

CONTENTS, ABSTRACTS AND KEYWORDS OF PAPERS

SODIUM CARBOXYMETHYLCELLULOSE AS BASIC CONSTITUENT OF POLYSACCHARIDE ADDITIVES (REVIEW)

M.N. Denisova, V.V. Budaeva, K.M. Minaev

Information search has been made on properties of polysaccharide additives whose basic constituent is carboxymethylcellulose. Their practical application is shown to be governed by the degrees of esterification and polymerization, and fractional composition. Subject to grades of carboxymethylcellulose, which are characterized by certain degrees of polymerization and substitutions, uses of the ester are different from that for stabilization of fresh and low-mineralized weighted drilling muds prior to stabilization of high-mineralized muds when drilling deep and ultradeep wells.

Keywords: polysaccharide additives, carboxymethylcellulose, degree of substitution, basic constituent content, viscosity.

PHYSICOCHEMICAL STUDIES OF COMPOSITION AND PROPERTIES OF POLYSACCHARIDE ADDITIVES

E.I. Makarova, M.N. Denisova, V.V. Budaeva, K.M. Minaev

Following the analytical overview of the methods for investigating properties of polysaccharide additives, whose basic constituent is sodium carboxymethylcellulose, software and physicochemical procedures have been developed for studying the composition and properties of polysaccharide additive specimens: degree of substitution, content of basic constituent, degree of polymerization, solubility, activity of hydrogen ions, and contents of free sodium hydroxide and sodium carbonate. The universality of the software and procedures for the determination of properties of polysaccharide additives with high substitution degree and high basic constituent content and of carboxymethylcellulose samples has been shown by trials on industrial samples.

Keywords: polysaccharide additive, CMC sodium salt, software and procedure for testing, composition, physicochemical properties.

HPLC FOR THE ANALYSIS OF OAT-HULL ENZYMATIC HYDROLYZATES

I.E. Makarova, V.V. Budaeva

By the use of a Millichrome A-02 microloumn chromatograph (HPLC), enzymatic hydrolyzates obtained from chemically pretreated oat hulls were qualitatively and quantitatively assayed. The sugar compositions of the hydrolyzates were found to be chiefly composed of glucose and xylose: 43,2 mg/mL and 5,6 mg/mL, and 36,6 mg/mL 8,3 mg/mL in the lignosellulosic feedstock obtained by the nitric-acid treatment and by the sodium-hydroxide method, respectively.

Keywords: oat hulls, enzymatic hydrolysis, HPLC, glucose, xylose.

STUDY OF THE CHARACTERISTICS OF HIGH-ENERGY MATERIALS WITH IRON OXALATE AND FERRIC FORMIATE

M.V. Komarova, A.G. Vakutin, A.B. Vorozhtsov

The results of experimental studies of high-energy compositions are reported. The materials are contained active tetrazole binder, electro-explosive aluminum nanopowders, iron oxalate and ferric formiate. Iron salts are a modifiers, since influence upon velocity of the combustion of the fuel matrix. Possibility of the use of iron salts for regulation of the combustion is discussed.

Keywords: nanosized metal powders, iron oxalate, ehigh-energy materials, burning rate.

ENERGY COVERING OF NANOALUMINUM ON BASE NITROTRIAZOLONUM

M.V. Komarova, N.V. Kozyrev, G.T. Sukhanov, I.A. Krupnova, N.V. Bychin

The results of thermal and termogravimetric measurements of physico-chemical characteristics nanoaluminum coated by weakly sensitive propellents are shown. The possibility to use N-substituted-3-nitro-1,2,4-triazol-5-OH covering of aluminum nanopowders in high-energy compositions is discussed.

Keywords: aluminum nanopowders, functional covering, high-energy compositions.

INFLUENCE FUNCTIONAL COVERING OF NANOALUMINUM ON THE BURNING RATE OF THE FUEL BASE

M.V. Komarova, A.B. Vorozhtsov, A.G. Vakutin

The results of experimental studies of high-energy materials are reported. The high-energy materials are contained «active» тетразольного связующее and nanoaluminum coated by polymers and by organic acids. The numerical data of thermogravimetric measurements and burning rates are shown. The high-energy compositions are the fuel fluid bases. Method of the regulation to burning rate by material of the covering is demonstrated.

Keywords: nanosized aluminum, functional covering, high-energy material, burning rate.

