Резюмета на научната продукция

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Публикации към дисертацията

Публикации в списания

1. Джонова Д. Б., Маджирски В. Х., Антонов И. С., "Числено моделиране на топлообмена в плоски турбулентни струи", *Известия на Техническия университет*, т.45, No.3, резюме, (пълен текст в техн.архив на унив.) (1990), стр.55

Abstract: NUMERICAL MODELING OF HEAT TRANSFER IN PLANE TURBULENT JETS- A numerical investigation of the transfer in free turbulent plane jets is presented. The partial differential equations governing the conservation of momentum, energy and mass are solved by means of finite - difference procedure. Several turbulence models of mean flow are used in the calculations. The comparison of the results with the experimental data confirms the applicability of the models to the flows under consideration. The heat fluxes that characterize the heat transfer are determined and compared.

Доклади, публикувани в пълен текст

2. Джонова Д. Б., Пресмятане на слабо неизотермична турбулентна струя по метод на крайните разлики, Научна сесия ВМЕИ "Ленин'"89, София, резюме, Секция машиностроене, (микрофилм в техн. архив на унив. и ЦНТБ), 5-7 октомври (1989), стр.77

Резюме: В работата е разработен метод за числено изследване на плоска неизотермична турбулентна струя без подемни сили, която изтича в неподвижна среда. За затваряна на описващите течението частни диференциални уравнения се използува модел на турбулентността на Прандтл за пътя на размесване. Системата е решена числено по метод на крайните разлики. В резултат са получени скоростните и температурните профили, затихването на осевата скорост и температура и скоростната и температурната граница на струята. Изчисленията се съгласуват добре с опитните данни. Методът е прост, ефективен и удобен за прилагане и сравняване на различни модели на турбулентността.

3. Джонова Д. Б., Маджирски В. Х., Антонов И. С., "Числено моделиране на топлообмена в ососиметрични турбулентни струи"- Юбилейна научна сесия 45 години ВНВВУ "Г.Бенковски", Долна Митрополия, (1990), стр.3-10

Резюме: В работата се прави опит за числено моделиране на ососиметрична турбулентна струя без подемни сили, която изтича в неподвижна среда, чрез система от частни диференциални уравнения на непрекъснатостта, движението и енергията и модели на турбулентността от типа

модели на усредненото течение. Изчисленията се съгласуват добре с опитните данни. Методът е пряк, алгебрически прост и удобен за прилагане и сравняване на различни модели на турбулентността, както и за обобщения с отчитане на промяна на плътността и др. по-сложни течения.

Публикации извън дисертацията

Публикации в списания с IF

4. Kolev N., Sv. Nakov, D. Djonova-Atanassova, "Mass transfer coefficient of arranged packings with vertical walls under gas-film control", *Chemical Engineering and Technology*, 18, No 6, (1995), 380-385. (IF$_{1996}$=0.276- намерени цитати 2)

Abstract: Packings with vertical walls, especially structured packings, are distinguished by their high efficiency and low pressure drop per mass transfer unit. Yet for these types of packings there is still no universal relationship for calculating gas-film-controlled mass transfer coefficients. The present work proposes such an equation. For arranged and structured packings the new equation fits the experimental data, both new results and those taken from the literature, with a mean error of 9%.

5. Nakov Sv., D. Djonova-Atanassova, , N. Kolev, "Dynamic hold-up of packings with vertical walls", *Chemical Engineering and Processing* 39, (2000), 391-397 (IF$_{2000}$=0.388)

Abstract: The packings with vertical walls and especially the 'honeycomb' packings are distinguished for their lowest pressure drop per one transfer unit. Yet there are no universal relationships for calculating the dynamic hold-up of that type of packings. The present work proposes equations for calculating this value under and over the loading point, derived on the basis of the experimental data for 11 arranged packings of that type with different form and dimensions.

