropic distribution of the surface roughness. The degree of isotropic distribution was defined as:

$$D = (Pp\text{-}Pc) / (Pp + Pc),$$

where P_p is the power of scattered radiation (roughness dispersion) in the plane perpendicular to roughness grooves and Pc is the power of scattered radiation (roughness dispersion) in the plane parallel to roughness grooves.

Evaluation of correlation of spatial distribution of scattered intensity and that of surface roughness during melting was performed with physical simulation method. Two steel samples with surfaces obtained by sandblasting and unidirectional grinding were used to simulate isotropic roughness and unidirectional roughness, respectively. The roughness of the samples was determined in mutually orthogonal directions with a contact profilometer Form Talysurf and AFM microscope "Smena". Spatial distributions of intensity scattered by the samples were measured with the camera LightWaySystems. The measurements were performed on experimental setup.

Obtained values of the correlation were 0.97 for the sandblasted surface and 0.92 for the unidirectional ground surface. The obtained values show high degree of correlation between the spatial distribution of the scattered radiation and the spatial distribution of the surface roughness.

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THE FINITE-SIZE SCALING RELATION FOR THE ORDER-PARAMETER PROBABILITY DISTRIBUTION OF THE SIX-DIMENSIONAL ISING MODEL

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The six dimensional ising model with nearest-neighbor pair interactions has been simulated on the Creutz cellular automaton by using five bit demons near the infinite-lattice critical temperature with the linear dimensions L=4,6,8,10. The critical temperature value of infinitive lattice has been obtained from the results of simulations by using finite-size scaling relation. More over the order parameter probability distribution for six dimensional ising model have been calculated at the critical temperature. The finite size scaling relation for the order parameter probability distiribution has been tested and verified nümerically by the Creutz Cellular Automaton simulation. The constants of the analytical function have been estimated by fitting to probability function obtained numerically at the finite size critical point. For the large finite size, the analytical function has been described the universal shape of order parameter probability distiribution function.
KEY WORDS: Ising Model, Order Parameter Probability Distiribution, Cellular Automaton, Finite-Size Scaling.

THERMOPHYSICAL PROPERTIES OF RED SEA WATER

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The changing of climate and increasing of middle temperature in the Earth and Seawater surface, aslo speeding up evaporation of Sea water. The Red Sea connects Indian Ocean and Mediterranean Sea, lying between Africa and Asia. The region has very high temperature in the most time in year up to T=323.15 K and this fact play important role for the evaporation of water. In this case, the salinity of water is increasing and reaches up to 41 ‰ in the northern part. The nature around of Red Sea is very dry and has much sand. The drink water resources are limited. In this case, desalination of Red Sea water for drinking and domestic use is very actually in this region. Only 18 desalination plants have Saudi Arabia along the Red Sea coast. The other countries (Yemen, Sudan, Eritrea, Djibouti, Egypt, Jordan and Israel) also have various activities, techniques, plants etc. for desalination of the Red Sea water for domestic purposes. Saudi Arabia also is reaches with oil and gas reservoirs. The ship navigation (mostly oil and container tankers) is also most active in this region. Because, they reach Europe through Suez canal and Mediterranean Sea faster than travelling of all African coast.

Developing of desalination techniques need the wide range thermophysical properties of the Rea Sea water. In this case, we analysed two sample of the Red Sea Water [one from "The Brothers Islands" (geographical coordinates 26°18'55" N; 34°50'28" E and 38.7 m deep) and another from "Daedalus" (geographical coordinates 24°55'52" N; 35°52'12" E and 28.2 m deep). It is first analysis of the Read Sea water and we will continue this work in future. In this conference, we will present the density of these samples at T=(278.15 to 413.15) K and at pressures up to 100 MPa. The density measurements of the Red Sea water at the high pressures were carried out using the Anton-Paar DMA HPM vibration-tube densimeter. The density measurements at ambient pressure also were carried out using the Anton-Paar DMA 4500 densimeter. The viscosity of samples were analysed using the SVM3000 Stabinger Viscometer. The chemical analysis of samples (cations and anions) were analysed using the IRIS Intrepid II Optical Emission Spectrometer and DX 100 ion chromotography.

An empiric equation of state for fitting of the (p,ρ,T) data of the Red Sea water samples has been developed as a function of pressure, temperature and salinity of water. This equation is used for the calculation of the thermophysical properties of samples.

EXPERIMENTAL STUDY OF PHASE EQUILIBRIUM IN THE SYSTEM N-ALKAN-WATER

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Under deposit conditions and during the process of layered fluid (oil) deposition is contacted with water that forming "gas - oil – water" system. A hydrocarbon is dominated In the oil composition. The presence of the aqueous phase is significant affect on the thermodynamic parameters of system. The study of phase equilibrium was carried out based on the experimental results of isochoric heat capacity. The phase equilibrium parameters definition is bused on the features of thermodynamic behavior of studied system at phase transitions. Methods of experimental study are described in detail in [1, 2]. The measurements of heat capacity by isochors were carried out on the experimental set-up that automated on the base temperature controllers LakeShore, digital multimeters Kethley and PC. A characteristics of Cv = f (T) at the phase transition (the maximum and jump on the heat capacity isochors) allows us to define the parameters of (temperature, density, pressure) bound area of phase equilibriums. Based on the obtained data, the phase diagrams ρ= f (T), were plotted. The mixing regions in the n-heptan-water with different content of polar component were defined.

It is shown that:
-The presence of the aqueous phase is significant affect on the hydrocarbon phase diagram configuration.
-The width of the separation region depends from water concentration in heptane.
- The studied n-heptane-water system has a state of azeotrope.

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OBTAINMENT OF MOLYBDENUM WIRE OF HEIGHTENED PLASTICITY

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This paper presents the results of research on the production of molybdenum wire of heightened plasticity. Studies on reduction of the content of intercalation impurities in molybdenum were carried out by raising the temperature of recovery to 150-200 ºC compared with the existing technology of production of metal powder, molybdenum brand Mch. Increasing the recovery temperature resulted to changes of physical and technological characteristics of the powders of molybdenum (e.g., increased bulk density and average particle size of the powder, reduction the oxygen content in powders). The high temperature of caking of pressed bars compacted (2300-2400 ºC) made of these powders allowed to maintain open porosity due to obtain large grains of powder and increase caking time and promote the fullest degassing process and remove fusible impurities.

Molybdenum rods underwent thermomechanical deformation to produce molybdenum wire of ⌀59 micron. Output of spiral wire of ⌀200-120 microns was 90-95%, a wire of ⌀100-59 microns - 75%, which is significantly higher than the results obtained by the existing technology (15-25%).

SEMI-CONDUCTOR PROPERTIES OF SOLID-STATE BORON NITRIDE

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Hexagonal boron nitride (h-BN) is a wide optical energy bandgap III –IV compound which has remarkable physical properties and chemical stability. In this study, florecence, UV and FTIR analysis were resulted of h-BN which is a boron high technology product. For optical properties studies, the samples were compacted as pellets, it was obtained purity and honeycomb layered structure of boron nitride. Optical absorption and florecence measurements were evaluated of pellets at room temperature, respectively. It has been concluded that semi-conductor properties of h-BN can take place in nano material applications.

KEYWORDS: h-BN, Florecence, UV, FTIR, semi-conductor.

ENVIRONMENT FRIENDLY BORON NITRIDE AND USEABILITY IN FOUNDRY MOLDS

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Hexagonal boron nitride (h-BN) is used in high temperature bed solid lubricants, glass and metal of the casting mold and the mold release, because of high temperature refractiveness, thermal conductivity, chemical inertness and easy processability properties.

In this study, XRD and SEM analysis of high purity h-BN were done for characterization studies, a mixture was prepared with appropriate pigment for mold release features and mold release experiments were done with pulverization of this mixture to stainless steel mold in 200 °C and 3 bar for two minutes in a foundry. It has been concluded that mold release which consists of h-BN has less service-life than commercial mold release, but a non hazardous new material for human health, environment friendly and economical product was developed.

KEYWORDS: h-BN, XRD, SEM, foundry mold, sustainable product.