STUDY OF THE BURNING RATE OF Al/MoO₃ THERMITE USING ULTRASOUND-DISINTEGRATED MOLYBDENUM OXIDE PARTICLES

V.V. Gordeev, N.V. Kozyrev, M.V. Kazutin

The time effect of ultrasound-assisted disintegration of MoO₃ particles on the burning rate of Al/MoO₃ thermite was studied. The MoO₃ particle shape and size were shown to considerably change for the initial 4 hrs of ultrasonic treatment. A further increase in time does not lead to the variation of these parameters. The burning rate of the thermite after an 8-h treatment rises and attains that of Al/MoO₃ nanothermite.

Keywords: nanothermites, ultrasonic disintegration, burning rate, molybdenum oxide (VI).

EFFECT OF FLUORO RUBBER AND CARBON NANOTUBE ADDITIVES ON EXPLOSION PERFORMANCE OF CuO/Al NANOTHERMITE

V.V. Gordeev, M.V. Kazutin, N.V. Kozyrev, E.A. Metsler

A number of CuO/Al nanothermite-based formulations doped with fluoro rubber and carbon nanotubes were examined to assess the possibility of desensitizing the same towards friction and ESD. The effects of the additives on the burning rate and critical diameter of detonation are demonstrated.

Keywords: nanothermite, friction sensitivity, minimum ignition energy, burning rate.

ON THE FEASIBILITY TO MANUFACTURE NANOTHERMITES IN AQUEOUS MEDIUM

V.V. Gordeev, M.V. Kazutin, N.V. Kozyrev, V.S. Glaktionov

Consideration is given to the possibilities of chemically stabilizing aluminum nanopowder in an aqueous solution and of manufacturing nanothermite composites in the aqueous medium. The experimental findings are reported.

Keywords: nanothermite, nanoaluminum, ultrasound technologies.

NANODIAMOND SYNTHESIS BY DETONATION OF TNT/CL-20 CHARGES

M.V. Kazutin, N.V. Kozyrev, E.A. Petrov, M.V. Komarova

The study reports the results of experimentally evaluating the detonation rate and nanodiamond yield upon detonation of melt-cast and pressed explosives charges of mixed trinitrotoluene (TNT) and hexanitrohexaazaisowurtzitane (CL-20) in TNT/CL-20 mass ratios of 70/30 and 60/40.

Keywords: detonation, detonation velocity, detonation nanodiamond, CL-20, trinitrotoluene.

MEASUREMENT FEATURES OF THE LASER RADIATION ATTENUATION IN OPTICALLY DENSE SUBMICRON DISPERSION MEDIA

E.A. Metsler, S.S. Titov, A.A. Zhirnov, A.A. Pavlenko, V.A. Arkhipov

In this paper, the basic conditions of applicability of the Bouguer-Lambert-Beer law to direct optical radiation passed through a dispersion medium. The results of the experimental into studies the attenuation of optical by radiation dispersion medium having small and large particles sizes for different experimental conditions (change in the field of view of the optical system of the collimator-photodetector, change in the distance between the photodetector and the cuvette with the model dispersion medium) are reported.

Keyword: aerosol, dispersion medium, particle size, spectral absorbance.

LIMITS OF APPLICABILITY OF THE HIGH-SELECTIVITY TURBIDIMETRIC METHOD

A.A. Zhirnov, E.A. Mezler, S.S. Titov, A.A. Pavlenko, O.B. Kudryashova

In tasks of remote contactless determination of disperse characteristics of aerosols it is important to know limits of applicability of the Buger-Lambert-Beer law in applications where as the receiver of radiation the spectrometer is used. Such data in passport characteristics of the measuring device are absent. For obtain of these characteristics a series of experiments was made. As a result the area of parameters in which the reception matrix of a spectrometer has linear dependence of an output signal for different lengths of waves on the optical thickness of the researched media is received.

Keywords: size of particles, spectrometer, linearity, optical thickness, Bugera-Lambert-Beerlaw, concentration of particles, optical filter.

ADDITIVE METHOD OF FORMATION OF PRODUCTS WITH POWDERS OF REFRACTORY COMPOUNDS

V.V. Promakhov, I.A. Zhukov, S.A. Vorozhtsov, M.V. Shevchenko,
V.V. Platov, V.A. Arkhipov, E.V. Muravlev

Taking into account the analysis of the modern scientific and technical decisions in the field of additive technologies the method of receiving three-dimensional products from ceramics is developed. The original 3D printer adapted to operation with thermoplastic suspensions of powders of refractory compounds and a technological binder is designed and made. The technological 3D modes of the printing are justified. On the example of ceramics of aluminum oxide the possibility of receiving samples with high physicomechanical properties is shown.

Keywords: additive technologies, ceramics, self-propagating high-temperature synthesis, structure, properties.

