1. B. Boyadjiev, Chr. Boyadjiev. On the mechanism and kinetics of the transport processes in systems with intensive interphase mass transfer. 4. Effect of the interface concentration. International Journal of Heat and Mass Transfer, 44, 2001, 2505-2509. JCR-IF (Web of Science):5.616 Q1 (Web of Science) Линк

Abstract: A comparative analysis of the non-stationary absorption rate of pure (concentrated) gases in a stagnant liquids has been performed. The results obtained indicate that the rate depends on the equilibrium concentration at the interface. A theoretical relationship has been developed. The relationship confirms the experimental data and explains the differences between the absorption and desorption rates as well. © 2001 Elsevier Science Ltd. All rights reserved.

2. B. Boyadjiev, Chr. Boyadjiev. On the non-stationary evaporation kinetics. 2. Stability. International Journal of Heat and Mass Transfer, 46, 2003, 1687-1692. JCR-IF (Web of Science):5.575 Q1 (Web of Science) Линк

Abstract: A stability analysis of the one-dimensional Oberbeck-Boussinesq equations has been done. It is shown, that the increase of the evaporation rate is result of the instability of the natural convection flow. Velocity parameter of this flow is obtained on the basis of experimental data. © 2003 Elsevier Science Ltd. All rights reserved.

3. Chr. Boyadjiev, B. Boyadjiev. On the non-stationary evaporation kinetics. 1. Mathematical model and experimental data. International Journal of Heat and Mass Transfer, 46, 2003, 1679-1685. JCR-IF (Web of Science):5.575 Q1 (Web of Science) Линк

Abstract: A theoretical analysis of the non-stationary evaporation kinetics based on experimental data has been done. A comparison between non-stationary diffusion rate and convective mass flow as a result of a Stephan flow is proposed. It is shown, that the evaporation do not change the temperature of the liquid interface. The mass transfer rate as a result of a diffusion and convection differs from the evaporation velocity, which is easy to explain with a natural convection on account of a instability of the system. © 2003 Elsevier Science Ltd. All rights reserved.

4. B. Boyadjiev, Chr. Boyadjiev. Effect of the velocity radial non-uniformity in the column apparatuses. Int. J. of Modern Trends in Engineering and Research, 2, 7, 2015, ISSN: 2349-9745, 324-334 Линк

Abstract: A theoretical analysis of the effect of the velocity radial non-uniformity in the column apparatuses is presented. A numerical analysis shows, that average concentration model, where the radial velocity component is equal to zero (in the cases of a constant velocity radial non-uniformity along the column height), is possible to be used in the cases of an axial modification of the radial non-uniformity of the axial velocity component. The use of experimental data, for the average concentration at different points along the column height, for a concrete process, permits to be obtained the model parameters, related with the radial non-uniformity of the velocity. These parameter values permit to be used the average concentration model for modeling of different processes in the cases of different values of the column height, average velocity, reagent diffusivity and chemical reaction rate constant.

5. B. Boyadjiev, M. Doichinova, Chr. Boyadjiev. On the “back mixing” effect in column chemical reactors. Int. J. of Modern Trends in Engineering and Research, 2, 8, 2015, ISSN: 2349-9745, 168-175 Линк

Abstract: A theoretical analysis of the “back mixing” effect in the column reactors is presented. It is sown, that the reduction of the conversion degree in the column chemical reactors, resulting from the radial non-uniformity in the velocity distribution in the cross sectional area of the column, is not possible to be explained by the mechanism of a back mass transfer (“back mixing” effect). The new approach for modeling of column apparatuses is used for a new explanation of this effect. It is obtained, that the radial non-uniformity in the velocity distribution in the cross sectional area of the column leads to the decrease of the average residence time of the flow in the column (chemical reaction time), the increase the average mass flux at the column outlet and ,as a result, to the decrease of the conversion degree in the column. This effect increases if the convection part of the convection-diffusion flow in the column increase, due to the average velocity increasing or to the flow viscosity reduction.