DEVELOPMENT AND APPLICATION OF EFFECTIVE COMPOSITIONS OF COMPOSITE THERMO-RESISTANT MATERIALS TO INCREASE THE PERFORMANCE OF ROCK BREAKING AND CUTTING TOOL – CHISEL IN PROCESS OF DRILLING OIL AND GAS WELLS

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The article presents the results of research of developed effective formulations of thermo-resistant composite materials class KHR, which allow increase in temperature of operation of drilling fluids based of developed composite materials to 200-220 ºC, increase of mechanical speed and endurance of rock breaking and cutting instrument by 10-15% and opening of productive horizons wells for oil and gas by 30-35%. It also provides the stability of the process of drilling oil and gas wells and the ecological safety of the environment.

PHYSICAL AND MECHANICAL PROPERTIES OF COMPOSITE MATERIALS FILLED WITH A MECHANICALLY ACTIVATED MINERAL INGREDIENTS USED FOR ROADS, BRIDGES AND AIRFIELDS

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The article presents the results of research pioneered effective compositions of composite materials filled with a mechanically activated natural sand and other ingredients, which improve strength properties, thermo-resistance, shear stability and crack resistance and the overall increase efficiency and durability of asphalt concrete composite pavements of roads, bridges and airfields.

PHYSICAL AND MECHANICAL PROPERTIES OF THERMO-FROST-RESISTANT SEALING COMPOSITE MASTIC

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The article presents the results of research pioneered thermo-frost-resistant composite materials based on organic ingredients from local raw materials and waste products with predetermined physical-mechanical and technological, properties for filling deformed joints of concrete roads and cracks of asphalt roads. They can be used in different climatic conditions of hot climate and high altitude ranging from minus 35 to plus 130 ºC, as well as improve the efficiency and durability of roads, bridges and airfields.

PECULARITIES OF CASTING TECHNIQUE OF BILAYERED CASTINGS OF PIPES GREY CAST IRON - ACID-RESISTING FERROSILITE

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Expirements on casting technique of bilayered castings of pipes were held on multiposition aggregate of type "Lipetsk", designed to production of one-layered pipes of diameter 109 mm and length 2000 mm. This aggregate consisits of lower and higher storey where are located rotating chill moulds. Each chill mould consists of solid rotor with steel and cast-iron chill mould put in it. In tail part of chill mould is located the ring, limiting the length of composite pipe. Water charger constructed for this purpose consists of double-chamber hopper with appropriate discharge holes and dual-channel ditch where the length of channels is different (Fig.1). Chill mould 9 is driven in rotation and then the dual - channel ditch heated to 500 ºC is imbeded into the cavity of the mold. Liquid gray cast iron (sign СЧ 24) and liquid ferrosilid (sign С15, with chemical composition - 0,53% C; 15,19% Si; 0,26% Mn; 0,024% P; 0,10% S) which are parallel smelted in two induction furnace sequentially poured into the chambers by the measuring spoon and through the appropriate tapping holes metal layers flow over different channels of the ditch (Fig. 2).

Metal of outer layer first enters into the cavity of a rotating mold from the spout of the short channel of the ditch and then quickly covers the entire length of the splayed and partially the composite units of the mold. The process of the solidification of the outer layer of the iron castings starts.

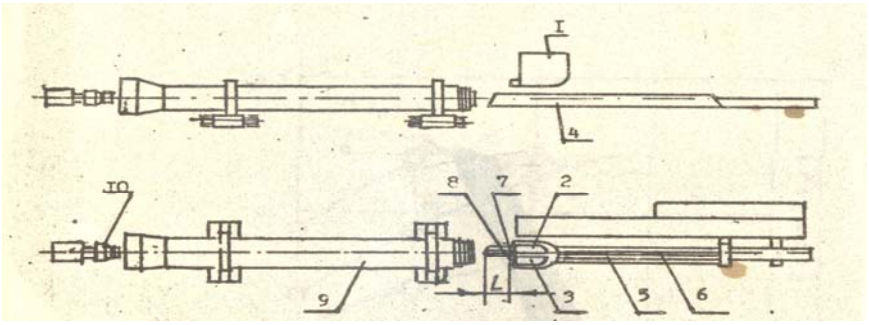

Fig.1. The scheme unit centrifugal machine with pouring device for casting a bilayer castings: 1 - hopper; 2 and 3 – chambers of loading hopper; 4 - ditch; 5 and 6 – channels of ditch; 7 and 8 - tapping holes of the hopper; 9 – casting form; 10 – a head with cores

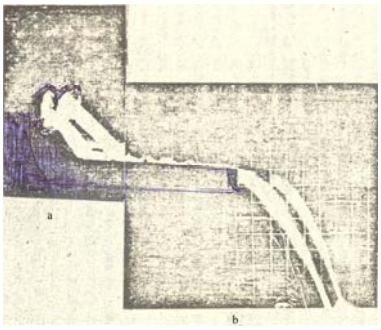

Fig.2. Movement of liquid metal layers of casting on elements of the filling device of the centrifugal machine: a - output of stream of liquid metal layers from the tapping hole of the riser; b - Movement of metal layers on channels of the ditch and pouring of them into the cavity of the mold.

Liquid ferrosilid is poured from the spout of the long channel of the ditch onto the freeze layer of grey cast iron after a time (8-20 seconds). Simultaneously continuing to pour liquid metal of ferrosilid of inner layer, gradually the ditch is derived from the mould. After pouring of the melts of the outer and inner layers of the casting the chill-mould should be in a rotating movement for about 35-55 seconds.

Table: Technological parameters of the centrifuging process of two-layer casting of grey cast iron - ferrosilid

	Process parameters	Otdika	Outer layer	Inner layer
1.	Alloy grade	-	СЧ24	СИ15
2.	Size castings; m			
	-diameter	0,109	0,109	0,098
	-length	2,0	2,0	2,0
	-wall thickness	0,01	0,006	0,004
3.	The thickness of parting compound, m	0,0008	-	-
4.	Speed of rotating mould, r.p.m.	810	810	810
5.	Temperature of the mould, C	420	-	-
6.	Temperature of pouring, C	1250-1300	1250-1300	1270-1399
7.	The initial length of t5he channel of the ditch, m	-	1,2	1,8
8.	Diameter of the tapping hole	-	0,035	0,045
9.	Pouring rate	-	2,2	3,2
10.	The average rate of increasing of the wall thickness, m/s	-	$0{,}28\ 10^{-3}$	$0{,}5\ 10^{-3}$

CONCLUSION. According to the results of the tests and appropriate management of the procedures and duration of the operation of the pouring of layers of metals, the cyclogram of the mode to obtain a two-layer casting was designed. It is shown in the table.

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THE CURRENT VOLTAGE CHARACTERISTICS OF Ag/TiO_2/n-InP/Au SCHOTTKY BARRIER DIODES

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Metal–semiconductor (MS) and metal-insulator-semiconductor (MIS) type Schottky barrier contacts play a significant role in semiconductor device technology [1-4]. The semiconductor technology is still explored and has attracted much interest during recent years. Group III–V compound semiconductors, particularly, InP is an attractive semiconductor due to its advantages for solar cells, laser diodes, photo detectors and high speed metal–insulator–semiconductor field effect transistors (MISFETS and) amplifiers operating at high power and high frequencies with low noise [2].

A Schottky diode is created when a junction forms between a metal and a semiconductor, creating a potential energy barrier that is referred to as a Schottky barrier [3]. The characterization of the Schottky barrier will continue to be important. For instance, during device fabrication the metallization of a semiconductor surface for external device connection may cause it to exhibit a potential barrier at the connection. It is difficult to obtain a Schottky barrier height (SBH) greater than 0.5 eV for n-InP semiconductor due to the surface Fermi level pinning which arises from the high density of surface states and other non stoichiometric defects [3]. This could lead to a large reverse leakage current in n-InP based Schottky diodes. Therefore, achieving a high SBH with low reverse leakage current is an important research issue in InP device development.

In this work, we have formed Ag/TiO_2/n-InP/Au Schottky barrier diodes (SBDs) and current-voltage (I-V) characteristics have been investigated in the temperature range 200-380K. TiO_2 film has been used as interfacial layer between metal and semiconductor layers. We calculated important parameters of the diode by using different methods. The zero-bias barrier height Φ_{bo} and ideality factor n determined from forward bias I-V characteristics were found dependent on temperature. According to these results, ideality factor n decrease and barrier height Φ_{bo} increase with an increase in temperature.