RESEARCHES OF PROCESSES OF DISPERGATING OF THE COMPACTED POWDERS

E.V. Muravlev, A.A. Pavlenko, I.R. Akhmadeev, O.B. Kudryashova,
M.Y. Stepkina, N.V. Korovina

Data on pilot studies of pulse processes of dispergating of the compacted powders are provided in article. The possibility of additional dispergating of powders and creation of clouds of aerosols for small is shown (about 0,5 c) periods.

Keywords: the compacted powders, a spray, dispersion.

DETERMINATION OF THRESHOLD OF SENSITIVITY OF SETUP FOR STAND-OFF DETECTION OF TRACES OF EXPLOSIVES

A.A. Pavlenko, E.V. Maksimenko, L.V. Chernyshova, A.V. Didenko

The article describes the method of theoretical and experimental determination of the detection limit of the measuring setup for stand-off detection of trace amounts of explosives, developed on the basis of the method of active spectral imaging. The calculation was performed with the HMX. The dependence of the mass of a substance from the detection distance was found. Minimally detecting surface concentration of HMX was calculated.

Index Terms: explosives, sensitivity of setup, surface concentration.

THEORETICAL RESEARCHES OF PROCESS OF PLASMOCHEMICAL SYNTHESIS OF POWDER MATERIALS

I.A. Zhukov, S.S. Bondarchuk, S.S. Titov

In this work the physical and mathematical model of evolution of a precursor in the evaporating drop of low-concentrated solution of salt of metal in a stream of the heat-transfer of the plasmochemical reactor is presented. The model is intended for estimation of morphology of ceramic particles of powders depending on the characteristics of solution and parameters of the high-temperature gaseous heat-transfer defining its heat-and-mass transfer with the drop environment.

Keywords: physical and mathematical model, plasma chemistry, diffusion, precursor.

THE SELF-PROPAGATING HIGH-TEMPERATURE SYNTHESIS OF THE NEW CLASS OF LIGATURES FOR ALUMINIUM ALLOYS

V.V. Promakhov, M.H. Ziatdinov, I.A. Zhukov, S.A. Vorozhtsov,
A.E. Matveev, S.S. Titov

The Self-propagating High-temperature Synthesis (SHS) is an efficient method of producing of a ligature on the basis of the Al-Ti-B system for modification of structure of aluminum alloys. SHS benefits are: low energy consumption, simplicity of the organization of process and purity of the obtained product. In this work on the basis of raw materials of the Russian production ligatures for aluminum alloys with particles of a diborid of titanium (TiB_2) are obtained. The structure of initial powders and the materials obtained after synthesis is studied. It is shown that the average size of particles TiB_2 in ligatures is 600 nanometers.

Keywords: light alloys, ligatures, Self-propagating High-temperature Synthesis, structure.

THE SELECTIVE INTRODUCTION ONE OF THE ACYL GROUP IN THE MOLECULE 2,6,8,12-TETRAACETYL-2,4,6,8,10,12-TETRAAZATETRACYCLO[5,5,0,0^{3,11},0^{5,9}]DODECANE

D.A. Kulagina, S.V. Sysolyatin, A.V. Shevchenko

Obtained monoacyl derivatives 2,6,8,12-tetraacetyl-2,4,6,8,10,12-tetraazatetracyclo[5,5,0,0^{3,11},0^{5,9}]dodecane.

Keywords: 2,6,8,12-tetraacetyl-2,4,6,8,10,12-tetraazatetracyclo[5,5,0,0^{3,11},0^{5,9}]dodecane, monoacylation.

ACID TREATMENT EFFECT ON THE Pd/C CATALYST EFFICIENCY IN DEBENZYLATION OF 2,4,6,8,10,12-HEXABENZYL-2,4,6,8,10,12-HEXAAZAISOWURTZITANE

A.I. Kalashnikov, S.V. Sysolyatin, V.V. Malykhin

The acid treatment of the Pd/C catalyst improves its performance efficiency in the hydrogenolysis reaction of 2,4,6,8,10,12-hexabenzyl-2,4,6,8,10,12-hexaazaisowurtzitane. The catalyst having pH = 3.85 exhibits the highest efficiency. A further increase in acidity of the catalyst (pH = 3.1) results in a considerable increment in the proportion of the oxidized palladium (Pd²⁺) and decreases its stability in DMF.

Keywords: HNIW, CL-20, 2,4,6,8,10,12-hexanitro-2,4,6,8,10,12-hexaazaisowurtzitane, 2,4,6,8,10,12-hexabenzyl-2,4,6,8,10,12-hexaazaisowurtzitane, 4,10-dibenzyl-2,6,8,12-tetraacetyl-2,4,6,8,10,12-hexaazaisowurtzitane, hydrogenolysis.

