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18th Congress of the Process Industry Belgrade, 2004

Dimitrije Lilić, PhD (Eng)[1)]

THE 18th Congress of the Process Industry, PROCESSING-2004, was held at the Faculty of Mechanical Engineering, Belgrade, 2 - 4 June 2004 with the Association of Mechanical and Electrical Engineers and Technicians of Serbia (SMEITS) and patronage of the Department of Science, Technology and Development of the Republic of Serbia. The Congress was organized with the accompanying exhibition.

General patron of the 18th Congress of the Process Industry, PROCESSING-2004, was the Faculty of Mechanical Engineering, Belgrade.

Sponsors of the Congress were: "Airtrend-Gobrid", Belgrade, "Banat", Nova Crnja, "CIM GAS", Subotica, "IMI International", Belgrade, "Interklima", Vrnjačka Banja, and "Marketinfo", Šalgotarjan, Hungary.

The Congress participants were experts and authors from Serbia, Montenegro, Macedonia, Bosnia and Herzegovina, Hungary, Austria and Canada.

The Congress was opened and the participants welcomed by Dragutin Popovic, professor retired from the Faculty of Mechanical Engineering, Belgrade, Professor Miloš Nedeljković, Dean at the Faculty of Mechanical Engineering in Belgrade and Martin Bogner, President of the Scientific and Organizing Committee of the 18th Congress of the Process Industry, PROCESSING-2004, Professor at the Faculty of Mechanical Engineering in Belgrade.

Diplomas of the scientific and professional journal *"Procesna tehnika"* and acknowledgements for meritorious experts and most efficient firms in the previous year, as well as to the so-called "processing-city of Niš", were awarded at the evening party at the hotel "Metropol", ending the first day of the Congress.

Presentations were grouped in 11 thematic areas:

1. Mechanical and Hydromechanical Operations and Apparatuses.
2. Heating and Diffusion Operations and Apparatuses.
3. Construction and Accessories in the Processing Industry. Welding.
4. Transport Processes and Equipment. Hydraulics and Pneumatics Transport.
5. Rational Use of Energy and Fuels. Energy Efficiency in Processing Industry Plants. Biomass Combustion in Processing Industry Plants.
6. Protection of the Environment.
7. About Water.
8. Modelling, Simulation, Handling and Processing Control.
9. Specificities of Alimentary Industry.
10. Specificities of Manufacture Processes and Metal and Nonmetal Manufacturing.
11. Maintenance in the Processing Industry.

RAREFIED GAS FLOW IN MICRO AND NANO-CHANNELS

Prof. Vladan D. Đorđević, Ph.D, Faculty of Mechanical Engineering, Belgrade

Rarefied gas flow in channels whose height is measured in micro- and nano- meters is discussed in this paper. In such channels the Knudsen number may vary from very low values (found in the classical continuum mechanics) to extremely high values (pertinent to free molecular flows). In order to cover the whole range of Knudsen numbers, in this paper, a slip boundary condition on the walls of the channel was imposed by means of a fractional derivative whereby the order specifically depends on the local value of the Knudsen number. Excellent agreement with the experimental and numerical results related to volume and mass flow rate, pressure drop, etc. has been achieved.

VENTURI APPARATUS INTEGRATED WITH PLATE HEAT EXCHANGER

Georgi Trombev, PhD (Eng), Cvete Dimitrieska, MSc (Eng), Risto Ristevski, MSc (Eng),(Technical Faculty, Bitolj, Macedonia.

The paper deals with the purification of polluted gases in Venturi apparatus integrated with the plate heat exchanger. Modular approach is important as it enables multiple use of optimization modules. The experimental model has been constructed and the results of initial measuring, flow parameters and values presented.