6. D. Dzhonova-Atanasova, N. Kolev, S. Nakov, "DETERMINATION OF THE LIQUID RADIAL SPREADING COEFFICIENTS OF SOME HIGHLY EFFECTIVE PACKINGS", *Chem. Eng. Technol.*, (2007), 30, No.2, 202-207. (IF$_{2007}$=1.22, намерени цитати-6)

Abstract: The liquid radial spreading coefficient of packings for absorption and rectification columns is necessary to determine the packing height which ensures uniform liquid distribution over the column cross section. The existing calculation methods can be used theoretically only when this coefficient is independent of the liquid superficial velocity, which is often not the case. A tracer method free from this limitation is developed and tested. The spreading coefficients for different sizes of modern, highly effective packings (Raschig Super-Ring, Ralu-Flow, and Impulse Metal Tower Packing are determined. Practically, in the range of the experimental error, the spreading coefficients of these packings are independent of the liquid superficial velocity. For such packings the tracer method is expected to give the same results as the existing single jet method. Some differences between the results of these two methods are discussed and an explanation is proposed.

7. D. Kolev, D. Dzhonova-Atanasova, N. Kolev, Vertical plates with inclined capillary grooves for redistribution of the liquid phase over the cross-section of packed columns I. Equations for calculating the liquid flow-rates in the capillary grooves, *Chem. Eng. Process.* 47 (2008) 833-841 (IF$_{2008}$=1.518)

Abstract: The uniform distribution of the liquid phase over the cross-section of a packed column is a major prerequisite for its effective operation. Regarding various distributor designs, the best uniformity is achieved with devices where the liquid is divided into jets with equal flow-rates. The final liquid redistribution, to obtain uniformity over a cross-section area of the size of a packing element, takes place in the packing itself or in a specially designed redistribution layer. For this purpose a new packing, especially proper for low liquid superficial velocity has been developed and investigated. It consists of parallel vertical polystyrene plates with inclined crossing capillary grooves stamped on them. A computer procedure has been developed for calculating the height of the redistribution layer for a distributor with a given distance between the feed points. The calculated height ensures, with a selected precision, equality of the flow-rates of the liquid phase leaving the capillary grooves. The comparison with other devices shows that for a given degree of uniformity, the new packing is characterized by significantly smaller height.

8. D. B. Dzhonova-Atanasova, D. N. Kolev, N. N. Kolev, Height of vertical plates with inclined capillary grooves for a redistribution packing layer of packed columns, *Bulg. Chem. Commun.*, 43 (3) 2011, 449-455

Abstract: The uniform distribution of the liquid phase over the cross-section of a packed column is a major prerequisite for its effective operation. Regarding various distributor designs, the best uniformity is achieved with devices where the liquid is divided into jets with equal flow-rates. The final liquid redistribution, to obtain uniformity over a cross-section area of the size of a packing element, takes place in the packing itself or in a specially designed redistribution layer. For this purpose a new packing, especially proper for low liquid superficial velocity has been developed and investigated. It consists of parallel vertical polystyrene plates with inclined crossing capillary grooves stamped on them. A computer procedure has been developed for calculating the height of the redistribution layer for a distributor with a given distance between the feed points. The calculated height ensures, with a selected precision, equality of the flow-rates of the liquid phase leaving the capillary grooves. The comparison with other devices shows that for a given degree of uniformity, the new packing is characterized by significantly smaller height.

9. D. N. Kolev, D. B. Dzhonova-Atanasova, N. N. Kolev, Pressure drop of vertical plates with inclined capillary grooves for a redistribution packing layer of packed columns, *Bulg. Chem. Commun.*, 43 (3) 2011, 456-459

Abstract: Experimental data for the pressure drop of a new redistribution packing at different gas velocities and liquid superficial velocities have been obtained and compared with data for other packings designed with the same purpose. The best uniformity of the liquid phase over the cross-section of a packed column, prerequisite for its effective operation, is achieved with devices, where the liquid is divided into jets with equal flow-rates. The final liquid redistribution, to obtain uniformity over a cross-section area of the size of a packing element, takes place in the packing itself or in a specially designed redistribution layer. For this purpose a new packing, especially proper for low liquid superficial velocity, has been developed and investigated. It consists of parallel vertical polystyrene plates with inclined crossing capillary grooves stamped on their surface. The results prove that of all compared redistribution packings, the proposed packing is characterized by the lowest pressure drop which is connected with its advantage to change the direction of the liquid phase without changing the direction of the gas phase.