ACYLATION OF 4,10-DIBENZYL-2,6,8,12-TETRAACETYL-2,4,6,8,10,12-HEXAAZAISOWURTZITANE

V.A. Kubasova, V.N. Surmachev

The results of the experimental studies on acylation of 4,10-dibenzyl-2,6,8,12-tetraacetyl-2,4,6,8,10,12-hexaazaisowurtzitane, a key intermediate in the synthesis of hexanitrohexaazaisowurtzitane, are reported.

Keywords: acylation, 4,10-dibenzyl-2,6,8,12-tetraacetyl-2,4,6,8,10,12-hexaazaisowurtzitane, hexanitrohexaazaisowurtzitane.

DEVELOPING A METHOD FOR THE SYNTHESIS OF 1-HYDROXYMIDAZOLAM

A.E. Paromov, I.A. Shchurova, S.V. Sysolyatin, A.I. Rogova, S.E. Gribkova

A process of preparing of 1-hydroxymidazolam, starting from midazolam, was studied in three steps: oxidation with meta-chloroperbenzoic acid, acylation, and hydrolysis. A new method is suggested for the oxidation of 1-acetoxymethyl-8-chloro-3a,4-dihydro-6-(2-fluorophenyl)-3H-[1,3]imidazo[1,5a]benzodiazepine with potassium permanganate over aluminum oxide to give 1-acetoxymidazolam, a precursor of 1-hydroxymidazolam.

Keywords: midazolam, 1-hydroxymidazolam, 4-hydroxymidazolam, benzodiazepines, metabolism, meta-chloroperbenzoic acid.

A SYNTHETIC METHOD FOR 4-HYDROXYTRIAZOLAM

A.E. Paromov, S.V. Sysolyatin, I.A. Shchurova, S.E. Gribkova

A three-stage method is suggested for the synthesis of 4-hydroxytriazolam, a metabolic product of triazolam, which includes oxidation of triazolam with m-chloroperbenzoic acid, acylation of the resulting oxide, followed by alkaline hydrolysis in a total yield of 50 %.

Keywords: triazolam, 4-hydroxytriazolam, benzodiazepines, metabolism, meta-chloroperoxybenzoic acid.

REACTION BETWEEN N,N-DI-TERT-BUTYL-1,2-ETHANEDIIMINE AND DIFFERENT AMINES

A.V. Rybaleva, S.G. Il'yasov

The study results on the optimization of the synthesis conditions of hexabenzylhexaazaisowurtzitan by transimination of di-tert-butyl-1,2-ethanediimine with benzylamine over a formic acid catalyst are presented. The reactions of di-tert-butylethane-1,2,-diimine with hexadecylamine and isobutylamine were studied. A new compound, di-hexadecyl-1,2-ethanediimine, was synthesized.

Keywords: transimination, N,N-di-tert-butyl-1,2-ethanediimine, hexabenzylhexaazaisowurtzitan, di-hexadecyl-1,2-ethanediimine, di-isobutyl-1,2-ethanediimine.

DEVELOPING A SYNTHETIC METHOD FOR TERT-BUTYLUREA NITRATE

V.A. Ermoshina, D.S. Il'yasov, S.G. Il'yasov

The reaction of tert-butylurea with nitric acid to furnish tert-butylurea nitrate and the nitration reaction of tert-butylurea to nitro- and dinitro-tert-butylurea were studied herein.

Keywords: tert-butylurea, tert-butylurea nitrate, nitration reaction, nitro-tert-butylurea.

REACTIVITY STUDY OF UREA DERIVATIVES WITH 2,3-BUTANEDIONE (DIACETYL)

V.S. Glukhacheva, S.G. Il'yasov, A.V. Rybaleva

The condensation reaction of urea and its derivatives with 2,3-butanedione (diacetyl) was studied; cyclic and linear derivatives were synthesized and new methods for the synthesis of earlier known dimethyl glycolurils were developed.

Keywords: urea, diacetyl, nitrourea, phenylurea, condensation.

PREPARATION OF BIS(N,N'-DINITROUREA)COPPER (II) AMMONIUM AND COPPER (II) NANOOXIDE

E.V. Rudakov, A.S. Il'yasov, M.V. Til'zo, S.G. Il'yasov,
V.M. Kuznetsov, A.I. Potekaev

The paper reports the results of the experimental studies on the reaction between diammonium salt of N,N'-dinitrourea and copper cation. A bis(N,N'-dinitrourea)copper (II) ammonium complex was synthesized. By-products resulting from the reaction were isolated and analyzed.