6. Boyadjiev, Chr., Doichinova, M, Boyadjiev, B. Some problems in the column apparatuses modeling. Bulgarian Chemical Communications, 47, 3, BAN, 2015, ISSN:0324-1130, 755-765. SJR (Scopus):0.153 Q4 (Scopus) Линк

Abstract: The solutions of some theoretical problems of the column apparatuses modeling in the cases of one-, two- and three-phase processes are presented in the approximation of the mechanics of continua. The effect of the radial non-uniformity of the velocity distribution, the effect of the tangential flow and simultaneous mass and heat transfer processes in one-phase column are analyzed. The possibility for obtaining the interphase distribution of the mass transfer resistances in two-phase columns is shown. An iterative numerical algorithm for non-stationary processes modeling in three-phase columns is also presented.

8. Boyadjiev, B., Boyadjiev, Chr.. New models of industrial column absorbers. 1.Co-current absorption process. Bulgarian Chemical Communications, 49, 3, BAN, 2017, 711-719. SJR (Scopus):0.156 Q4 (Scopus) Линк

Abstract: A new approach to modeling the industrial column absorbers is presented. A theoretical analysis of the effect of the velocity radial non-uniformity on the co-current absorption processes in the column apparatuses is presented. The average concentration model, where the radial velocity component is equal to zero (in the cases of a constant velocity radial non-uniformity along the column height), is used in the cases of an axial modification of the radial non-uniformity of the axial velocity components in the gas and liquid phases. The use of experimental data, for the average concentrations in the gas and liquid phases at the column end, for a concrete process (absorption of an average soluble gas), permits to be obtained the gas and liquid phase model parameters, related with the radial non-uniformity of the velocities. These parameter values permit to be used the average concentration models for different absorption processes modeling in co-current columns.

9. Boyadjiev, B., Boyadjiev, Chr.. New models of industrial column absorbers. 2.Counter-current absorption process. Bulgarian Chemical Communications, 49, 3, BAN, 2017, 720-728. SJR (Scopus):0.156 Q4 (Scopus) Линк

Abstract: A theoretical analysis of the effect of the velocity radial non-uniformity on the counter-current absorption processes in the column apparatuses is presented. The average concentration model, where the radial velocity component is equal to zero (in the cases of a constant velocity radial non-uniformity along the column height), is used in the cases of an axial modification of the radial non-uniformity of the axial velocity components in the gas and liquid

phases. The modeling problem in the counter-current flows is complicated, because the model equations has to be presented in two-coordinate systems (in a one-coordinate system one of the equations has no solution due to the negative Laplacian value).

The use of experimental data, for the average concentrations in the gas and liquid phases at the column end in the cases of highly and lightly soluble gases, permits to be obtained the gas and liquid phases model parameters, related with the radial non-uniformity of the velocities. These parameter values permit to be used the average concentration models for different absorption processes modeling in counter-current columns.

10. Boyadjiev, B., Boyadjiev, Chr.. New models of industrial column chemical reactors. Bulgarian Chemical Communications, 49, 3, BAN, 2017, 706-710. SJR (Scopus):0.156 Q4 (Scopus) Линк

Abstract: A new approach to modeling the industrial column chemical reactors is presented. A theoretical analysis of the effect of the radial non-uniformity of the axial velocity component in the industrial column chemical reactors is presented. A numerical analysis shows, that average concentration model, where the radial velocity component is equal to zero (in the cases of a constant velocity radial non-uniformity along the column height), is possible to be used in the cases of an axial modification of the radial non-uniformity of the axial velocity component. The use of experimental data, for the average concentration at the column end, for a concrete process and column, permits to be obtained the model parameters, related with the radial non-uniformity of the velocity. These parameter values permit to be used the average concentration model for modeling of different processes.

