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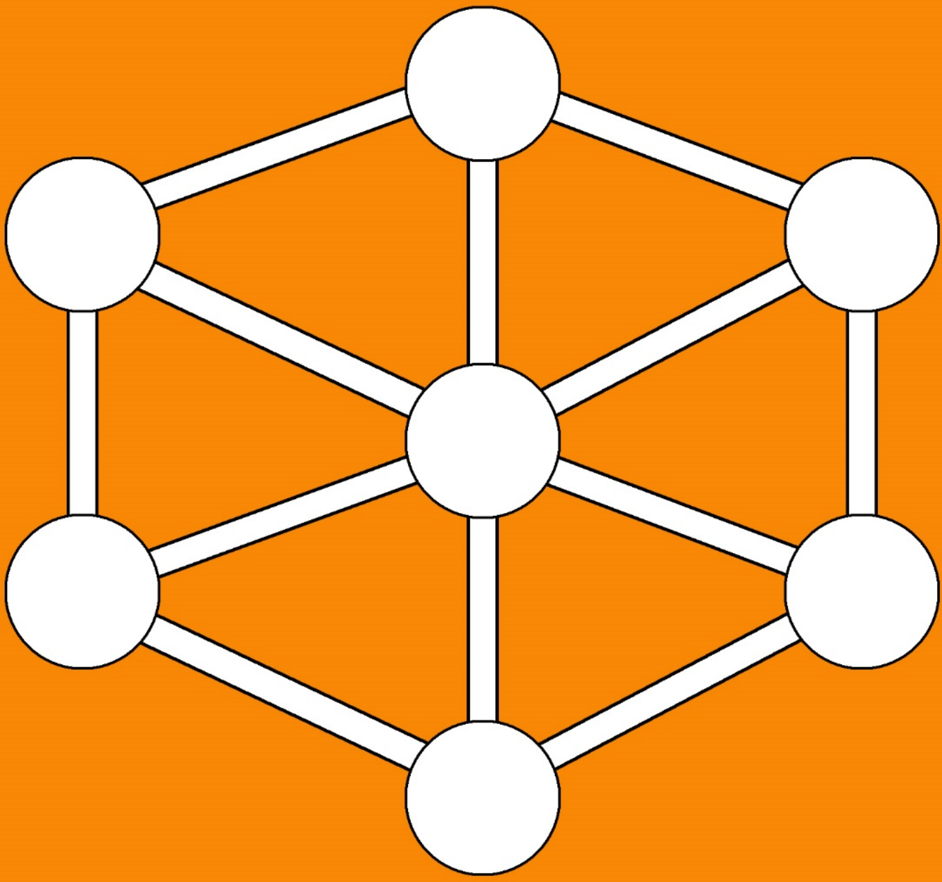
Eastern European Scientific Journal

Ausgabe 2-2017



ISSN: 2199-7977

KOMMUNIKATIONS- UND VERLAGSGESELLSCHAFT MBH

Eastern European Scientific Journal

(ISSN 2199-7977)

Journal

KOMMUNIKATIONS- UND VERLAGSGESELLSCHAFT MBH

www.auris-verlag.de

DOI 10.12851/EESJ201702

IMPRESSUM:

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Düsseldorf - Germany

Internet:
http://www.auris-verlag.de

E-Mail:
M.Moneth@auris-verlag.de

Verlagsredaktion:
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Layout:
Moneth M.

Umschlaggestaltung:
Moneth M.

Coverbild:
AURIS Kommunikations- und Verlagsgesellschaft mbH

DOI 10.12851/EESJ201702

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IR spectral analyzes are studied. IR analysis using a spectrophotometer, the 1000,48-1105,81 cm^{-1} light absorption shows ferrotsenil group. OH groups are in 1407.48 cm^{-1} light absorption and -NH- groups in 3094.01 cm^{-1} are evidence of it. Fluid temperature is equal to 105 ^{o}C.