Keywords: complexation, diammonium salt of N,N'-dinitrourea, bis(N,N'-dinitrourea)copper (II) ammonium, copper complex, copper (II) nanooxide.

ETHYLATION OF 3-NITRO-1,2,4-TRIAZOLE-5-ONE WITH DIETHYL SULFATE

I.A. Krupnova, G.T. Sukhanov, Yu.V. Filippova, A.G. Sukhanova, K.K. Bosov, V.A. Istoshina

The ethylation of 3-nitro-1,2,4-triazole-5-one with diethyl sulfate in an acidic medium is non-selective and takes place across the N1 and N4 atoms of the cycle to furnish chiefly an N4-substitution product. The ratio of the isomeric N-ethyl-3-nitro-1,2,4-triazol-5-ones is 0.60:0.40. The alkylation mixed products were detected to contain a negligible proportion (up to 3 %) of the diethylation product, 1,4-diethyl-3-nitro-1,2,4-triazol-5-one.

Keywords: 3-nitro-1,2,4-triazol-5-one, N-ethyl-3-nitro-1,2,4-triazol-5-ones, 1,4-diethyl-3-nitro-1,2,4-triazol-5-on.

REACTION OF 3-NITRO-1,2,4-TRIAZOLE SODIUM SALT WITH ETHYLENE CHLOROHYDRIN

V.A. Istoshina, I.A. Krupnova, G.T. Sukhanov, Yu.V. Filippova, A.G. Sukhanova, K.K. Bosov

The new in the alkylation reaction between 3-nitro-1,2,4-triazole sodium salt and ethylene chlorohydrin is that a new compound – bicyclic 2-[2-(3-nitro-[1,2,4]triazole-1-yl)-ethyl]-2,4-dihydro-[1,2,4]triazol-3-one is formed alongside with 1-(2-hydroxyethyl)-3-nitro-1,2,4-triazole. Nitration of the alkylation mixed products affords the respective nitrate- and nitro derivatives: 1-(2-nitroxyethyl)-3-nitro-1,2,4-triazole and 5-nitro-2-[2-(3-nitro-[1,2,4]triazole-1-yl)-ethyl]-2,4-dihydro-[1,2,4]triazole-3-one.

Keywords: 3-nitro-1,2,4-triazole, alkylation, ethylene chlorohydrin.

REGIOSPECIFIC ALKYLATION OF 3-NITRO-1,2,4-TRIAZOL-5-ONE WITH ALCOHOLS IN ACIDIC MEDIA

I.A. Krupnova, G.T. Sukhanov, A.G. Sukhanova, Yu.V. Filippova, K.K. Bosov, V.A. Istoshina

*The alkylation of 3-nitro-1,2,4-triazol-5-one with secondary alcohols in acidic media is shown to proceed in a selective manner and, from the perspective of kinetic control, the corresponding 1-alkyl-3-nitro-1,2,4-triazole-5-one (alkyl=*i*-Pr-, cyclo-C₆H₁₁-) is generated as the single product.*

Keywords: 3-nitro-1,2,4-triazole-5-one, alkylation, acidic media, alcohols.

LIQUEFACTION LIGNIN AS A COMPONENT OF MOTOR FUEL

I.V. Kazantsev, S.G. Il'yasov

Spend thyroid stimulating depolymerization of lignin, lignin and alkali lignin acetone in ethanol under supercritical conditions. The optimal technological parameters of liquefaction lignins, ensuring maximum yield of the liquid fraction. A comparative analysis of the effect of liquefaction on lignins octane motor fuel.

Keywords: hydrotropic lignin, alkali lignin, atsetonlignin, depolymerization, liquefaction, octane.

TO DESIGN SAMPLING ROTOR-STATOR SYSTEM FOR PROCESSING OF CELLULOSE CONTAINING SUSPENSIONS

M.S. Vasilishin, O.S. Ivanov, A.G. Karpov

Data on a substantiation of sampling of basic constructive and technological parameters of multistage rotor-stator systems, intended for processing of cellulose containing suspensions are resulted.

Keywords: cellulose containing suspensions, processing in rotor-stator system, sampling of design data of equipment.

ESTIMATION OF DISPERGATION PARAMETERS OF TECHNICAL CELLULOSE IN ROTOR-STATOR SYSTEM

M.S. Vasilishin, O.S. Ivanov, V.V. Budaeva, N.V. Bychin,
V.N. Zolotuhin, Yu.A. Gismatulina

Possibility of a dispergation of the technical cellulose gained from miscanthus in rotor-stator system is experimentally confirmed. The estimation of pressure level originating in the processed medium at its passage through radial clearances multistage rotor-stator system is executed.