11. B. Boyadjiev, Chr. Boyadjiev. New Approach to Modeling of Industrial Catalytic Columns. Journal of Engineering Thermophysics, 27, Pleiades Publishing, 2018, ISSN:1810-2328, DOI:10.1134/S1810232818040215, 593-612. SJR (Scopus):0.399, JCR-IF (Web of Science):0.881 Q2 (Scopus) Линк

Abstract: A new approach to modeling the catalytic processes in column apparatuses in cases of physical and chemical adsorption mechanism is presented. Numerical analysis shows that average concentration model, where the radial velocity component is zero (in cases of a constant velocity radial non-uniformity along the column height), can be used in cases of an axial modification of the radial non-uniformity of the axial velocity component. The use of experimental data, for the average concentration at the column end, for a concrete process and column, allows obtaining the model parameters related with the radial non-uniformity of the velocity. These parameter values allow the use of the average concentration model for modeling of different processes.

13. B. Boyadjiev, Chr. Boyadjiev. Modeling and Simulation of Chemical and Mass Transfer Processes in Industrial Column Apparatuses. 2, B P International, 2022, ISBN:978-93-5547-737-8, DOI:10.9734/bpi/racms/v2/2819A, 39, 70-108 Линк

Abstract: In the Chapter is presented theoretical analysis of the methods for industrial processes modeling and simulation. Two main problems in the modeling of the kinetics of industrial mass transfer processes are solved that arise from the need for information about the interphase boundaries and velocity distributions in the phases in the column apparatuses and the interaction between the simple (elementary) processes in the complex process, i.e., information about the process mechanism.

14. Boyadjiev, B., Boyadjiev, Chr.. Chapter 3. Modeling and Simulation of Chemical Processes in Industrial Column Apparatuses. In book: Modeling and Simulation in Chemical Engineering, Project Reports on Process Simulation, Editor: Christo Boyadjiev, Springer International Publishing, Book Series: Heat and Mass Transfer, 2022, ISBN:978-3-030-87659-3, DOI:10.1007/978-3-030-87660-9_3, 19, 35-44 **Линк**

Abstract: A new approach for the chemical processes modeling in column apparatuses is presented in industrial column apparatuses. An exact approach for solutions of the equations in the convective type models is used. The use of experimental data, for the average concentration at the column end, for a concrete process and column, permits to be obtained the model parameters, related with the radial non-uniformity of the velocity. These parameter values permit to be used the average-concentration model for modeling of chemical processes with different reaction rates.

15. Boyadjiev Chr., Doichinova M., Popova-Krumova P., Boyadjiev B.. Intensive column apparatus for chemical reactions. Open Access Library Journal, 1, 3, 2014, DOI:0.4236/oalib.1100413, 1-9 **Линк**

Abstract: A solution of the intensification problem of the column chemical reactors is presented in the approximation of the mechanics of continua. The effect of the radial non-uniformity of the velocity distribution, the effect of the tangential flow and simultaneous mass, and heat transfer processes are analyzed. A theoretical analysis of the simultaneous mass and heat transfer processes in column reactors is presented.

16. Boyadjiev Chr., Doichinova M., Popova-Krumova P., Boyadjiev B.. Gas purification from SO_2 in thermal power plants. Chemical Engineering & Technology, 37, 2014, 1243-1250. JCR-IF (Web of Science):2.278 Q1 (Web of Science) **Линк**

Abstract: Solid fuel combustion in thermal power plants, which use sulfur-rich fuels, poses the problem of SO_2 removal from waste gases. In addition, purification of huge amounts of gas with low SO_2 concentration is necessary. A maximum absorption rate could decrease the size of required big apparatuses. Gas purification from low-concentrated SO_2 in physical and chemical absorption is analyzed theoretically. A convection-diffusion type of models is applied for creating average concentration models and for quantitative description of the absorption processes. Theoretical analysis of methods and devices for waste gas purification from SO_2 by $CaCO_3$ suspension indicates that the process is practically physical absorption.