Публикации в списания без IF

10. Djonova D. B. "Experimental and numerical study of a horizontal heated round jet", *Journal of Theoretical and Applied Mechanics*, No. 2, (1993),87-93) (reported at the 7th National Congress on Theoretical and Applied Mechanics,1993, Sofia)

Abstract: Horizontal heated jets have found a wide application in power engineering and venti1ation. But the empirical and theoretical information on these flows is still not enough for their satisfactory prediction. In the present paper an experimental study of heated jets discharging horizontal1y from a round nozzle into a still ambient is presented. The conclusions from the analysis of the experimental results concern: the validity of the assumption of axial symmetry of a horizontal heated jet and the initial conditions in which the buoyant forces in it can be neglected. A numerical prediction method for non-vertical round jet is described. Two turbulence models are used: a k -ε -T' model with differential equations for turbulent kinetic energy, for its dissipation rate and for temperature fluctuations, and a second order model with supplementary differentia1 equations for Reynolds stresses and for turbulent heat fluxes. The partial - differentia1 equations governing the flow are solved by means of a finite - difference procedure. The calculations are in good agreement with our own measurements and with experimental data of other authors. The two turbulence models are compared and evaluated. As a result of the numerical prediction, the unstudied turbulence characteristics of a horizontal heated round jet, such as turbulent kinetic energy, Reynolds stresses and turbulent heat fluxes, are calculated.

11. Djonova-Atanassova D., Sv. Nakov, N. Kolev, "Liquid-phase mass transfer coefficient for stacked packings ", *Theoretical Foundations of Chemical Engineering*, 30, No 3, (1995), 239-241.

Abstract: It is noted that no dimensionless-number relation for calculating the liquid-phase mass-transfer coefficient for packings with vertical walls is available, although these packings are characterized by high efficiencies and low hydraulic resistances. A relation of this kind is proposed in this paper. This relation fits all known experimental data to an accuracy of 3.4%.

12. D. Dzhonova-Atanasova, N. Kolev, S. Nakov, M. Gyupchanov, M. Christov, "New method for determination of the radial spreading coefficient of the liquid phase in packed bed columns." *Comptes rendus de l'Academie bulgare des Sciences*, Tome 58, N 11 (2005) 1281-1286 (намерени цитати-2)

Abstract: The information about the radial spreading coefficient of packing for absorption and rectification columns is necessary for determination of the packing height which ensures uniform liquid distribution over the column cross-section. The existing method for determination of this coefficient can be used theoretically only in case when this coefficient is independent of the liquid superficial velocity, which in many cases is not fulfilled. A tracer method free from this limitation is created and tested. The spreading coefficient for different sizes of a new highly effective packing Raschig Super-Ring is determined.

13. N. Kolev, D. Kolev, D. Dzhonova-Atanasova, D. Popov, "Thermodynamic investigation of a new type highly effective gas turbine operating partially at isothermal expansion",PRES'09 12th International Conference on Process Integration, Modelling and Optimisation for Energy Saving and Pollution Reduction 10-13 May 2009 - Rome, Italy, *Chemical Engineering Transactions*, Ed. Juri Klemes, v.18, part 2 (2009) 929-934

Abstract: The greatest shortcoming of a gas turbine is that to decrease its inlet temperature, the burning chamber operates with a large excess of air which significantly reduces the efficiency. This work presents the solving of the problem by operating in the burner with lack of air and adding the rest of it, up to the stoichiometric value, thought the internals' cooling channels of the first part of the turbine. This ensures significant increasing of the efficiency and prevention of NOx, emissions. The work presents the principles of the new cycle and thermodynamic investigation to determine the optimal operating conditions.