Keywords: technical cellulose from miscanthus, dispergation in rotor-stator system, estimation of pressure level in a processed material.

ALKALINE DELIGNIFICATION OF NON-WOODY CELLULOSIC FEEDSTOCKS UNDER PILOT PRODUCTION CONDITIONS

O.V. Baibakova, E.A. Skiba, V.V. Budaeva, V.N. Zolotukhin

Alkaline delignification of non-woody cellulosic raw materials is the initial step of the proprietary combined method for pulping and the initial step of transforming the feedstock into bioethanol and other products of microbiological synthesis via biotechnology. Under the pilot production conditions, the process of alkaline delignification was studied in a 250-L atmospheric-pressure reactor. The two non-woody cellulosic feedstocks, oat hulls and Miscanthus, were examined. Chemical compositions of the resulting products were quantified and their matching to laboratory specimens was shown. The high yields of the alkaline delignification products of oat hulls and Miscanthus suggest a good scalability of the process under manufacturing conditions (scale-up ratio by volume is 1:200).

Keywords: alkaline delignification, oat hulls and Miscanthus, alkaline delignification product, pilot production, reactor, scale-up.

STRUCTURAL FEATURES OF BACTERIAL CELLULOSE SYNTHESIZED ON ENZYMATIC HYDROLYZATE OF OAT-HULL LIGNOCELLULOSIC MATERIAL

E.K. Gladysheva, E.A. Skiba, L.A. Aleshina

*The cultivation of symbiotic culture *Medusomyces gisevii* on an enzymatic hydrolyzate of oat-hull lignocellulosics was studied. The oat-hull lignocellulosic material was produced by one-stage pre-treatment of the feedstock with a dilute nitric-acid solution in a pilot plant, and enzymatic hydrolysis of the oat-hull lignocellulosics was run in an 11-L fermentor. The enzymatic hydrolyzate of the oat-hull lignocellulosics was found to be not a good quality medium for the synthesis of microbial cellulose: by the end of the cultivation, the proportion of the non-utilized substrate in the nutrient broth was 30 %; the microbial cellulose yield was at most 3 %; the bacterial cellulose degree of polymerization was observed to be decreasing when the cultivation time was more than 10 days. The bacterial cellulose samples were studied by IR spectroscopy to show that the bacterial cellulose structure is commensurate with that of plant cellulose. The X-ray diffraction pattern revealed that the bacterial cellulose was composed of the triclinic Ia phase.*

*Keywords: bacterial cellulose, *Medusomyces gisevii*, IR spectroscopy, X-ray studies, enzymatic hydrolyzate, oat hulls.*

ALTERNATIVE FEEDSTOCKS FOR NITROCELLULOSE

A.A. Korchagina

*A mini-review of rapidly renewable new sources of high-quality cellulose of plant and microbial origins is reported herein. The study results on producing pulps with high quality attributes from *Miscanthus*, oat hulls, and intermediate flax straw are provided. A conceptual feasibility of obtaining cellulose nitrates of the plant and microbial origins is demonstrated.*

*Keywords: *Miscanthus*, oat hulls, intermediate flax straw, pulp, bacterial cellulose, cellulose nitrates.*

ASSESSMENT OF SUBCRITICAL AND SUPERCRITICAL CO₂ PRETREATMENT OF NON-WOODY FEEDSTOCK

I.N. Pavlov

A lignocellulosic material was pretreated under subcritical and supercritical carbon dioxide to improve reactivity to enzymatic hydrolysis. Oat hulls were thus processed in a versatile thermobaric setup under carbon dioxide pressure for a specified period of time while controlling the temperature from 20 to 100 °C and pressure from 5.0 to 10.0 MPa. The CO₂ steam explosion causes distortion of the lignocellulosic structure and increases the accessible surface of the products to enzymatic hydrolysis. In the subcritical liquid CO₂ pretreatment, the yield of reducing sugars is quite negligible and similar to that of untreated oat hulls. The supercritical CO₂ treatment at elevated temperature and pressure facilitates the penetration of the CO₂ molecules into the material structure to subsequently produce post-explosion products that provide a higher yield of reducing sugars.

Keywords: lignocellulose, oat hulls, supercritical CO₂, pretreatment, enzymatic hydrolysis.

STUDY OF THE HYDROTROPIC COOKING OF PINE SAWDUST

M.N. Denisova, I.N. Pavlov

The study results of the hydrotropic pulping of pine sawdust are reported herein. The yields and basic characteristics of the pulp specimens are given as a function of delignification conditions (temperature, time). A rise in pulping temperature and time, as well as extraction prior to the process, was found to not facilitate a more complete delignification.