17. B. Boyadjiev, Chr. Boyadjiev. A new approach for the catalytic processes in column apparatuses. Int. J. of Modern Trends in Engineering and Research, 2, 8, 2015, ISSN: 2349-9745, 152-167 **Линк**

Abstract: A new approach for the catalytic processes modeling in column apparatuses, in the cases of physical and chemical adsorption mechanism, is presented. A convection-diffusion model is obtained in the approximations of the mechanics of continua, where the mathematical point is equivalent to the medium elementary volume, which is sufficiently small with respect to the column volume and at the same time sufficiently large with respect to the intermolecular volumes of the medium. On this base convection–diffusion type models are created, which permit to be made qualitative analysis of the process. They are a base of average concentration models, which are used for the quantitative description of the catalytic processes in the column apparatus. The model parameters are obtained, using experimental data.

18. B. Boyadjiev, M. Doichinova, Chr. Boyadjiev. Computer modelling of column apparatuses: 1. Two-coordinate systems approach. J. Eng. Thermophysics, 24, 3, 2015, 247-258. SJR (Scopus):0.709, JCR-IF (Web of Science):0.989 Q2 (Scopus) Линк

Abstract: The computermodeling of the mass transfer processes in column apparatuses on the basis of a new approach is presented. A convection-diffusion type model and an average concentration type model are used for solving the calculation problems in the cases of counter-current gas–liquid or liquid–liquid processes. In these conditions, the mass transfer process models are presented in two-coordinate systems, because in a one-coordinate system, one of the equations has no solution by the reason of the negative equation Laplacian value. A combination of iterative algorithms and MATLAB are used for the solutions of the equations set in different coordinate systems. As a result, it is shown, that the experimental data obtained from the column with real radius and small height are useful for the parameters identifications in the average concentration type models.

19. B. Boyadjiev, M. Doichinova, Chr. Boyadjiev. Computer modelling of column apparatuses: 2. Multistep modeling approach. J. Eng. Thermophysics, 24, 4, 2015, 362-370. SJR (Scopus):0.709, JCR-IF (Web of Science):0.989 Q2 (Scopus) Линк

Abstract: A new approach for computer modeling of the mass transfer processes in column apparatuses, on the base of the convection-diffusion type of models in the physical approximations of the mechanics of continua, is proposed. In the cases of a nonstationary chemical adsorption in gas-solid systems, the presence of mobile (gas) and immobile (solid) phases in the conditions of long-time processes, leads to the nonstationary process in the immobile phase and stationary process in the mobile phase, practically. As a result, different coordinate systems must be used in the gas and solid phase models. A combination of a multistep algorithms and MATLAB are used for the solutions of the equations set in different coordinate systems. As a result, it is shown that the experimental data, obtained from the column with real radius and small height, are useful for parameters identifications in the average concentration-type models.

20. B. Boyadjiev, M. Doichinova, Chr. Boyadjiev. Computer modelling of column apparatuses: 3. Perturbation method approach. J. Eng. Thermophysics, 24, 4, 2015, 371-380. SJR (Scopus):0.709, JCR-IF (Web of Science):0.989 Q2 (Scopus) Линк

Abstract: A new approach for the column apparatuses modeling is proposed. The method is based on the convection–diffusion-type models, which are obtained on the base of physical approximations of the mechanics of continua. The velocity distributions of fluids in column apparatuses are unknown practically and for a quantitative analysis of the processes must be created average concentrations models. All these new type models are characterized by the presence of small parameters at the highest derivatives. As a result, the use of MATLAB for solving the model differential equations is difficult. This difficulty is eliminated by three algorithms, using the perturbations method.

21. Boyadjiev, Chr., Boyadjiev, B., Popova-Krumova, P., Doichinova, M.. An Innovative Approach for Adsorption Column Modeling. Chemical Engineering & Technology, 38, 4, Wiley, 2015, ISSN:1521-4125, DOI:10.1002/ceat.201400584, 675-682. SJR (Scopus):0.606, JCR-IF (Web of Science):2.144 Q1 (Scopus) Линк

Abstract: A new method for physical and chemical adsorption modeling in column apparatuses is presented. A convection-diffusion model is obtained in the approximations of the continua

mechanics, where the mathematical point is equivalent to the medium elementary volume, which is sufficiently small with respect to the column volume and the same time sufficiently large with respect to the intermolecular volumes of the medium. The created convection-diffusion type model allows performing qualitative analysis of the process and obtaining the effect of the velocity radial non-uniformity in the column. An average concentration model is applied for quantitative description of physical and chemical adsorption in the column apparatus. The methods for model equation solutions and the model parameter identification are described.