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INVESTIGATION OF THE EFFECT OF TOOL ROTATIONAL SPEED ON THE MICROSTRUCTERE AND HARDNESS BEHAVIOUR OF FRICTION STIR WELDED 7075 ALUMINUM ALLOYS

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Friction stir welding (FSW) is a new solid-state joining technique that was utilized for welding high strength metallic materials such as aluminum alloys, magnesium, copper and metal matrix composites (MMC). In friction stir welding, the joint is generated by frictional heating between the nonconsumable tool and workpiece to be welded.

This study aims to investigate the effect of rotational speed of the tool on the microstructure and the hardness behavior of the friction stir welded 7075 aluminum alloys. Therefore, welding processes were achieved by a constant translational speed through three different rotational speed. Firstly, test specimens were taken from welded sheets for microstructure investigation and the hardness measurements. Afterwards, joint performance was investigated by taking into consideration the effects of the rotational speed on the microstructure and the hardness of the friction stir welded zone.

THERMODYNAMIC PROPERTIES OF SEMICONDUCTOR-METAL TYPE GaSb-CrSb EUTECTIC COMPOSITE

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The differential thermal analyzes (DTA) of GaSb-CrSb eutectic composite on the 290-1200 K temperature range have performed by "PerkinElmer STA 6000" device (Fig.1). It was established that the initial and final temperatures of melting are 943 K and 965 K, respectively, and enthalpy of melting is equal to 56,45808 J/g.

The heat flow and specific thermal capacity on the 200-900 K temperature range are obtained by "NETZSCH DSC 204F1" device. The exothermic peaks at the 516 K and 690 K and endothermic peak at the 868 K are observed on the heat flow temperature dependence (Fig.2 and 3).

The temperature dependence of enthalpy ($H = \int_0^T C_p\, dT$), entropy ($S = \int_0^T \frac{C_p}{T}\, dT$) and Gibbs energy ($G = H - TS$) were established from the $C_p(T)$ dependence expressed by polynomial expressions on the T_1=300-502 K, T_2=525-652 K, T_3=705-785 K temperature ranges:

$$C_1(T_1) := 0.2998 - 0.0008 \cdot T_1 + 2.6144 \cdot 10^{-6} \cdot T_1^2 - 2.5107 \cdot 10^{-9} \cdot T_1^3;$$

$$C_2(T_2) := 0.297 - 0.00082 \cdot T_2 + 2.614 \cdot 10^{-6} \cdot T_2^2 - 2.4 \cdot 10^{-9} \cdot T_2^3;$$

$$C_3(T_3) := 0.115 + 0.00049 \cdot T_3 - 5.0676 \cdot 10^{-7} \cdot T_3^2$$

The $C_p(T)$ dependence and established values of enthalpy, entropy and Gibbs energy are plotted on the Fig. 4.

It is significant that, when investigated transport parameters, in the temperature between 490 K and 515 K the change of of Hall coefficient sign, and in the 600-650 K temperature range on σ(T) dependence the deviation is observed.

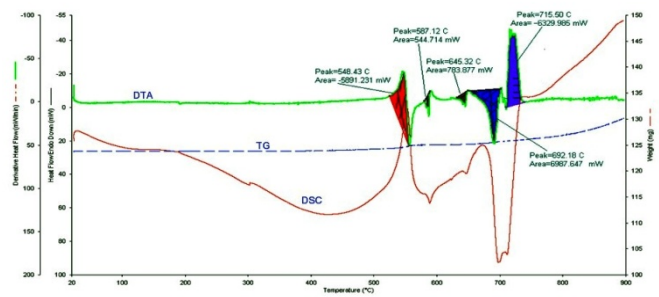

Figure 1

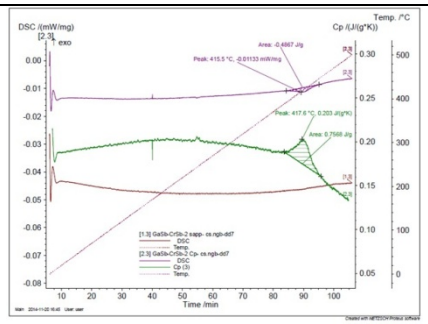

Figure 2

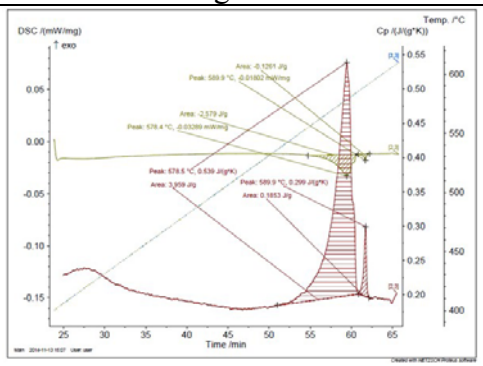

Figure 3

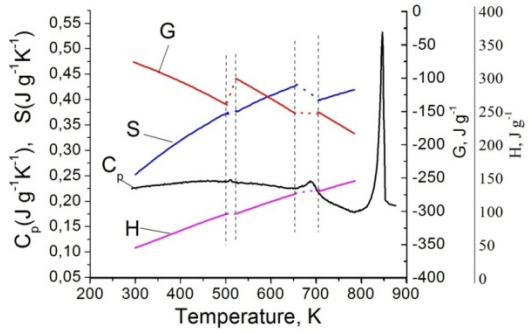

Figure 4

INFLUENCE OF FULLERENE C_{60}, C_{70}, C_{120} ON THE CHANGE OF HEAT CAPACITY OF LIQUID HYDRAZINEHYDRATE IS IN A WIDE RANGE OF STATE PARAMETERS

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KEYWORDS: Fullerene C_{60}, C_{70}, C_{120}, thermo physical properties, hydrazine hydrate, hydrazine and phenyl hydrazine, calorimeter, equation of type Tait, solutions, density, viscosity, temperature, pressure.

Properties of individual substances used in technological processes and their mixtures are determined not only by the nature and content of the mixture components, but also by the condition of the process. Obtaining reliable experimental data on the thermo physical properties of hydrazine hydrate and their colloid solutions (hydrazine hydrate +C_{60} fullerene,C_{70}, C_{120}) is an important practical task, providing further development progress. Besides independent scientific and practical impotence (significance) of studying phase transitions and critical phenomena of associated components, the data on thermal conductivity are the criteria of the accuracy estimation of the thermodynamic equations of state and a measure of internal consistence of data on different caloric and thermal properties in all realizable - homogeneous, heterogeneous and met stable experimental bated. Data on thermal conductivity in addition to the independent scientific and practical value of studying phase transitions, critical phenomena associated compounds are the criteria of the accuracy estimation of the thermodynamic equations of state and a measure of internal consistency of data on different caloric and thermal properties in all States implemented the experiment Homogeny, heterogeneous met stable. After our was completely evacuated from the C-calorimeter by the vacuum pump. The aim of this work was to investigate the specific heat of liquid Hydrasilikata and with the addition of fullerene (C_{60}, C_{70}, C_{120}) from 0.1 to 1 g and phase equilibrium critical areas. As object of research was taken liquid hydrazine hydrate. The generalization the study the heat capacity of the samples in a wide range of state parameters shows regularities in the behavior of the heat capacity in different regions of the phase diagram on the curve of phase equilibrium in the vicinity of the critical point. To measure the heat capacity

of the colloidal liquid (hydrazine hydrate +C_{60} fullerene, C_{70}, C_{120}) at different temperatures and pressures, we used a method with the fist kind regular mode heat [1]. This installation was automated. The error in the measurement of heat capacity is measured in the liquid phase is 0,9-1,5%, in the vapor phase- is 1,6-3,0 % and near the critical point in the region with the abrupt change of heat capacity – is 3.2 - 4.3 % [1].Special attention was attended to filling the calorimeter wise material. After our was completely evacuated from the C-calorimeter by the vacuum pump, valve tee overlap and Calorimeter filled colloidal hydrazinehydrate, the filling capillary was over loped by the needed valve, that provides a complete tightness. The mass of analytic material in the calorimeter was determined by difference of weighing the container before and after filling on an analytical balance of engagement -200 GM with the accuracy of 0.01 g. Data on the coexistence curve of liquid colloidal hydrazine hydrate were approximated with the modern theory and the use of advanced information technology (computer and programm), i.e. computer simulation. During experimental results processing the main objectives are checking the adequacy of the mathematical model, the model parameters and their confidence intervals [1]. The nature of changes in the heat capacity of the colloidal liquid hydrazine hydrate (as in colloidal solutions - our research [1] showed that it increases. It is known that on the basis of experimental data on thermo physical properties (thermal conductivity, density, heat capacity) one can calculate the activity coefficient of component (liquid hydrazine hydrate and fullerene C_{60}, C_{70}, C_{120}). In addition to the determination of heat capacity of the systems we used Tait bike equation. This equation also describes the original values for other parameters (such as density, viscosity and thermal conductivity) of liquids and solutions. Tait equations have a good extrapolation quality pressure.