14. Elena N. Razkazova-Velkova, Daniela B. Dzhonova-Atanasova, Influence of the Viscosity and Surface Tension of the Liquid Phase on the Wettability of Different Packing Materials for Column Apparatuses, 12th International Symposium Materials, Methods and Technologies, June 11 – 14, 2010, Sunny Beach, Bulgaria, *Journal of International Scientific Publications*, Materials, Methods and Technologies, Vol.4, Part 1, ISSN 1313-2539, http://www.science-journals.eu/mmt/ISP-MMT-4-1-2010.swf , pp.194- 204;

Abstract: The study aims at preliminary determination of the wettability of materials appropriate for design of packings for column apparatuses. Some classic and two new packing materials are investigated at dynamic conditions by measuring the width of a film flowing over a plate of every of them. The influence of the viscosity and surface tension of the liquid phase is presented. Dimensionless equations for calculation of the film width at different physicochemical properties of the liquid phase are given in the paper.

15. Daniela. B. Dzhonova-Atanasova, Elena N. Razkazova-Velkova, Ljutzkan A. Ljutzkanov, Current problems and development in flue gas desulfurization, *Journal of International Scientific Publications*, Materials, Methods and Technologies, Vol.5, Part 1, ISSN 1313-2539, 2011, EU, http://www.science-journals.eu/mmt/5/ISP-MMT-5-1.pdf , pp. 74-103

Abstract: One of the most widely used processes of SO_2 removal from flue gases is absorption by slurry containing $CaCO_3$. The existing installations are designed for big capacity boilers and provide low degree of absorption. The stringent environmental protection regulations for SO_2 emissions in EU call for better solutions. The aim of the present discussion on the current problems and achievements in gas desulfurization is to help the finding of the proper direction of the efforts for developing of a new technology and the choice of apparatuses and equipment.

16. Elena N. Razkazova-Velkova, Daniela B. Dzhonova-Atanasova, LIQUID PHASE LEAKAGE IN THE FREE VOLUME SECTION OF COLUMN APPARATUSES FILLED WITH "HONEYCOMB" PACKINGS, 13th International symposium Materials, methods and technologies 7-10 June 2011, Sunny Beach, *Journal of International Scientific Publications*, Materials, Methods and Technologies, Vol.5, Part 1, ISSN 1313-2539,2011, EU, http://www.science-journals.eu/mmt/5/ISP-MMT-5-1.pdf, pp.156-170

Abstract: Among all types of packings for packed-bed columns, the vertical-wall "honeycomb" packings show the lowest pressure drop per transfer unit, i.e. the lowest energy consumption for carrying out absorption processes. A limitation for its practical application is the possibility for tearing the liquid film flowing over the packing's wall and its leakage in the free volume of the packing in the form of drops and trickles. This leads to two effects. The first one is positive, related to the increasing of the total interphase surface area due to the additional surface of the drops and

trickles. The second effect is negative, because of the increasing rate of longitudinal mixing in the liquid phase due to the different velocity of the liquid film and leaky liquid. The influence of the viscosity and surface tension of the liquid phase over the leakage from packings manufactured from different materials is studied. The flowrates under which there is no leakage in the two different ways for arrangement of the "honeycomb" packings are obtained

17. Ljutzkan A. Ljutzkanov, Elena N. Razkazova-Velkova, Nikolai N. Kolev, Dimitar N. Kolev, Daniela B. Dzhonova-Atanasova, EQUILIBRIUM PARTIAL PRESSURE OF SO_2 OVER THE ABSORPTION SLURRY IN CASE OF PURIFICATION OF THE FLUE GAS FROM SULFUR DIOXIDE USING GYPSUM TECHNOLOGY, 13th International symposium Materials, methods and technologies 7-10 June 2011, Sunny Beach, *Journal of International Scientific Publications*, Materials, Methods and Technologies, Vol.5, Part 1, ISSN 1313-2539,2011, EU, http://www.science-journals.eu/mmt/5/ISP-MMT-5-1.pdf , pp.297-303