22. Boyadjiev, Chr., Doichinova, M., Popova-Krumova, P., Boyadjiev, B.. On the SO_2 Problem in Thermal Power Plants. 1. Absorption processes modeling. International Journal of Engineering Research, 4, 10, 2015, ISSN:2347-5013, 550-557 Линк

Abstract: A theoretical analysis, of the processes for gas purification from low SO2 concentration in the thermal power plants, is presented. A new approach, for qualitative analysis (convection-diffusion type of model) and quantitative description (average concentration model) of the absorption processes in column apparatuses, is proposed. The theoretical analysis of the physical absorption, chemical absorption and absorption with two-phase absorbent is shown. The presented theoretical analysis of the methods and apparatuses for waste gases purification from SO2, using two-phase absorbent (CaCO3 suspension), shows, that the process is physical absorption practically and the mass transfer resistances in the gas and liquid phases are 44% and 56% respectively. In these conditions, a new patent is proposed, where the process optimization is realized in two-zone column, where the upper zone is physical absorption in gas-liquid drops system and the lower zone is physical absorption in liquid-gas bubbles system. The chemical reaction takes place in the column tank.

23. Boyadjiev, Chr., Popova-Krumova, P., Doichinova, M., Boyadjiev, B.. On the SO_2 Problem in Thermal Power Plants. 2. Two-steps chemical absorption modeling. International Journal of Engineering Research, 4, 10, IJER, 2015, ISSN:2347-5013, 557-561 (Scopus) Линк

Abstract: The modeling of the gas absorption in a new column apparatus for waste gases purification from SO_2, using two-phase absorbent ($CaCO_3$ / H_2O suspension) is presented. The process is realized in a three-zone column. In the upper zone, a physical absorption in gas-liquid drops system is realized and the big convective transfer in the gas phase leads to a decrease of the mass transfer resistances in this phase. In the middle zone, a chemical absorption in liquid-gas bubbles system takes place and the big convective transfer in the liquid phase leads to a decrease of the mass transfer resistances in this phase. The large volume of the liquid in the middle zone causes an increase of the chemical reaction time and as a result, a further decrease of the mass transfer resistances in the liquid phases is realized. The third zone is the column tank, where the chemical reaction takes place only.

24. Christo Boyadjiev, Maria Doichinova, Petya Popova-Krumova, Boyan Boyadjiev. On the gas purification from low SO_2 concentration. Recent Innovations in Chemical Engineering, 7, 1, Bentham Science, 2015, ISSN:2405-5204, DOI:10.2174/2211334707666141218204238, 39-46. SJR (Scopus):0.102 Q4 (Scopus) Линк

Abstract: The solid fuel combustion in the thermal plants, which use sulfur-rich fuels, poses the problem of SO_2 removal from waste gases. This problem is complicated by the fact, that it is required to purify huge amounts of gas with low SO_2 concentration. The huge gas amounts

need big size apparatuses, which is possible to be decreased if the absorption rate is maximal. The theoretical analysis of the methods and for purification of waste gases from SO_2, using two-phase absorbent ($CaCO_3$ suspension) shows, that the process is practically a physical absorption and the mass transfer resistances in the gas and liquid phases are 44 % and 56 %, respectively. In these conditions a new patent is proposed, where the process of optimization is realized in three zone columns, where the upper zone is a physical absorption in gas-liquid drops system, the middle zone is a physical absorption in liquid-gas bubbles system and the chemical reaction takes place at the bottom of the column. The convection-diffusion type of models permits to create the average concentration models and give quantitative description of the absorption processes.