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ANTIMICROBIAL EFFICACY OF ELECTROSPUN BIOCOMPATIBLE NANOFIBERS

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Nanotechnology is the ability of manipulating atoms and molecules of materials in a basic definition. Thus, due to this technology, materials can have great and better properties than their macro sized condition [1].

Electrostatic spinning is one of the popular nanotechnological methods which is used for producing nanodimensional fibers. This method has been explored recently; because of its easy-to-use process, the possibility of various modifications at the obtained nanofibers [2].

Electrospun nanofibers basically are made of natural and synthetic polymers and their combinations. Many polymers have great potential to inhibit the bacterial and fungal activity. Regarding to these properties, a natural polymer and an antimicrobial agent based nanofiber structures were produced with electrospinning method and their high antibacterial and antifungal activities were achieved.

As a result, this newly developed polymer-antimicrobial agent based nanofiber configuration is a promising study for better understanding antimicrobial properties of nanofibrous structures.

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STRUCTURAL AND VIBRATIONAL PROPERTIES, QUANTUM CHEMICAL CALCULATION OF 2,5-DİMETHYL-3-FUROİC ACİD

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Literature reveals that to the best of our knowledge DFT calculations and experimental studies on molecular structure and vibrational spectra of 2,5-dimethy-3-furoic acid ($C_8O_3H_7$) molecule have not been reported so far. Therefore, we have carried out detailed theoretical and experimental investigations on the molecular structure and vibrational spectra of 2,5-dimethy-3-furoic acid molecule completely. We have utilized the B3LYP [1-3] with 6-311++G(d,p), cc-pVDZ , cc-pVQZ and cc-pVTZ basis sets.

The FT-IR spectrum of 2,5-dimethy-3-furoic acid molecule is recorded in the region 4000–400 cm^{-1} on Vertex 80 spectrophotometer. The FT-Raman spectrum of 2,5-dimethy-3-furoic acid molecule has been recorded using 1064 nm line of Nd: YAG laser as excitation wavelength in the region 50-3500 cm^{-1} on the Thermo scientific DXR Raman Microscope. The ^1H and ^{13}C NMR spectra are taken in solutions and all signals are referenced to TMS on a Bruker Ultrashield FT-NMR Spectrometer. All NMR spectra are measured at room temperature.

The calculations were performed at DFT levels by using Gaussian 09 program package, invoking gradient geometry optimization [4-5]. In order to establish the stable possible conformations, the conformational space of 2,5-dimethy-3-furoic acid molecule was scanned with theoretical methods. The optimized structural parameters were used in the vibrational frequency calculations at the DFT level to characterize all stationary points as minima. Then, vibrationally averaged nuclear positions of of 2,5-dimethy-3-furoic acid molecule were used for harmonic vibrational frequency calculations resulting in IR and Raman frequencies. In the present work, the vibrational modes were assigned on the basis of TED analysis for 6-311++G(d,p) basis set, using SQM program [6].

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THERMAL DIFFUSIVITY OF GADOLINIUM IN THE TEMPERATURE RANGE 287 - 1277 K

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The several papers are devoted to experimental study of the gadolinium thermal conductivity and thermal diffusivity. Available data are few in number, in some cases ones are significantly disagree and do not overlap the temperature range 310...600 K. Presented in this work results allow to fill this gap and to clarify the existing information on the heat transfer coefficients of gadolinium in the temperature range 287...1277 K.

The thermal diffusivity of gadolinium was measured with laser flash method on the LFA-427 installation using the procedure described in [1]. The experimental setup was tested using both standard samples inconel and pirokeram and experiments with well-studied transition d-metals: nickel, cobalt and iron. The difference of obtained and reference data does not exceed 2-4%.

Gadolinium sample was cut from metal ingot of GDM-1 mark and 99.85 wt % purity and it had a disk shape with a diameter of 12.6 mm and a thickness of 2 mm with the plane parallel grinded end faces. Immediately before measurements the sample was anneal in a vacuum (1 mPa) at the temperature of 1400 K within 3 hours. The experiment was performed in an atmosphere of high purity argon (99.992 vol.%) using tantalum holder. Its lower surface was irradiated with short laser impulses from Nd: YAG laser with 0.8 ms duration and energy up to 10 J. Temperature change of the upper surface was registered by IR-detector (InSb) cooled with liquid nitrogen. Measurements at preset temperature were performed after prolonged thermostating of sample at a constant temperature in the series of three laser "shots". The interval between the "shots" was three minutes. The coefficient of thermal diffusivity was calculated on the thermogram taking into account heat losses according to the model [2]. The correction for finite duration of laser impulse and its real form was introduced [3]. In determining of the thermal diffusivity thermal expansion of sample was taken into account. The critical exponent for thermal diffusivity of gadolinium above the Curie point has been determined.

In the intersecting intervals the measurement results are in good agreement with most of the literature data. Reference tables of heat transfer coefficients of gadolinium have been developed for the scientific and practical using. The limitation of laser flash method application in the regions of phase transformations has been briefly discussed. The authors gratefully acknowledge the financial support for this research from the Russian Foundation for Basic Research (project № 14-08-00602).

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MODELING OF MATERIAL REMOVAL RATE ON DRY TURNING OF Ti-6Al-4V BY 3D FEM & EXPERIMENTAL TESTS

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This manuscript presents a modeling and simulation analysis with FEM for a turning process and an experimental validation of the simulated cutting parameters. Cutting speed, feed rate, and Depth of Cut (DOC) have been taken into consideration as the influential factors. Experiments have been carried out in accordance with a design of experiment (DOE). FEM based Deform-3D have been applied to experimentally determined data in order to validate the results with experiments. Obtained results have been confirmed for MRR using the proposal simulation model and they were in harmony with experimental results.

KEYWORDS: Turning, MRR, Cutting Parameters, DOE, Deform-3D

INFLUENCE OF ALUMINUM OXIDE NANOPARTICLES ON THE VISCOSITY OF ISOPROPYL ALCOHOL

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Viscosity is an important feature for the heat exchangers design, since it determines the cost of energy for pumping fluids and significantly affects the efficiency of heat transfer processes. However, experimental studies conducted to date for the viscosity of nanofluids, are very limited and contradictory.

The aim of this work was the experimental study of the influence of nanoparticles of aluminum oxide on the viscosity of isopropyl alcohol. In the preparation of the samples of nanofluids, special attention was paid to ensuring their sustainability over time. For the system isopropyl alcohol/Al_2O_3 initial concentration of nanoparticles was 20 wt.%. To the desired concentration, the mixture was diluted with pure isopropanol, then was attained by using an ultrasonic disperser and centrifuges. The average size of the nanoparticles was determined by dynamic light scattering (laser correlation spectroscopy) and amounted to 50 nm.

The viscosity was measured by the capillary tube method. The viscometers were placed in a glass Dewar vessel where the temperature was maintained constant by pumping the temperature control fluid through the heat exchanger. The diameter of the capillaries used for these experiments was 0.62 and 0.82 mm. The measurements were carried out over a temperature range from 30 to 70 °C with the uncertainties not more than 1.2 %.

