Резюмета на научната продукция

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Публикации към дисертацията

Публикации в списания

1. Boyadjiev Chr., **Doichinova M**., (1999) Non-linear mass transfer and Marangoni effect, *Hung. J. Ind. Chem.,* **27**, 215-219.

Abstract The comparative analysis of the influence of the effect of non-linear mass transfer and the Marangoni effect on the mass transfer kinetics has been done. Co-current two-phase (gas and liquid) flow in the laminar boundary layer along the flat phase surface is considered. One of the components of the first phase reacts with a component of the second phase. The chemical reaction rate is of first order. The heat effect from the chemical reaction creates a temperature gradient, i. e. the mass transfer together with a heat transfer can be observed. Non-linear mass transfer and Marangoni effect are results of a large concentration gradient and interfacial tension gradient. The data for heat and mass transfer coefficients are obtained.

2. Boyadjiev Chr., **Doichinova M**., (2000) Opposite-current flows in gas-liquid boundary layers- I. Velocity distribution, *Int. J. of Heat and Mass Transfer*, **43**, 2701-2706.

Abstract The theoretical analysis of gas-liquid counter-current flow in laminar boundary layers with flate phase boundary based on similarity variables method has been done. The obtained numerical results for the velocity distribution in both phases are compared with analogous results from asymptotic theory and experimental data. The dissipation energy in boundary layer is determined and the results corresponding to counter-current and co-current flows are compared. The comparison shows significant differences in dissipation energy values in gaseous phase.

3. **Doichinova M**., Boyadjiev Chr., (2000) Opposite-current flows in gas-liquid boundary layers- II. Mass transfer kinetics, *Int. J. of Heat and Mass Transfer*, **43,** 2707-2710.

Abstarct A theoretical analysis of mass transfer kinetics based on similarity variables method for gas-liquid opposite-current flow has been done. The obtained numerical results for the mass transfer rate (Sherwood number) in case of a laminar boundary layer with flat phase boundary are compared with analogous results for co-current flow. The ratio between the mass transfer velocity and the dissipation energy in boundary layer is determined. The advantages of co-current flow because of lower energy losses than in case of counter-current one is shown.

4. **Doichinova M**., Boyadjiev Chr., (2001) Opposite current flows in gas-liquid layers-III Non-linear mass transfer, *Int. J. Heat Mass Transfer*, **44**, 2121-2125.

Abstarct A theoretical analysis of non-linear mass transfer kinetics based on similarity variables method for gas-liquid counter-current flow in the conditions of big concentration gradient has been done. The obtained numerical results for the energy dissipation in laminar boundary layers with flat phase boundary and mass transfer rate are compared with analogous

results for co-current flows. The ratio between the mass transfer rate and energy dissipation is determined. The induced secondary flow in the gas phase when interphase mass transfer is limited by mass transfer in gas phase influence significantly mass transfer kinetics.

Доклади от научни конференции в пълен текст

5. Chr. Boyadjiev, **M.Doichinova**, *Opposite current flow in gas-liquid boundary layers - I. Velocity distribution*, Apollonia'99, 4th Workshop "Transport Phenomena in Two-Phase Flow", 119-130,1999.

Abstract The theoretical analysis of gas-liquid counter-current flow in laminar boundary layers with flate phase boundary based on similarity variables method has been done. The obtained numerical results for the velocity distribution in both phases are compared with analogous results from asymptotic theory and experimental data. The dissipation energy in boundary layer is determined and the results corresponding to counter-current and co-current flows are compared. The comparison shows significant differences in dissipation energy values in gaseous phase.

6. **M.Doichinova**, Chr. Boyadjiev, *Mass Transfer in opposite current flow –1. Linear Theory*, Orpheus'00, 5th Jubilee Workshop "Transport Phenomena in Two-Phase Flow", 43-48, 2000.