Abstract: The most widely used process for purification of flue gases from SO_2 is its absorption with slurry containing $CaCO_3$. Up to now there are installations for carrying out of the SO_2 absorption according to this process only for big capacity boilers because of the great height of the existing absorbers for this technology, about 20-30 m. To create new absorbers for small and middle capacity boilers, equilibrium data for the absorption of SO_2 are necessary. Up to now such data are available in the literature only for a temperature of $25^{o}C$. That is why experiments for obtaining of equilibrium data for the partial pressure of SO_2 over slurry containing $CaCO_3$, $CaSO_3$ and $CaSO_4$ at different temperatures are carried out. The results show that the increasing of the temperature from 25 to $45^{o}C$ leads to about 3 times increasing of the partial pressure of SO_2 in the area of the lowest partial pressures. The respective increasing for the range of 25° to $60^{o}C$ is about 10 times.

18. Ljutzkan A. Ljutzkanov, Elena N. Razkazova-Velkova, Nikolai N. Kolev, Daniela B. Dzhonova-Atanasova, Dimitar N. Kolev, Oxidation of $CaSO_3$ by air in the technology for purification of flue gases from SO_2, 13th International symposium Materials, methods and technologies 7-10 June 2011, Sunny Beach, *Journal of International Scientific Publications*, Materials, Methods and Technologies, Vol.5, Part 1, ISSN 1313-2539,2011, EU, http://www.science-journals.eu/mmt/5/ISP-MMT-5-1.pdf , pp.304-325

Abstract: The presented investigations are connected with creation of a new suitable for small and middle capacity boilers technology for removal of SO_2 from flue gases by absorption with $CaCO_3$ slurry, producing gypsum for building material. To reduce the capital investments it was decided to eliminate the hydrocyclone block and the centrifuge of the existing technologies and to dry the slurry of $CaSO_4.2H_2O$ directly in a spray dryer by flue gases, utilizing the heat of evaporation in a contact economizer system. This decision required practically full oxidation of the $CaSO_3$ to $CaSO_4$ in the oxidizer. A construction of a new oxidizer, divided by vertical partitions into 4 chambers with regular distribution of the air in the slurry by means of perforated horizontal tubes, is described. Some possibilities for cleaning of the orifices of the tubes are specially investigated and a solution is found. It is shown that at presence of catalysts, Fe and Mn ions, more than 99% of the slurry can be oxidized in 9 hours. The obtained after the drying of the slurry gypsum is white. The test of its compressive strength shows a value of 3.5 MPa, i.e. 40% higher than the requirements of the Bulgarian national standard for building gypsum. The obtained data are used for designing the oxidizer of an industrial installation for purification of flue gases from SO_2.

19. Nikolai N. Kolev, Ljutzkan A. Ljutzkanov, Dimitar N. Kolev, Daniela B. Dzhonova-Atanasova, Elena N. Razkazova-Velkova, NEW TECHNOLOGY FOR PURIFICATION OF THE FLUE GAS FROM SULFUR DIOXIDE, 13th International symposium Materials, methods and technologies 7-10 June 2011, Sunny Beach, *Journal of International Scientific Publications*, Materials, Methods and Technologies, Vol.5, Part 1, ISSN 1313-2539,2011, EU, http://www.science-journals.eu/mmt/5/ISP-MMT-5-1.pdf , pp. 375-382

Abstract: A new type of installation for SO_2 removal from flue gas, producing high quality gypsum, is described. It ensures conditions at which the absorption process is practically gas side controlled with elimination of the resistance in the liquid phase boundary layer between gas and liquid and between the liquid and solid $CaCO_3$ used as absorbent. This gives the possibility to calculate the absorption using data from literature, which eliminates the necessity of performing experiments for the given system and absorber construction. The new installation ensures high absorption degree, more than 99%, and provides optimal conditions for oxidation of the $CaSO_3$ to gypsum, small height of the packing of the absorbers and low pressure drop. The installation is intended for removal of SO_2 from the flue gases from small and middle capacity boilers, but with small changes can be used for big boilers too.