For the description of the received kinematic viscosity data at various temperatures and concentrations, the following equations was obtained

$$\log \nu = \sum_{i=1}^{1} \sum_{j=0}^{2} a_{ij} t^i x_м^j , \qquad (1)$$

where: a_{00} = 7.001·10^{-1}, a_{01} = 6.434·10^{-2}, a_{02} = -2.074·10^{-3}, a_{10} = -1.080·10^{-2}, a_{11}=-2.740·10^{-4}, a_{12} = 1.088·10^{-5}; $x_м$ – mass concentration of nanoparticles, %; t – temperature, °C. Comparison between experimental data and calculation results showed that the discrepancies do not exceed 4%.

The results of measured of kinematic viscosity and calculated dynamic viscosity data are shown in the Table:

Table: Viscosity of isopropyl alcohol with Al_2O_3 nanoparticles

t, °C	$x_м$ = 0.12%		$x_м$= 5.0%		$x_м$ = 11.1%	
	ν·106, м2/с	η·103, Pa·c	ν·106, м2/с	η·103, Pa·c	ν·106, м2/с	η·103, Pa·c
30,0	2.42	1.03	4.18	1.85	6.00	2.81
50,0	1.45	1.04	2.33	1.74	3.39	2.67
70,0	0.948	1.06	1.37	1.59	1.91	2.34

Dynamic viscosity was processed in the form of the dependence of the reduced viscosity η/η_0 from the volume concentration of the nanoparticles. It was found that the effect of nanoparticles on the viscosity depends on temperature. To describe this effect, Einstein's model was modified by introducing a function of temperature.

THE CHARACTERISTIC OF COMPOSITE WOOD–POLYMERIC MATERIALS FOR BEARING OF FRICTION UNITS OF THE MACHINES

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The most acceptable wood material as bases anti-friction composite material of the sort are sliding for bearing of the slide - a poplar and melted.

The Known that in base all technology production wood-polymeric composite material on base of the poplar and melted lies preparation of raw wood to pressing by way to giving to her plasticity. Considering that with increasing of the temperature and moisture raw wood her (its) component parts - lignin and hemicelluloses are vastly softened and become more viscous in consequence of which resistance compression falls. So originally wood was subjected to the preliminary timber a ferry under low temperature.

For the reason increasing mechanical characteristic, her(its) water- and wood willow and for reception of the stocking up bearing slides from poplar and melted, they are soaked fluid mineral mask. Exist the different ways of the soak, which is caused by need of the deep filling capillary-porous system more viscous material. One of such ways of the soak wood is a way of the soak wood without using the surplus pressure. At way raw wood first warms up in hot-tub before 95-115 ºC, residing in capillary-porous system, air enlarges and partly leaves outward. Then raw wood fits in bath with cool by composition, remained at air decreases in volume, creating inwardly it vacuum, which is filled by modifier. Small wood are soaked during 60 mines in hot-tub and are carried on 60 mines in get cold. This way is well soaked wood moisture before 10 %.

On base of the called on studies is designed way of the soak wood-poplar and melted the machine mask and polymeric composition (the polyethylene to high density, modified by smut or graphite), which is realized on unceasing scheme under determined mode of their reception as follows:

- Cutting of beams and boards on stocking up, having section in the manner of square or rectangle by length before 300 mms;
- A simultaneous drying and soak wood in oil bath, warmed before t = 40-60 ºC during 24-48 hours. Then temperature of the butter is brought before t = 110-120 ºC, herewith occurs partial wood-willow for 2 hours, with the following cooling in butter; oil; grease before t = 20-25 ºC during 12-15 hours;
- Keeping imbrued sample on storehouse before their modification and pressing, herewith their shrinkage or swelling are negligible will measly be small, but cracking is practically excluded;
- Modification and soak loaded timber melted before t = 150-160 ºC solution mixture to polymeric composition at pressure P = 1,2 -1,5 MPa and the temperature 393-413 K;
- A drying imbrued timber modified by polymer in dry camera for 10 hours at the temperature 333-363 K;
- A pressing hot modified timber in cool die under specific load 15.0-20.0 MPa before necessary degree of the pressing;
- An endurance of the pressed stocking up in die under universal press during 5-10 mines for cooling them before the temperature t = 40-50 ºC;
- A removing pressed self-lubricated pressed modified timber - a stocking up the details from die;
- A normalization (maturing) pressed wood in surrounding air ambience under t = 15-25 ºC or in bath with cool dehydrated mask during 24-48 hours.

Such soak wood with butt end under pressure provides relative lightness of the advancement to liquids along filaments wood and displacing from container of water and air, high velocity of the filling damp wood. She enables to change in given direction structure wood material by way of stocking up through channel of the variable section under simultaneous presenting the flow of the heated modifier in her(its) butt end under the action of high pressure.

Thereby, at present, with provision for such soaks wood mask and polymeric composition, us are received composite wood-polymeric material (CWPM) on base local cheese - a poplar (CWPM-1, CWPM-2) and willow (CWPM-3, CWPM-4), which characteristic are provided in table.

Table: Physical, mechanical and frictional properties of composite wood-polymer materials

Indicators	Composite wood-polymer material			
	CWPM-1	CWPM -2	CWPM -3	CWPM -4
Density, ρ, g / cm^3	0.9-1,0	0.9-1,0	0.9-1,0	0.9-1,0
Compressive strength, MPa	9,0	10,0	12,0	14,0
Brinell hardness, MPa	90	110	120	130
friction coefficient	0,11	0,12	0,13	0,14
Wear rate, I.10-9	0,8	0,85	0,90	1,0
Water absorption for 24 h,%	48,3	35-45	35-45	37,4
Degree of compaction,%	38,5	38,1	37,8	36,1
The degree of compaction, Δh	1,5-2,0	1,5-2,0	1,5-2,0	1,5-2,0
During pressing force, MPa	10-15	10-15	10-15	10-15
Swelling in oil for 24 hours,% by weight	3-5	4-5	3-5	1-2
by volume	0-2	1-2	0-2	0-2
Swelling in water for 24 hours,% by weight	35-45	35-45	35-45	35-45
by volume	18-28	20-25	20-25	20-25

As can be seen from table, designed composite wood-polymeric material possess it is enough high strength and anti-friction characteristic meeting the demands, presented to material bearing slides for nodes of friction worker organ of the machines and mechanism, working in condition of friction and wear-out. On base these material is designed optimum designs bearing slides for nodes of friction worker organ of the machines and mechanism in lieu thereof bearing of the swing.

Such design bearing slides from composite wood-polymeric material on base of the local sort wood and thermoplastic polymer promotes the improvement to reliability and efficiency of the functioning(working) the nodes of friction worker organ of the machines and mechanism, working in condition strong conditions surrounding ambiences.

Called on test in working conditions bearing slides from composite wood-polymeric material has shown that, using them in nodes of friction worker organ of the machines and mechanism will allow vastly to raise double resource of their work, as well as will allow to raise reliability and capacity to work of the machines, working in condition of friction and wear-out.

HIDROGEN SULFIDE 2 PHASE AND SURFACEACTIVE SUBSTANCES OF DIFFERENT LOWCARBONS STUL CORROSION IN OIL CARBOHIDROGEN EFFECT

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Many oil and gas fields are hydrogen sulfide wells. Therefore, oil and gas processing, chemical industry and other sectors of the industry, the machines, equipment and technology intensive, aggressive environments containing hydrogen sulfide corrosion of pipelines exposed to spills. Recently, within the 2-5% sulfur, sulfur containing enormous amounts of oil are produced and processed. Therefore, as a matter of urgent protection of corrosion of metal hydrogen sulfide is ahead /1,2,3/.

In this article, the Baku oil fields have been developed on the basis of oils and amines inhibitors of carbohydrate-electrolyte system lowcarbon two-phase corrosion of steel is considered the study of the impact. It should be noted that the hydrocarbon phase of the oil-soluble layer, forming a strong impact on corrosion inhibitor desorption strong reduces the effectiveness of its security.