THE EFFECTS OF PLATE FREE AREA ON THE PRESSURE VARIATION AT THE BOTTOM OF A MULTIPHASE RECIPROCATING PLATE COLUMN IN THE PRESENCE OF RASHIG RINGS

Ivana B. Banković-Ilić, PhD (Eng), Faculty of Technology, Leskovac), Mirko Aleksić, MSc (Eng) (Higher Agriculture-Alimentary School, Prokuplje), V. B. Veljković, PhD (Eng) and M. L. Lade, PhD (Eng) (Faculty of Technology, Leskovac) and D. U. Skala, PhD (Eng) (Faculty of Technology and Metallurgy, Belgrade)

The paper deals with the effects of operating conditions (vibration speed and superficial gas velocity) and the plate free area on the pressure variation at the bottom of a multiphase reciprocating plate column, filled with distilled water and 1% aqueous solution of carboxymethylcellulose (sodium salt, CMC), in the presence of a number of Rashing rings (diameter and height: 12mm) placed in interplate spaces. Independently of liquid properties, the pressure variation at the column base increased with increasing of the vibration speed as well as with decreasing the gas flow rate and plate free area.

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CONVECTIVE DRYING KINETICS – RESEARCH RESULTS

Slavica Prvulović, MSc (Eng) and Prof. Dragiša Tolmač, PhD (Eng), Technical Faculty "Mihajlo Pupin", Zrenjanin

Experimental and theoretical research on an actual industrial convective dryer with pneumatic transport of material was conducted. The research was done in order to investigate and analyse the drying kinetics and numerical drying indicator. Heat transfer is achieved by convection, owing to the drying principle based on a direct contact between the heated air and wet material. Thereby, intensive heat and mass exchange occur. Results obtained by the research of drying kinetics and relevant numerical indicators of convective drying are presented in this paper.

MATHEMATICAL MODEL OF THE SHRINKABLE BODY DRYING

Gligor H. Kanevče, Macedonian Academy of Sciences and Arts, Skoplje, Ljubica P. Kanevče and Vangelče B. Mitrevski, Technical Faculty, Bitolj, Macedonia

In this paper, a mathematical model for convective drying of a shrinkable body is presented. The nonlinear partial differential equations of heat and mass transfer with the initial and boundary conditions are solved numerically. The results of calculation are compared to the experimental data of convective drying of a potato. Volume average, moisture content and temperature changes during drying as well as transient moisture content and temperature profiles are shown. The results are also compared with the model that does not take into account the shrinking during drying.

PRESSURE DROP ON UNWETTED GRAVITATION LIQUID DISTRIBUTORS WITH SIEVE BOTTOM

Pavle I. Andrić, MSc (Eng), Faculty of Mechanical Engineering, Belgrade

The paper deals with the results obtained from the research of pressure drop on unwetted gravitation liquid distributors with the sieve bottom. At one-phase gas flow, the liquid distributor shows resistance to flow, whereby it is assumed that resistance coefficient is the function of the Reynolds number for gas phase and distributor's light cross-section. Based on 94 examined working modes/regimes, it was shown that the pressure drop on unwetted gravitation liquid distributors may be presented as given in the paper, with the note that expressions obtained from investigation on this distributor type provided good predictions of pressure drop on unwetted sieve bottom, for which experimental data were taken from available references (152 working regimes were checked).

ANALYSES OF SEGMENT DIVISION EFFECTS ON THERMAL AND ELECTRICAL CHARACTERISTICS OF THE DRUM HEAT EXCHANGER

Mića Vukić, MSc (Eng), Goran Vučković, Nenad Radojković, PhD (Eng), Gradimir Ilić, PhD (Eng), Faculty of Mechanical Engineering, Niš and Žarko Stevanović, PhD (Eng), Institute of Nuclear Sciences "Vinča", Belgrade

The paper presents results of the experimental research and numerical simulation of fluid flow and heat transfer in the laboratory experimental drum heat exchanger with one segment division wall. The position of the segment division along the heat exchanger's envelope and the division's stack were (22%, 26%, 32%). During each experiment, fluid pressure and temperature drops were measured on pre-defined locations along the envelope of the heat exchanger. 3D numerical simulation of the fluid flow in the heat exchanger envelope and heat transfer was performed by the software package PHOENICS 3.3.1. For modelling the heat exchanger geometry, the concept of porous environment (volume porosity and surface permeability) as well as the distributed resistance approach were used. The standard k-ε model was also used. At the end of this paper, the results of actual and numerical experiments were compared.