Abstarct A theoretical analysis of mass transfer kinetics based on similarity variables method for gas-liquid opposite-current flow has been done. The obtained numerical results for the mass transfer rate (Sherwood number) in case of a laminar boundary layer with flat phase boundary are compared with analogous results for co-current flow. The ratio between the mass transfer velocity and the dissipation energy in boundary layer is determined. The advantages of co-current flow because of lower energy losses than in case of counter-current one is shown.

7. **M.Doichinova**, Chr. Boyadjiev, *Mass Transfer in opposite current flow –2. Non-linear Theory*, Orpheus'00, 5th Jubilee Workshop "Transport Phenomena in Two-Phase Flow", 49-54, 2000.

Abstarct A theoretical analysis of non-linear mass transfer kinetics based on similarity variables method for gas-liquid counter-current flow in the conditions of big concentration gradient has been done. The obtained numerical results for the energy dissipation in laminar boundary layers with flat phase boundary and mass transfer rate are compared with analogous results for co-current flows. The ratio between the mass transfer rate and energy dissipation is determined. The induced secondary flow in the gas phase when interphase mass transfer is limited by mass transfer in gas phase influences significantly mass transfer kinetics.

8. Chr. Boyadjiev, **M.Doichinova**, *Simulation of opposite-current stratified flows*, Bourgas'01, 6th Workshop "Transport Phenomena in Two-Phase Flow", 135-138, 2001.

Abstarct A theoretical analysis of hydrodynamic processes in opposite current flows in approximation of boundary layer for two immiscible liquids (or gas-liquid) is done. A calculating algorithm for the approximate solution of corresponding boundary value problem is made. The algorithm is based on the decomposition of calculated domain to two subdomains with iterative satisfying conditions on the boundaries of subdomains.

9. Chr. Boyadjiev, **M. Doichinova**, *A method for non-linear stability analysis, Varna'02*, 7th Workshop "Transport Phenomena in Two-Phase Flow", 73-82, 2002.

Abstract Many systems in chemistry, physics, biology and technique might be unstable at certain condition. Small disturbances might bring out them of their equilibrium state, after which they achieve itself to a new stable state. The method developed here concerns a non-linear analysis of hydrodynamic stability. It allows the determination of the kinetic energy distribution between the main flow and the disturbance, when the equilibrium value of the disturbance amplitude is determined.

10. Chr. Boyadjiev, **M. Doichinova**, *On the energy efficiency of the co-corrent and counter-current flows, Sunny Beach'03*, 8th Workshop "Transport Phenomena in Two-Phase Flow", 189-194, 2003.

Abstract A theoretical analysis of gas-liquid counter-current flow in laminar boundary layers with flat phase boundary based on similarity variables method has been done. The obtained numerical results for the energy dissipation, mass transfer rate and their ratio are compared with analogous results for co-current flows

Публикации в списания (извън дисертацията)

11. Chr. Boyadjiev, **M. Doichinova**, *A method for stability analysis of the non-linear heat and mass transfer processes* Thermal Science**, 8,** 95-105, 2004.

Abstract Many systems with non-linear heat and mass transfer processes might be unstable at certain conditions. Small disturbances might bring out them of their equilibrium state, after which they achieve itself to a new stable state. The method developed here concerns a non-linear analysis of hydrodynamic stability of the systems with intensive heat and mass transfer. It allows the determination of the kinetic energy distribution between the main flow and the disturbance, when the equilibrium value of the disturbance amplitude is determined.

12. Chr. Boyadjiev, **M. Doichinova**, *Nonlinear Mass Transfer and Self-Organized Dissipative Structures,* Journal of Engineering Thermophysics*,* 17, №. 2, pp. 142–150, 2008.

Abstract The stability of laminar boundary layer flow is investigated when the big concentration gradient induce secondary flow at the solid interface. A self-organized dissipative structure was obtained when the mass transfer is directed from the volume to the solid interface. The stable amplitude of periodical disturbances was obtained for different wave numbers.
This structure is subcritical bifurcation which intensify the mass transfer process in the boundary layer flows.