References:

1. *Pauson PL. Ferrocene-how it all began": J. Organomet. Chem, 2001; 637–639.*
2. *Lide DR. ed. Handbook of Chemistry and Physics (86th ed.). Boca Raton (FL), CRC Press.2005; 3.258.*
3. *Kealy TJ, Pauson PL. A New Type of Organo-Iron Compound: Nature, 1951; 168 (4285): 1039.*
4. *Asqarov IR. Derivatives of ferrocene. Fergana, 1999.*
5. *Nesmeyanov AN. Chemistry of ferrocene. Moscow, 1969.*
6. *Khozhimatov MM, Asqarov IR. Ferrocene stimulants: Scientific notice. Andijan State University 2015, №3; 27-29.*

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Numerical Study of the Effect of Coal Particle Size on the Process of Coal-Dust Flame Burning

Key words: *combustion, combustion chamber, numerical modeling.*

Annotation: *In the wide range of modern scientific and technical problems the modeling of heat and mass transfer processes takes on special significance and has large practical application. At the present time numerical and computational experiments are the main instruments of theoretical investigation of nonlinear processes of heat and mass transfer and medium movement with account*

of various physical phenomena such as radiant heat transfer, combustion and so on. At the same time mathematical modeling includes not only the development of numerical methods and performance of numerical calculations but also thorough analysis of the involved model and its correspondence to a real process. Combustion is a complex physical and chemical process and it should be analyzed according to influence of many physical and chemical parameters of combustion.

The investigation of influence of diameters of particles of monodisperse coal dust on the process of convective heat and mass transfer in the reactive powder-gas flows in the fields of real geometry has been performed in this work. Computational experiments have been carried out for different coal particles sizes on the base of program FLOREAN for modeling of flows, heat transport, combustion and formation of pollutants. *(1,2)*. This program complex has been adapted for power objects of Kazakhstan and allows carrying out a wide range of computational experiments. Numerical experiment has consisted of several stages: the description of physical model of the phenomena; mathematical model for the described process; the development of the numerical method and algorithm; program testing; the solution of physical task, analysis and results processing; the comparison of obtained results with data of physical experiment *(3)*.

As initial equations for simulation of turbulent transport in turbulent powder-gas flow with chemical reactions the Navier-Stocks equations have been used and these equations are expanded by corresponding equations of chemical kinetics, conservation equations of mixture species taking into account the influence of variable properties of medium and the sizes of coal particles.

Generalized transport equation in the form of tensor for transport variable ϕ:

$$\frac{\partial(\rho\phi)}{\partial t} = -\frac{\partial\left(\rho u_j \phi\right)}{\partial x_j} + \frac{\partial}{\partial x_j}\left[\Gamma_\phi \frac{\partial \phi}{\partial x_j}\right] + S_\phi \quad , \qquad (1)$$

Taking into account generilized equation (1) change of transport variable ϕ results in following equations:

Law of mass conservation:

$$\frac{\partial \rho}{\partial t} = -\frac{\partial\left(\rho u_j\right)}{\partial x_j} \qquad (2)$$

Here: $\phi = 1 \quad \Gamma_\phi = 0 \qquad S_\phi = 0$

Law of momentum conservation:

$$\frac{\partial(\rho u_i)}{\partial t} = -\frac{\partial\left(\rho u_i u_j\right)}{\partial x_j} + \frac{\partial \tau_{ij}}{\partial x_j} - \frac{\partial p}{\partial x_i} + \rho g_i \quad , \qquad (3)$$

where $\phi = u_i \qquad \Gamma_\phi = \mu \qquad S_\phi = -\frac{\partial p}{\partial x_i} + \rho \cdot g_i + \frac{\partial}{\partial x_j}\left(\mu \cdot \left(\frac{\partial u_j}{\partial x_i} - \frac{2}{3}\cdot\delta_{ij}\frac{\partial u_l}{\partial x_l}\right)\right)$.