MODELLING OF HEAT AND MATTER TRANSFER IN SPRINKLING HEAT EXCHANGERS

Goran Vučković, Mića Vukić, MSc (Eng), Gradimir Ilić, PhD (Eng), Nenad Radojković, PhD (Eng), Faculty of Mechanical Engineering, Niš and Žarko Stevanović, PhD (Eng), Institute of Nuclear Sciences "Vinča", Belgrade

This paper deals with the mathematical modelling of heat and matter transfer in sprinkling heat exchangers. Even today, there is no generally accepted method of analytical determination of thermal power for sprinkling heat exchangers, although it was the subject of many studies. In this paper ID mathematical model of evaporative cooling of the working fluid with counter-direction airflow is presented.

THE GLASS SLOPE PF STRUCTURES ON WATER AND ITS INFLUENCE ON SOLAR RADIATION HEAT BALANCE

Dimitrije Lilić, PhD (Eng), Military Technical Institute, Belgrade

Solar radiation penetration through a glazed surface near water surface depends on a series of factors. The formed mathematical model comprises the complex interaction of relevant parameters and an example is given showing the influence of the glass slope on reflected, absorbed and penetrated solar radiation for the single, south-oriented glass of structures near water surface.

THE POWER CONSUMPTION IN A RECIPRO-CATING PLATE REACTOR FILLED WITH NEWTONIAN LIQUIDS

Olivera Stamenković, MSc (Eng), I.S. Stamenković, Ivana Banković-Ilić, PhD (Eng), M. Lazić, PhD (Eng), V. Veljković, PhD (Eng), Faculty of Technology, University of Niš, Leskovac) and D.U. Skala, PhD (Eng), Faculty of Technology and Metallurgy, Belgrade

The effects of the solution concentration, intensity of vibration, gas flow rate and content of solid phase on the power consumption in a gas-liquid-solid reciprocating plate reactor filled with Newtonian liquids were studied. The aqueous solutions of carboxymethylcellulose (sodium salt, CMC), the polypropylene spheres (mean diameter: 8,3 mm) and air were used as liquid, solid and gas phases. The power consumption is increased when the content of the solid phase and vibration intensity increased but decreased when the gas flow rate increased. The solution concentration did not affect the power consumption.

DETERMINATION OF DISTANCE BETWEEN THE PIPELINE'S MOVABLE (SLIDING) SUPPORTS

Prof. Martin Bogner, PhD (Eng), Faculty of Mechanical Engineering, Belgrade and Miodrag Stanković, BSc (Eng), Gowi Group, Belgrade

In determining the distance between the pipeline's movable supports installed on the steel structure or laid in channels, incorrect data may be taken. This may lead to disturbances in heat dilations of the pipeline and, even worse, breakdown. This paper includes calculation examples and procedure for determining the distance between sliding (movable) supports.

DETERMINING FAN DELIVERY HEAT FOR

PREVENTING HARMFUL PARTICLES' PENETRATION INTO CLEAN AREAS

Slobodan B. Rackov, PhD (Eng) and Slobodan M. Ristić, PhD (Eng), Higher Technical-Mechanical School, Belgrade – Zemun

Clean spaces in hospital operating rooms are protected from harmful particles (bacteria penetration) by overpressure. Overpressure created with a fan makes air feeding quantity by 10-20% higher than the exhaust air quantity. Consequently, overpressure does not allow harmful particles to penetrate clean rooms. In this paper physical and mathematical modelling will show how overpressure is formed and how fan delivery head is determined.

FACTORS AFFECTING THE BRIQUETTE COMBUSTION KINETICS

Prof. Dragan Mitić, PhD (Eng), Emina Mihajlović, PhD (Eng), Faculty of Work Safety, Niš and Batić Milanović, MSc (Eng), Researcher on Project NPEE 601-111 B, Niš

The paper presents a review of experimental results showing how the kinetics of briquette and composite briquette combustion are influenced by the material type, excess of air coefficient, coke residue content, reactivity index and combustion temperature.