13. K. Panayotova, **M. Doichinova** and Chr. Boyadjiev, *On the scale effect and scale-up in the column apparatuses 1. Influence of the velocity distribution,* International Journal of Heat and Mass Transfer, 52, pp. 543-547, 2009.

Abstract A diffusion type of model is proposed for modeling of the scale effect in column apparatuses. The mass transfer with chemical reaction model is investigated. The influence of the radial non-uniformity of the velocity distribution on the mass transfer efficiency, column height and scale-up is obtained. The effect of Fourier and Damkohler numbers on the process efficiency is analyzed. The present data show that mass transfer efficiency in column apparatuses decreases with the column diameter increase.

14. K. Panayotova, **M. Doichinova** and Chr. Boyadjiev, *On the scale effect and scale-up in the column apparatuses 2. Scale effect modeling,* International Journal of Heat and Mass Transfer, 52, 2358-2361, 2009.

Abstract The mass transfer with chemical reaction model is investigated. A diffusion type of model is proposed for modeling of the scale effect in column apparatuses, where the velocity and concentration distributions are replaced with theirs average values at the cross-section areas of the column. The obtained results show that scale effect is related with one parameter which is possible to be calculated using experimental data for average concentration at some different points at the column height.

15. K. Panayotova, **M. Doichinova** and Chr. Boyadjiev, *On the scale effect and scale-up in the column apparatuses 3.Circulation zones,* International Journal of Heat and Mass Transfer, 53, 2128-2132, 2010.

Abstract A diffusion type of model is proposed for modeling of the mass transfer with chemical reaction in the column apparatuses in the cases of circulation zones. The presence of rising and descending flows (the change of the velocity direction) leads to using three coordinate systems. An iterative algorithm for the concentration distribution calculation is proposed. The influence of the zones breadths on the mass transfer efficiency in the column is investigated.

16. **M. Doichinova**, P. Popova, Chr. Boyadjiev, *Mass Transfer in counter-current flows,* Transactions of Academenergo, 4, 4-22, 2010.

Abstract A theoretical analysis of gas-liquid counter-current flow in laminar boundary layers with flat phase boundary based on similarity variables method has been done. The obtained numerical results for the energy dissipation, mass transfer rate and their ratio are compared with analogous results for co-current flows. A diffusion type of model is proposed for modeling of the mass transfer with chemical reaction in the column apparatuses in the cases of circulation zones. The presence of rising and descending flows (the change of the velocity direction in this liquid counter-current flow) leads to using three coordinate systems. An iterative algorithm for the concentration distribution calculation is proposed. The influence of the zones breadths on the mass transfer efficiency in the column is investigated.

17. P. Popova, **M. Doichinova**,Chr. Boyadjiev, *Parameter identification of multi equation models,* Transactions of Academenergo, 2,7-23, 2011.

Abstract A very important stage of model development is parameter identification through inverse problem solutions.

The kinetics of many chemical, biochemical, photochemical, and catalytic reactions is very complex, the kinetic model consists of many equations and parameters. Model parameter identification in these cases is very difficult because of the multiextremal least square function or because of the fact that some minima are of ravine type. The solution of this problem needs very good initial value approximations for the parameters (in the attraction area of the global minimum) for the minimum searching procedure. A polynomial approximation of the experimental data permits to propose a hierarchical approach for obtaining initial parameters values in the global minimum area, using a consecutive approximations method.
The hierarchical approach for parameter identification of multiequation models is tested for two bioprocesses-modeling of fermentation systems and microalgae growth kinetics. The model parameter values are obtained on the bases of real experimental data.

18. **M. Doichinova**, O.Lavrenteva, Chr. Boyadjiev, *Non-linear mass transfer from a solid spherical particle dissolving in a viscous fluid,* International Journal of Heat and Mass Transfer, 54, 2998-3003, 2011.