It is very important to have enough highly effective inhibitors. An example of such inhibitors in the composition of surfactants containing amines items (SAM) can be shown. These kind of aggressive environments, containing hydrogen sulfide inhibitors have shown high efficiency [4]. Therefore, the goal of this research work in the laboratory and highly effective two-phase hydrogen sulfide inhibitors is to keep the aggressive environment. Ct-3 phases of steel corrosion test carbohydrate-electrolyte volume, ratio of 1:10 which was carried out in two-phase system. If necessary, the aqueous phase 600-650 mg/l concentration of hydrogen sulfide is full. Special device required speed the flow of the liquid mixture is created. It should be noted that the action of the flow is a large amount of water, it washes the steel surface layer of protection and highly metal inhibitor protection inhibitor difficult.

As a result of experiments it was determined that 3% solution of NaCl system H_2S steel corrosion inhibitor with an increase in temperature in the absence of a sharp increase in the speed of the maximum temperatures pass 50 °C temperature 50-80 °C range is approximately 2 times the corrosion rate decreases. The temperature is almost unchanged. Apparently, this effect is due to the reduction of oxygen dissolved in the system. The temperature in the logarithm of the rate of corrosion lgk 20-50 °C temperature range of linear dependence between the price of T^{-1} is observed. It was determined that the two-phase system, the effective activation corrosion process when Kgl rises to 34/69 from 12.75. As expected, the two-phase system to be included in the study inhibitor temperature by adsorption to the surface of the metal from corrosion-active components to displace oxygen and other leads. Literature that is known, to play role in [4]-iron sulfide electrochemical corrosion simulator.

Inhibitor study of 400 mg/l concentration of highly, aggressive environment, protection effect when the show. Further increase in the concentration of inhibitor almost doesn't enforcement affect. It was determined that, with the rise of temperature changes on the negative potential of steel. At this time, both at the cathode, the anode as well as accelerating the process. However, the inhibitor is added to the environment in all cases, the weakening of the cathode, the anode and the speeding up of the process is observed.

Table: The composition at a temperature of 20 °C FD inhibitor 600 mgl NaCl-H_2S containing 3% petrol (10:1 volume ratio) of two-phase system efficiencies

Inhibitor	Inhibitor phase of the water concentration in mg/l	Speed of corrosion		Attenuation coefficient	Protective effect
		A/sm^2	g/m^2, hour		
FD	200	$1{,}01\cdot10^{-4}$	1,05	17,7	94,35
	400	$5{,}74\cdot10^{-4}$	0,60	31	96,80
	600	$4{,}13\cdot10^{-5}$	0,57	32,88	97,43

In our opinion, this kind of inhibitor affect can be explained as follows: relatively low temperatures (up to 50 °C) HS^- ions adsorb to the surface of the metal were negative loaded it and thus create conditions for cationic active inhibitor metal surface electrostatic adsorption.

CONCLUSIONS:

1. It was determined that the two-phase system, the effective activation energy of hydrogen sulfide corrosion process increases when rises to 34.69 from 12.75- to 34.69 Kdjl.
2. As a result of experiments it was determined, that the oil H_2S presentation 3% NaCl in the speed of corrosion inhibitor in the absence of sharp increases in temperature increased to 50 °C, and then decreases, and it is associated with a decrease in dissolved oxygen.

KEYWORDS: speed of corrosion, energy of activating, inhibitors.

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SPRAY DEPOSITION OF TIN OXIDE AND ZINC OXIDE THIN FILMS FOR PHOTOVOLTAIC SOLAR CELLS

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SnO_2 and ZnO belong to the important family of large gap transparent conducting oxides (TCO) that combine low electrical resistance with high optical transparency in the visible range of the electromagnetic spectrum. These properties are sought in a number of applications, notably in solar cells. Currently, most photovoltaic solar are based on silicon p-n junctions. However since the prototype of a dye-sensitized solar cell (DSSC) was reported in 1991 by O'Regan and Gratzel [1] with photoelectric conversion efficiency of 11% [2], many research groups have been focused on the improving the photocurrent and photovoltage by developing new organic-inorganic solar cells. Recently, people are pursuing some new materials for replacing the widely used TiO_2 in order to avoid its limitations and agree in that ZnO and SnO_2 are promising materials for DSSCs [3].

In this work, we deposit thin films of tin and zinc oxides on glass substrates by spray pyrolysis technique. The starting solution was tin chloride $SnCl_2$, $2H_2O$ for SnO_2 and zinc chloride or zinc acetate for ZnO diluted in ethanol and distilled water with few drops of acetic acid to prevent precipitation. Resulting vapors were driven into deposition chamber by compressed-air flow. We report structural and morphological results of the films using X-ray diffraction and scanning electron microscopy. Optical transmittance and reflectance spectra were obtained with a Cary double beam spectrophotometer of wavelength λ in the range of 320→2500nm.

Structural and optical properties of the films were studied as a function of deposition parameters. Tin oxide thin films exhibit tetragonal rutile crystal structure and showed a preferential orientation along (101). Diffractive peaks indicated that the zinc oxide samples were polycrystalline würtzite structure. Intensity of the (0 0 2) peak was much stronger than that of (1 0 0) and (1 0 1) peaks. Crystallite size is affected by variation of deposition parameters. The optical analysis shows that transmittance is higher than 80% in the visible range and near IR for all the films.

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SQUARE-WELL THEORY AND KINETIC COEFFICIENTS OF TETRAFLUOROMETHNE (R14) IN THE RARIFIED GAS STATE

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The Davis-Rice-Sengers square-well theory of transport properties of a model fluid is tested for tetrafluoromethane. The applicability of the hard-sphere model is performed using rigorous expressions for hard-sphere transport coefficients but corrected for the effects of molecular collisions. Numerical calculations are made for the case of the coefficients of self-diffusion, thermal conductivity and viscosity of liquid and rarified gas states of tetrafluoromethane (see Table 1).

Table 1: Thermal conductivity viscosity and self-diffuse coefficients of gaseous CF_4 at very law density

T, K	$\sigma \cdot 10^{10}$, m	$\lambda_0 \cdot 10^3$,W/(m·K)	$D_{11} \cdot 10^6$, m2/s
173.15	5.622	6.74	2.214
183.15	5.544	7.45	2.449
193.15	5.474	7.95	2.771
203.15	5.412	8.80	3.065
213.15	5.354	9.50	3.374
223.15	5.298	10.27	3.696

PHYSICO-MECHANICAL AND TRIBOTECHNICAL PROPERTIES OF COMPOSITE POLYMERIC MATERIALS OF THE FUNCTIONAL PURPOSE

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The present level of development of composite polymeric materials (CPM) allows you to create unique materials, efficient in extreme conditions at low and high temperatures, pressures, aggressive and abrasive environments. Trends in the development of this direction are the creation of highly reinforced and very strong CPM with adjustable performance characteristics of structural, special and multi-purpose. However, existing polymer materials and compositions based on them may not find wide application in the working bodies of machines and mechanisms of various branches of engineering, particularly in the working bodies of the cotton processing machines because of lack of development to create a strong and effective CPM production technologies and manufacturing are engineering products and components. In these circumstances, the creation of the CPM and efficient manufacturing techniques are engineering products and components for the workers of the machinery is the main focus in this area, as their application in mechanical engineering will improve the efficiency and performance of these machines. Therefore, the development of composite polymeric materials must take into account their purpose and operating conditions of cotton processing machines working in conditions of friction and wear in contact with raw cotton.

THERMAL AND APPARENT MOLAR PROPERTIES OF AQUEOUS CALCIUM ACETATE SOLUTIONS

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The (p,ρ,T) properties of aqueous $CaAc_2$ solutions with 8 different mass concentrations w=(0.7719, 1.4598, 3.6274, 5.4391, 11.9642, 14.4661, 17.6169 and 22.3204) %, at T=(273.15 to 353.15) K and pressures up to p=100 MPa are investigated for the first time. The obtained values were fitted to the equation of state. The apparent molar volumes of $CaAc_2$ (aq) solutions were calculated using this equation:

$$V_\phi = (\rho_W - \rho_s)/(m\rho_s\rho_W) + M/\rho_s , \quad (1)$$

where ρ_W and ρ_s are densities of the water and solution, m is the molality of solution and M is the molar mass of the dissolved $CaAc_2$ in water.