Keywords: pine sawdust, extraction, hydrotropic cooking, pulp, lignin.

CHARACTERISTICS OF CEREALS STRAW PULPS OBTAINED BY HYDROTROPIC PROCESS AND RESULTS OF THEIR STUDY AS SUBSTRATES FOR ENZYMATIC HYDROLYSIS

M.N. Denisova

The hydrotropic process to produce pulps from cereals straw was investigated. The resultant pulps were found to contain up to 83 % of α -cellulose. The study results of the obtained pulp specimens to be used as substrates for enzymatic hydrolysis are reported. The pulp derived from oat hulls is shown to exhibit the highest reactivity towards enzymatic hydrolysis.

Keywords: cereal straw, pulp, hydrotropic process, substrate, enzymatic hydrolysis, reducing sugars.

NITRIC-ACID PULPING (REVIEW)

Yu.A. Gismatulina, V.V. Budaeva

The paper provides a review on the nitric-acid method for producing pulp. The mechanism of the nitric acid action on hemicellulose and lignin is described in brief. The examples of the nitric-acid process application to various plant resources (wood and grass with indicated process features and resultant pulp properties) are outlined.

Keywords: nitric-acid process, pulp, lignin nitration.

CELLULOSE NITRATES FROM NON-WOODY FEEDSTOCKS

A.A. Korchagina

The nitration of pulps obtained by the nitric-acid process from the different renewable resources, Miscanthus and oat hulls, was studied. Under the optimum nitration conditions used, cellulose nitrates were synthesized to have similar characteristics as follows: 11.72–12.41 N%, 10–14 cP, 93–97 % alcohol-ester mixture solubility, 0.04–0.36 ash, and 128–141 % yield. The nitrates derived from Miscanthus and oat hulls were found to be commensurate in basic parameters with the commercial "N"-Colloxylin. The ampule-chromatographic method revealed the resultant pulps to be chemically stable compounds. The IR- and TGA analyses confirmed the obtained cellulose nitrates to be similar to Colloxylin "N" in basic intrinsic frequencies, onset decomposition point, and specific decomposition heat.

Keywords: Miscanthus, oat hulls, pulp, nitration, cellulose nitrates, ampule-chromatographic method, IR spectroscopy, TGA.

SIMPLE MODELS OF DYNAMICS OF ACCUMULATION DINITRAMIDE UPON RECEIPT SULFAMATE MANNER IN A BATCH PROCESS

A.P. Vandel, S.V. Lailov, A.V. Sologubov, K.N. Karpechenko, E.A. Komarova,
V.S. Kormacheva, D.I. Koleno, E.A. Petrov

A simplified kinetic model of the process of obtaining dinitramide (ADN) nitration sulfamate. The influence of the dosage time of the original on the dynamics of accumulation of the product. A comparison of the calculated and experimental curves of accumulation of DNA, and it is shown that the experimental results can be described in the Annex predpo-reducing kinetic constants during the flow of the process.

Keywords: dinitramide, kinetics, nitration, model.

OBTAINING POLYMER COMPOSITIONS CONTAINING 3-METAKRILOKSISULFOLAN, FOR THE APPLICATION OF SURGICAL IMPLANTS AND NON-RESORBABLE POLYMER FILAMENTS FOR RECONSTRUCTIVE SURGERY

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In this paper, the technology of obtaining polymeric composition containing anti-inflammatory with antimicrobial action 3-metakriloksisulfolan. The proposed method of antimicrobial coating of implants for reconstructive surgery, including treatment and drying at a temperature of 30...40 °C net material made of synthetic polymer fibers, knit produced on a warp knitting machines, polyvinylidenfluoride and polypropylene monofilaments. Technology of applying the polymer composition on the mesh endoprosthesis worked out for buscapersonas method.

Keywords: technology, composition, 3-metakriloksisulfolan, polymer, implants.

OPTIMIZATION OF THE EDI EPOXY BINDER FORMULATION FOR FILAMENT-WOUND BASALT FIBER-REINFORCED PRODUCTS

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The EDI epoxy binder composition was optimized for filament-wound basalt fiber-reinforced items. The optimum ratio of the components ensuring the most satisfactory combination of technical and mechanical behaviors of the formulation was identified. A positive effect from the optimized binder formulation was achieved in a microplastic and in a unidirectional plastic using basalt roving. The heat resistance of the compositions was determined.

Keywords: epoxy binder, viscosity, pot life, basalt roving, microplastic, composite material.