IGNITION AND COMBUSTION TIME OF FIREPLACE BRIQUETTES

Emina Mihajlović, PhD (Eng) and Prof. Dragan Mitić, PhD (Eng), Faculty of Work Safety, Niš

During the experimental combustion of fireplace briquettes it was noted that they could be easily ignited without any initial ignition source, i.e. only by the heat emitted by the heated furnace. The paper presents the influence of the firing temperature on time of the ignition delay and total combustion time for samples of fireplace briquettes made of different biomass and with different binding agents. Furthermore, comparative analysis of ignition time and combustion with conventional briquettes is presented

USE OF ANIONIC ION-EXCHANGE RESINS METHOD FOR DECREASING THE CONTENT OF NATURAL ORGANIC MATTER IN WATER

Danijela Jašin, MSc (Eng), Mile Klašnja, PhD (Eng), Faculty of Technology, Novi Sad and Veselin Mulić, BSc (Eng), Higher Technical School, Zrenjanin

Subterranean water in northern and central Banat, used for water supply of this region, has high content of natural organic matters (NOM). Negative effects of NOM presence in drinking water are: unacceptable colour, taste and odour of water, formation of disinfection by-products, and potential danger of microbial growth in the distribution system. Difficulties in removing NOM from water make the drinking water preparation process more complicated and expensive. In order to decrease NOM content and obtain the prescribed drinking water quality, the use of anionic ion-exchange resins was studied. Results for the following ion-exchange resins are presented: IMAC HP 555, IMAC HP 661, AMBERLITE IRA 402 Cl, AMERJET 4200 Cl and AMERBLITE IRA 900 obtained in static operation conditions.

DETERMINING TECHNICAL CHARACTERISTICS OF THE AERATION SYSTEMS FOR OIL REFINERY WASTE WATER TREATMENT

Prof. Miroslav Stanojević, PhD (Eng), Faculty of Mechanical Engineering, Belgrade, Stojan Simić, MSc (Eng), Oil Rafinery a.d., Modriča, BiH, Dejan Radić, MSc (Eng), Faculty of Mechanical Engineering, Belgrade

While designing a plant for biological aerobic wastewater treatment, it is important to choose proper aeration equipment. The main purpose of this equipment is to provide sufficient amount of oxygen in each phase of the biological treatment of wastewater and consequently achieve a more efficient refinement. The results of the experimental research of aeration of wastewater from a plant of regeneration of the used oils in oil refinery are presented in the paper. Two cases were taken into consideration: aeration by air distributor introduction and aeration by simultaneous introduction of air by the distributor and mechanical mixing of wastewater. Research was carried out on a special experimental installation that can compare different aeration systems and their effects on refinery wastewater purification. Special attention was paid to the determination of the oxygen mass transfer coefficient in different aeration systems.

SIMULATION OF PULVERIZED COAL UTILITY BOILER FURNACE OPERATING CONDITIONS

Srđan Belošević, PhD(Eng), Miroslav Sljerčić, PhD (Eng) and Prof. Simeon Oka, PhD (Eng), Institute of Nuclear Sciences "Vinča", Belgrade, Prof. Ljubiša Brkić, PhD (Eng), Prof. Titoslav Živanović, PhD (Eng), Faculty of Mechanical Engineering, Belgrade

Results of numerical simulation of the chosen operation parameters that characterize the operating conditions of pulverized coal utility boiler and tangentially fired furnace with solid slag removal are presented in the paper. The simulation has been performed on the basis of the complex 3D mathematical model of the processes and corresponding numerical algorithm and computer code, specially developed for the purpose of simulating the processes in industrial scale boiler furnaces. For the furnace of TENT-A2 210 MW_e utility boiler, flue gas temperatures and carbon-dioxide concentrations are presented and unburned matter content in bottom slag has been evaluated. Some results of the model have been compared with the available measurements. The importance of numerical simulations of utility boiler furnaces operation parameters has been emphasized, in case of diagnostics of operating conditions and situations in the furnace, and plant control.