The apparent molar volume of $CaAc_2$ at infinite dilution V_ϕ^0 at constant temperature T and pressure p can be evaluated from the following equation:

$$V_\phi = V_\phi^0 + A_v m^{1/2} + B_v m , \quad (2)$$

where: V_ϕ^0 is the apparent molar volume of $CaAc_2$ at infinite dilution, which is the same as the partial molar volume of $CaAc_2$ at infinite dilution, A_v is the Debye-Hückel limiting slope, m is the molality, and B_v is an adjustable parameter.

These investigations have been examined for the first time and the data gathered here would contribute greatly to further work about this field.

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THE PORTLANDTSEMENT PROPERTY MODIFIED BY STRUCTURE-FORMING MINERAL COMPOSITION OF "TERMOALUNIT-FOSFOANGIDRIT"

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Work is devoted to development of scientific and technological bases of receiving the extending structures knitting on the basis of clinker not of rated mineralogical structure with use as the expanding agent of composite local breeds with the content of alumstone in composition with other ingredients which are actively participating in process of formation of an ettringit and structurization of a cement composite, giving it the expanding properties, and in the conditions of expansion restriction – the straining properties. Structures of the composite additives composite knitting, providing crystallization of an ettringit in initial stages of hydration by a variation of a ratio including are developed for achievement of effect of expansion of a cement stone: 1). the thermoactivated breed from alumstone and lime; 2). also fosfoangidrit the thermoactivated breed from alumstone; 3) the thermoactivated breed from alumstone, lime also fosfoangidrit. The conditions providing the increased structural density and the subsequent coordinated development of processes of hardening and expansion of a cement composite are revealed.

STUDY ON THE SHEAR PERFORMANCE OF PERFORATED FOAM CORE SANDWICH COMPOSITES: EFFECT OF CORE THICKNESS

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Sandwich composites are popularly used in marine, wind turbines, space and aircraft vehicles. Sandwich composites are made of the core, which is lighter but thicker and has lower strength, and the facesheets, which are rigid and stronger. Based on the core material thickness, the rigidty of the sandwich composites may vary such that higher thickness values indicate increased rigidity. However due to the application methods, it may not be possible to increase the thickness of the sandwich composites up to desired values. Thus in this study it is aimed to analyze the effect of thickness on the shear performances of sandwich composites with the comparison of regular and improved sandwich composites with different core thicknesses.

Sandwich composites were manufactured using PVC foam core and directionally oriented unidirectional glass fiber mats by vacuum infusion method. Four different types of sandwich composites were manufactured. Three core thickness vales as 10, 15 and 20 mm were selected and the cores have been perforated prior to composite manufacture. The hole diameter and density were the same for all of the specimens. During the infusion process, these holes were filled with epoxy. As the reference, sandwich composites with un-perforated core of 20 mm thickness have been manufactured. Shear tests were performed by using specially designed apparatus according to ASTM C273 standard and the results were compared.

From experimental results it is concluded that epoxy columns, due to the holes in the cores, increase the shear strength and rigidity. For the specimens with the perforated cores, the shear strength values increase with decreasing core thickness. To decide the appropriate core thickness, shear tests shall better be evaluated taking in consideration the bending performances of the sandwich composites.

KEYWORDS: sandwich composite, shear, glass fiber, epoxy, PVC foam.

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INCREASE THE MECHANICAL PROPERTIES OF TEXTILE MATERIALS BY APPLICATION OF POWDER DYE COMPOSITION

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The effect of metal complexes on strength of textiles materials based on cotton has been studied. Found that by the application of metal complexes the strength of cotton fabric increases. Simultaneously with the application of metal complexes the elongation of cellulosic textile materials is increased: cotton fabric warpwise of 4.7% and wefting 23.5. As is known, increased elongation at break improves deformation properties of textile materials that are particularly important for knitwear. Application of metal complexes contributes to increasing of wrinkle resistance of textile materials based on cotton. The total opening angle and wrinkle resistance of the fabric containing metal complexes is increased by 15%. As a result, metal complexes of polyvalent metal cations which have their own chromophoric properties give saturated colors to cellulose and protein fabric, characterized by high resistance to various physical and chemical influences (for wet treatments, organic solvents actions, to abrasion, light), due to the high resistance of metal complexes and their binding to the fiber by strong covalent bonds.

ANALYZING DISSIMILAR HOT PLATE WELDING OF 40% TALC/40% CALCITE FILLED POLYPROPYLENE

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This paper examines and optimizes hot plate welding of dissimilar 40% talc and 40% calcite filled polypropylene. The quality of the joint was evaluated by examining the characteristics of the joint efficiency as a result of weld strength. The plate temperature and the heating time were selected as process parameters. These process parameters were considered as variables and their effect and relative significance were investigated by utilizing design of experiment (DOE) and analysis of variance (ANOVA) methods. The main effects, as well as interactions are assessed with regard to a process response weld strength. Simultaneously, a mathematical predictive model of the weld strength was developed in terms of HPW parameters. Moreover, morphology of welded surfaces was analyzed by scanning electron microscopy (SEM).

KEYWORDS: Hot plate welding, polypropylene, design of experiment

PROPERTIES OF WEATHER AND CHEMICAL RESISTANT OF POLYOLEFIN COMPOSITES EXPOSED TO THE PESTICIDES AND ATMOSPHERIC FACTORS

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It is well known that the function of the tanks fulfils in contact with aggressive liquids under the action of various climatic factors. Influence of aggressive environment imposes high demands to selection of materials for the manufacture of tanks and their elements machines on chemical processing of cotton. In this case, polymers and compositions based on them act not only as a substitute for traditional materials, but also used independently in the design of aggregates of machines for chemical treatment of cotton, liquor of pesticides conjunction with the sowing of it in the growing season.

Studies of chemical and atmospheric resistance of selected materials showed that the most resistant to toxic chemicals and weathering were polyolefins (polyethylene and polypropylene). Based on these results for use in the construction of reservoirs was recommended composition MDPE -2 comprising 0.1% of OA benzon (OA benzon is a light stabilizer against atmospheric aging) and 0.8% of NN diaphene (NN Diaphene – is a heat stabilizer to prevent decomposition of the starting material in the process of rework into products at high temperatures). This material has an atmospheric and chemical resistance, is economical as compared with stainless steel. It is well processed by rotational molding allows to obtain large hollow products, tanks of various capacities.

The experimental data allowed to recommend a composition based on low-density mark 168.0 of polyethylene stabilized 0.8% of benzon and 0.1% of NN diaphene, for the manufacture by rotational molding containers of pesticides agricultural machinery, long working outdoors.

Based on received results and conducted tests was developed composite polymeric materials for the manufacture of tanks for the chemical treatment of cotton.

The use of composite polymeric materials based on polyolefins in the casting tanks by rotational molding for machines of chemical treatment of cotton can significantly reduce their weight and to increase the durability of machines, and reduce labor costs in their manufacture.

THERMODYNAMIC PROPERTIES OF ETHYLENGLYCOL ETHERS AND ACETALS

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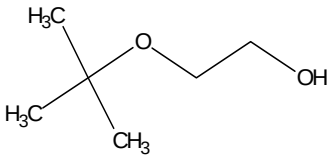
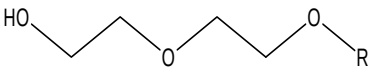
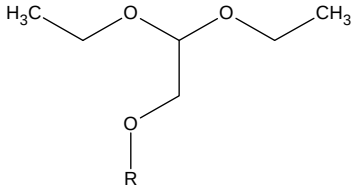
Polyols and their ethers are important products of organic synthesis. They can be applied in different areas of manufacturing as solvents, intermediates, plasticizer, etc. [1] In the present work we studied ten commercially available liquid samples of mono-, di-, and triethylene glycol alkyl ethers and acetals.