VISCOSITY PROPERTIES AND RHEOKINETICS OF EPOXY-ANHYDRIDE BINDERS FOR FILAMENT-WINDING USE

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V.V. Firsov, D.E. Zimin

The results from experimental studies into rheokinetic plots of the viscosity of epoxy-anhydride binders of different quantitative compositions versus heating temperature are reported. Formulations and temperature regime for the fabrication of filament-wound composite items were determined.

Keywords: filament-wound items, binder, rheokinetic plots, viscosity, gelation, structurization.

MANUFACTURING TECHNOLOGY OF POLYMERIC ITEMS BY THE ROTOMOLDING TECHNIQUE

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The basic criteria of the rotomolding technology are presented. A conceptual flowsheet has been built for manufacturing items by the rotomolding technique for the non-waste production, on the basis of which process equipment can be selected. The experimental study results on the fractional composition of the raw materials are reported. The speed ratios of the primary and secondary axes of the rotational molding machine as a function of the item shape are given. Details on how the metal-mold material affects the production technology of complex items are highlighted.

Keywords: rotomolding, gravitational distribution, disk crusher, recycling.

BASALT CRUSHING BY ELECTROHYDRAULIC TECHNIQUE

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This work aimed to develop a low-power electrohydraulic machine and test it as applied to basalt crushing. The study results on the fractional composition of basalt particles resulted from electrohydraulic crushing are reported herein. The devised machine proved effective. The crushed particles take on a round shape, without sharp corners. Further partition into fractions with tailored sizes is possible through hydrostatic and sieving techniques.

Keywords: crushing, electrohydraulic machining, basalt, suspension, differential function, integral function, weight distribution of particles by size.

TOWARDS THE THERMAL RESISTANCE EVALUATION OF ALUMINOSILICATE FIBERS

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The thermal resistance of aluminosilicate staple fibers fabricated in a setup by the induction melting of a binary mixture of alumina and silica, followed by blowing the melt with compressed atmospheric air, has experimentally been studied. The limit operating temperature was evaluated against the linear contraction value under a fixed specific loading of 1000 Pa at a heating rate of 5°/min. The temperature curve of the contraction of the aluminosilicate fibrous material was shown to be steppable and have four temperature intervals, the onset of the last interval (1250 °C) being particularly the limit operating temperature. The data obtained were confirmed by thermal analysis on a Mettler-Toledo instrument by heating the sample under nitrogen at 10°/min.

Keywords: heat insulation, aluminosilicate fiber, thermal resistance, density, contraction, operating temperature.

THERMOANALYTICAL STUDY OF POLYMERIC COMPOSITE MATERIAL

N.N. Khodakova, V.V. Samoilenko, A.N. Blaznov, N.V. Bychin

The experimental study results on determining the thermophysical behavior of a polymeric composite material reinforced with continuous glass fibers are reported herein. By the use of the advanced techniques of thermomechanical analysis and differential scanning calorimetry, the following thermo-physical characteristics were measured: glass transition, linear expansion coefficient in the axial and radial directions, and degree of cure (polymerization) of the composite.

The study of the thermophysical properties enables the determination of the limit operating temperature, durability and long-term serviceability of the item at high temperatures without decrease in elastic-strength properties. The findings showed that the chosen cure regime of the item was appropriate.

Keywords: glass transition, linear expansion coefficient, thermomechanical analysis, differential scanning calorimetry, degree of cure (polymerization).

DEVELOPMENT OF PROGRAM CONTROL SYSTEM FOR THE FABRICATION OF FILAMENT-WOUND ITEMS FROM POLYMER COMPOSITE MATERIALS

V.V. Samoilenko

The groundwork for creating a laboratory-scale setup fitted with program control system elements to fabricate filament-wound composites is presented. A conceptual control diagram of the filament-winding machine is given and some issues on operating the software are highlighted.

Keywords: polymer composite materials, winding, computer numeric control, technology, equipment.

HEAT RESISTANCE OF COMPOSITES WITH DIFFERENT DEGREE OF CURE

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Compounding and process research was performed for the EDI binder and basalt fiber- and fiberglass-reinforced plastics based thereon. Specimens of the composites were fabricated for power transmission line pylons. The glass transition of the composites as a function of the degree of cure was studied. The glass transition of the composites was shown to be dependent on the binder composition and to be almost not dependent on the filler – the basalt and glass rovings. Comparative testing of identical specimens by differential scanning calorimetry (DSC) and dynamic mechanical analysis (DMA) and by the proprietary method of longitudinal bending revealed similar results in determining the glass transition. A composition of the EDI resin is suggested for preparing epoxy composites with a higher heat resistance.

Keywords: composite-based power pylons, basalt-reinforced plastics, glass-reinforced plastics, epoxy binder, heat resistance, glass transition, degree of cure.