CALCULATION OF THERMODYNAMIC VALUES OF STEAM BY USING IAPWS-IF97 METHOD

Dragoljub Živković, PhD (Eng), Dejan Mitrović, MSc (Eng), Predrag Živković, BSc (Eng), Faculty of Mechanical Engineering, Belgrade, Niš

In this paper, the latest method for calculating basic thermodynamic parameters of the state water and water steam is presented. The International Association recommends this method for the Properties of Water and Steam.

LEACHING OF SPHALERITE FROM PB-ZN-CU-FE SULPHIDE CONCENTRATE BY SULPHURIC ACID IN THE PRESENCE OF SODIUM NITRATE

Miroslav Sokić, MSc (Eng), Nataša Vučković, MSc (Eng), Branislav Marković, MSc (Eng), Vladislav Matković, Institute for Technology of Nuclear and other Mineral Raw, Belgrade and Željko Kamberović, PhD (Eng), Faculty of Technology and Metallurgy, Belgrade

During floatation of polimetalic ores, in addition to selective concentrates, there is a collective sulphide concentrate due to the presence of small mineral types and their complex inter-relations. The existing metallurgic capacities cannot process collective concentrates and therefore, the research was focused on a possibility to process concentrates by leaching with euphoric acid in the

presence of sodium nitrate as an oxidant. A part of the research related to the leaching of zinc from polimetalic concentrate in the abovementioned conditions comprises the following phases: thermodynamic analysis of possible leaching reactions, characterization of polimetalic concentrate, investigation of the temperature and time effects on zinc leaching and kinetic analysis of experimental research.

MEASURING AND BALANCING OF LIME FURNACES WITH LARGE COAL COMBUSTION

Branislav Repić, PhD (Eng), Marina Jovanović, MSc (Eng), Rastko Mladenovć, BSc (Eng), Borislav Grubor, PhD (Eng), Nenad Crnomarković, MSc (Eng), Institute of Nuclear Sciences "Vinča", Belgrade

It is necessary to know the lime furnace operation parameters in order to: manage the lime baking process at all furnace zones, define and control air quantity, input raw material (stone, i.e. limestone), fuels, etc. Actual operation parameters of the lime furnace may be obtained only by taking measurements during the operation. Only then, the operation balancing may be performed. Detailed measuring was performed on a pit lime furnace in the lime factory "Veljko Dugošević", Kaona, Kučevo. Based on the obtained measurements, the design parameters were defined for a new experimental plant for lime baking by coal. Technological design was made for the reconstruction of firing of lime furnace with pulverized coal instead of large coal.

ANALYSIS OF SOLIDIFICATION PROCESS IN ALUMINIUM ALLOY CASTING

Zoran Marković, BSc (Eng), Institute of Nuclear Sciences "Vinča", Belgrade, Prof. Boško Rašuo, PhD (Eng), Faculty of Mechanical Engineering, Belgrade

Owing to its low density and corrosion resistance, aluminium is the most frequently used material in the aircraft industry. The sand casting process is one of the most common procedures for obtaining the aluminium alloy casts. The casting temperature before filling the mould and temperature change during the cooling process have considerable effect on the occurrence of the delayed tension and change of cast shape after removing from the mould, as well as the need and possibility for additional thermal processing over the mould. This paper presents the results obtained by numerical simulation of temperature field change in sand mould and aluminium alloy cast during the 60 minute solidification process. Using the finite element method and “enthalpy” model, developed by the Solidification Group at the Wales University, Swansea, the solidification process simulation was performed. The problem was simplified to a case of already cast alloy in the mould with uniform distribution of initial temperatures of mould and castings. The mould casing radiation was not taken into account.

In conclusion, a unanimous impression of the participants was that the 18th Congress of Process Industry, PROCESING-2004, successfully finished on 4th June 2004 demonstrated an outstanding professional and scientific level.

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18. Kongres o procesnoj industriji PROCESING 2004

18-ый конгресс о процессовой промышленности

Le 18ième congrès sur l’industrie de processus