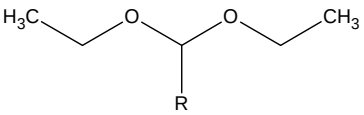
ethylene glycol tert-butyl ether



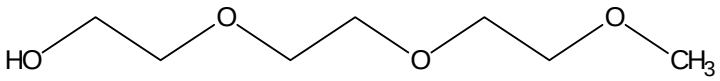
diethylene glycol n-butyl ether
R= C4



alcoxyacetaldehyde diethyl acetal
R=C1,C2



alkylaldehyde diethyl acetal
R= C2,C3,i-C3



triethylene glycol n-alkyl ether
R= C1,C2,C4

For these compounds thermodynamic characteristic of sorption and Kovat´s indices were determined by the method described in [2-4]. We combined experimental data with our previous results [5] and was derived the equation of dependence of sorption enthalpy $\Delta_{sp}H_i^o$ (kJ/mol) from Kovat´s indices. This equation can be applied for estimation of enthalpy of sorption for other polyols and ethers.

Enthalpies of vaporization for ethers and acetals were derived from the temperature dependencies of the vapour pressure measured by the transpiration method [6]. Using our own and literature data we have modified [7] the QSPR-method for prediction of vaporization enthalpies for the oxygen containing compounds.

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THERMOPHYSICAL PROPERTIES OF PROPYLENE GLYCOL / WATER / TiO_2 NANOPARTICLES MIXTURES

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Creation of indirect refrigeration systems the method to decrease human impact on the environment by reducing the direct emissions of refrigerants with high value of global warming potential. The secondary coolant is used for heat transfer from the cooled object to the refrigerant in this type of refrigerating machine. Such chillers with secondary coolants require additional financial expenses for the creation of heat exchangers and additional energy consumption of the circulation pump. These expenses can be significantly reduced or even eliminated by the choice of secondary coolant with optimal thermophysical, physico-chemical and service properties. Such coolants should have a high heat capacity and thermal conductivity values and low dynamic viscosity values. Now more and more researchers are exploring the nanotechnology perspectives for controlling thermophysical properties of secondary coolant.

The aim of this work is studying the effect of nanoparticle TiO_2 (size <25 nm) and isopropyl alcohol additives on the solution propylene glycol 54 wt. % / water 46 wt. % thermophysical properties.

The density of the samples of secondary coolant with composition as follows: propylene glycol (PG) 54 wt.% / water (W) 46 wt.%; PG 53.73 wt.% / W 45.77 wt.% / isopropyl alcohol (IPA) 0.50 wt.% in the temperature range 233-353 K has been measured by pycnometric method. The analysis shows that the uncertainty for the density measurements did not exceed -0.05%.

Assessment the impact of nanoparticles on the thermophysical properties of secondary coolant investigated for nanofluids propylene glycol (PG)/water (W)/isopropyl alcohol (IPA)/TiO_2 nanoparticles with composition as follows: for the thermal conductivity – PG 53,68 wt.%/W 45.73 wt.% /IPA 0,48 wt.%/TiO_2 0.11 wt. %; for the thermal capacity PG 53.68 wt. %/W 45.73 wt. % /IPA 0.48 wt. %/TiO_2 0,11 wt. %; for the viscosity - PG 53,68 wt. %/W 45.73 wt. % /IPA 0.48 wt. %/TiO_2 0.11 wt. % and PG 52.41 wt. %/W 44.64 wt. % /IPS 2,40 wt. %/TiO_2 0.55 wt. %.

Studies of the secondary coolant viscosity implemented in the temperature range 233-362 K on a experimental setup, the main element of which is a glass capillary suspended-level viscometer. The analysis shows that the confidence interval measurement error of the kinematic viscosity did not exceed 0.035 mm^2/s. For the experimental investigation of secondary coolant thermal conductivity in the temperature range 276 - 366 K the transient hot-method (wire heater diameter 0.05 mm) was used. The relative error of the experimental data did not exceed 1.2%. The secondary coolant thermal capacity measured in an adiabatic calorimeter in the temperature range 234 - 369 K. The analysis shows that the error of measurement of the thermal capacity in the experiments did not exceed -0.35%.

Isopropyl alcohol additive provide nanoparticles aggregative stability in the secondary coolant. Besides isopropyl alcohol additive can reduce the propylene glycol/water solution viscosity at low temperatures. This effect undoubtedly has a positive significance for the low-temperature heat transfer fluids. Even small TiO_2 nanoparticles additive in the solution propylene glycol/water/isopropyl alcohol improves the low-temperature secondary coolant conductivity. Such increase the thermal conductivity of solution contributes to enhancement of heat transfer in heat exchangers of refrigeration systems.

Based on the result obtained the recommendations for the choice of secondary coolant optimal composition have been proposed. The method for predicting nanofluids thermophysical properties in wide range of parameters of state with using minimum empirical information has been considered.

THERMOPHYSICAL PROPERTIES OF REFRIGERANT R600A/MINERAL OIL SOLUTIONS WITH ADMIXTURES OF THE Al_2O_3 NANOPARTICLES

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During the study the prospects of nanotechnology applications in refrigeration engineering is important to identify the effect of nanoparticles on thermal properties of refrigerant/compressor oil solutions. (ROS – R600a/mineral oil and R600a/mineral oil/Al_2O_3). At present, the influence of nanoparticles on pseudocritical parameters, surface tension, viscosity and vapor pressure of the ROS is the least studied. In addition, the thermodynamical properties substantially determine the performance of the indicators of the compressor system and the intensity of boiling heat transfer of working fluid in the evaporator of refrigeration machine.

Investigation of the saturated vapor pressure of ROS have been performed at oil mass concentrations: 10%, 30%, 60% at the temperature range from 288 K to 343 K. Investigation of nanoparticles effect on the saturated vapor pressure of ROS have been done at the mass concentration of Al_2O_3 nanoparticles 0.5 % and oil mass concentrations 20%, 35%, 60%. It was shown that admixtures of Al_2O_3 nanoparticles lead to slight increase in ROS vapor pressure at high concentrations of oil.

Investigation of the viscosity of ROS have been performed at the oil mass concentrations 37%, 74% at the temperature range from 263 to 293 K. Investigation of Al_2O_3 nanoparticles effect on ROS viscosity have been done at the mass concentrations of nanoparticles: 0.5% and mass concentrations of oil: 74%, 53%. Obtained data shows that Al_2O_3 nanoparticles admixtures leads to increase in viscosity of the refrigerant oil solution. Effect of nanoparticles presence largely pronounced at low temperatures.

Surface tension of R600a/oil solutions have been measured at mass concentrations of oil: 10%, 20%, 48% and 75%, at the temperature range from 277 K to 303 K. Investigation of Al_2O_3 nanoparticles effect on ROS surface tension have been performed at the nanoparticles mass concentration 0.5% and oil mass concentrations: 16%, 32%, 49%. Obtained data show that Al_2O_3 nanoparticles admixtures leads to reduction in surface tension of the refrigerant oil solutions. Effect of nanoparticles presence largely pronounced at high temperatures.

In order to processes the obtained experimental data for the first time the model SP-QSPR - Skaling Principles - Quantitative Structure -Property Relationship has been applied [1]. In framework of this model, the concentration dependence of the pseudocritical parameters of the R600a/oil/ Al_2O_3 nanoparticles solutions has been studied. It is shown that the presence of nanoparticles admixtures reduces the pseudocritical temperature, reduces the pseudocritical saturated vapor pressure and increases the pseudocritical density of studied objects.

The proposed model for predicting the saturated vapor pressure, viscosity and surface tension in a wide range of temperatures adequately describes the experimental data and allows to predicting the properties in the ranges of parameters that use in household refrigeration engineering.

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1. Zhelezny V, SechenyhV, Nikulina A†A New Scaling Principles−Quantitative Structure Property Relationship Model (SP-QSPR) for Predicting the Physicochemical Properties of Substances at the Saturation Line // J. Chem. Eng. Data 2014, 59, 485−493

Company Presentation

Anton Paar

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Thermodynamics is a very fascinating scientific field which has to do with many different phenomena in nature and technique. As an interesting example we can regard climate change which at the moment is on the agenda of many political decision makers and scientists. Climate change is partly caused by the emission of the carbon dioxide molecule to the atmosphere from farming, from technical combustion in energy technique and transport and from many other human related processes. The heat transfer processes in the atmosphere clearly have to do with thermodynamics. on the other hand, measures to reduce human impact on the environment, like CCS, carbon capture and storage, from combustion also involve thermodynamics processes.

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