Abstract Theoretical study of the non-linear mass transfer from a solid particle, suspended in a viscous fluid, is presented. In the cases of intensive mass transfer the processes is completed by the secondary flow as a result of the big concentration gradients and the decrease of the particle radius as a result of the particle dissolution.

Доклади от научни конференции в пълен текст (извън дисертацията)

19. **M. Doichinova** and Chr. Boyadjiev, *Diffusion models and scale-up,* Сборник докладов VII Всероссийская конференция с международным участием "Горение твердого топлива", Част 1, 115-128р., Новосибирск, 10-13 ноября 2009.

Abstract A model for mass transfer processes in column apparatuses has been done. The model may be modified for different volume course (chemical reaction, interphase mass transfer). The using of the average velocities and concentration permits to solve the scale - up problems. A hierarchical approach for model parameter identification has been proposed.

20. K. Panayotova, **M. Doichinova** and Chr. Boyadjiev, *On the scale effect and scale-up in the column apparatuses 3.Circulation zones,* Journal of International Scientific publication: Materials, Methods and Technologies, Volume 4 (1), 467-481, 2010.

Abstract A diffusion type of model is proposed for modeling of the mass transfer with chemical reaction in the column apparatuses in the cases of circulation zones. The presence of rising and descending flows (the change of the velocity direction) leads to using three coordinate systems. An iterative algorithm for the concentration distribution calculation is proposed. The influence of the zones breadths on the mass transfer efficiency in the column is investigated.

21. Chr. Boyadjiev, **M. Doichinova**, P. Popova, *On the SO_2 Problem in Power Engineering. 1. Gas absorption,* Proceedings, 15th Workshop on Transport Phenomena in Tow-Phase Flow, Sunny Beech, Sept.17-22, 94-103, 2011.

Abstract A theoretical analysis of SO_2 absorption with alkaline absorbents in packed bed columns is presented. The absorption kinetics in the cases of irreversible chemical reactions is analyzed on the base of a qualitative analysis of the mathematical model. Diffusion type of model and average concentration model are used for modeling of gas absorption in column apparatuses.

22. Chr. Boyadjiev, P. Popova, **M. Doichinova**, *On the SO_2 Problem in Power Engineering. 2. Two-phase absorbents,* Proceedings, 15th Workshop on Transport Phenomena in Tow-Phase Flow, Sunny Beech, Sept.17-22, 104-115, 2011.

Abstract The presented theoretical analysis shows, that the low SO_2 concentration in the waste gases of the thermal power plants needs an irreversible chemical reactions of SO_2 with alkaline reagents in the liquid phase in case of gas-liquid dispersion system. For the purification of huge amounts of waste gases must be used inexpensive reagents ($CaCO_3$ or $Ca(OH)_2$ suspensions). The presence of the active component in the absorbent as both a solution and solid phase leads to an increase of the absorption capacity of the absorbent, but the introduction of a new process (the dissolution of the solid phase) creates conditions for a variation of the absorption mechanism (interphase mass transfer through two interphase surfaces – gas/liquid and liquid/solid). At these conditions the mass transfer resistance is distributed in the both phases, i.e. the convection-diffusion equations of SO_2 (in gas and liquid phases) and $CaCO_3$ (in liquid phase) must be solved together.

23. Chr. Boyadjiev, **M. Doichinova**, P. Popova, *On the SO_2 Problem in Power Engineering. 3.* Gas adsorption *,* Proceedings, 15th Workshop on Transport Phenomena in Tow-Phase Flow, Sunny Beech, Sept.17-22, 116-124, 2011.

Abstract The presented theoretical analysis shows, that the using of synthetic anionites for gas purification from SO_2 is very useful, because these adsorbents permit to be regenerated. The using of basic anion-exchange resins as adsorbents lead to pure SO_2 and NH_4NO_3, i.e. to a wasteless gas-cleaning technology.