Law of energy conservation:

$$\frac{\partial(\rho h)}{\partial t} = -\frac{\partial(\rho u_i h)}{\partial x_i} + \frac{\partial}{\partial x_i}\left(\frac{\mu}{Pr}\cdot\frac{\partial h}{\partial x_i}\right) + S_h \quad , \qquad (4)$$

where $\varphi = h \qquad \Gamma_\phi = \frac{\mu}{\mathrm{Pr}} \qquad S_\phi = S_h$. (5)

Considering heat exchange processes in the technical reactive flows in the furnace chambers it can be seen that the radiation heat transfer contributes greatly in the total heat transfer. In the flame region the contribution of radiant heat transfer reaches 90%. The six-flow model of De Marco and Lockwood *(4)* in Cartesian coordinates is used to describe the radiant heat exchange in this work. In this model the distribution of radiant energy flow in corresponding regions is approximated by power series and spherical functions. The distribution of intensity in different directions is approximated by Taylor power series by solid angle.

Source term due to radiant heat transfer in the equation of energy balance (4) is obtained by integration of total intensity along solid angle Ω =4π. Thus we have following:

$$S_{h,Str} = \frac{4\pi}{3}\cdot K_{abs}(B_1 + B_2 + B_3) - 4\cdot K_{abs}\cdot\sigma\cdot T^4 \qquad (6)$$

It is important to take into account the mechanisms of radiation of gas and solid particles at the definition of integral absorption factor K_{abs}. If there is a thermodynamical equilibrium between gas and solid particles the radiation of suspension is described by addition of radiation of dust and gas. Thus the part for gas and solid particles is described by the sum [5]:

$$K_{abs} = K_{abs,G} + \sum K_{abs,P,k} \tag{7}$$

If the substances in the solid phase are in the reactive flows it is important to take into account the fact that the influence of solid particles on the radiant heat transfer can be several times greater than the influence of components in gaseous phase (water vapor and carbon dioxide).

We have for solid particles:

$$K_{abs,P,k} = X_{abs} \cdot \tilde{n}_{P,k} \cdot d^2_{P,k} \cdot \frac{\pi}{4} \tag{8}$$

Here $\tilde{n}_{P,k}$ is a number of particles in the elementary volume. Coefficient X_{abs} is determined experimentally and for dust coal flame it has the following value X_{abs} = 0,85 *(5)*.

Law of conservation for individual component of reaction:

$$\frac{\partial\left(\rho c^*_\beta\right)}{\partial t} = -\frac{\partial\left(\rho c^*_\beta u_i\right)}{\partial x_i} + \frac{\partial}{\partial x_i}\left(\rho \cdot D_{c^*_\beta} \cdot \frac{\partial c^*_\beta}{\partial x_i}\right) + S_\beta, \tag{9}$$

where $\phi = c^*_\beta \qquad \Gamma_\phi = \rho \cdot D_{c*_\beta} \qquad S_\phi = S_\beta$.

The computer simulation experiments were conducted for low-rank Ekibastuz bituminous coal incinerated at the boiler with steam productivity 475 ton per hour. The boiler is installed on Ermakovskaja Thermal Power Plant in Kazakhstan. The furnace size is as follows: 30 m height, 10 m in width and 7 m depth. Twelve swirl burners are mounted on the furnace of the boiler. They are placed in two layers by six ones in every layer opposite to each other. In accordance with our presumption six of the burners are equipped with plasmatrons. They are placed in the lower layer. The furnace grid of 25x47x58 size, this comprises 68150 control volumes, was used for numerical simulation.

The coal moisture content is 7%; volatile matter is 24%; lower calorific value is 16750 kJ/kg

The numerical results for combustion of the pulverised coal in the furnace are presented in the following figures in the form of the fields of main characteristics of turbulent combustion of dust coal torch (T, CO, CO_2 etc.).

Figure 1 shows the comparison of temperature fields for the combustion of dust coal torch for different diameters of particles of pulverized coal. The analysis of this distribution shows that in case of combustion of smaller particles (d_p = 60 microns) the hottest temperature is observed in the region of burners. However as we move away from the region of intensive combustion the temperatures become equalized.

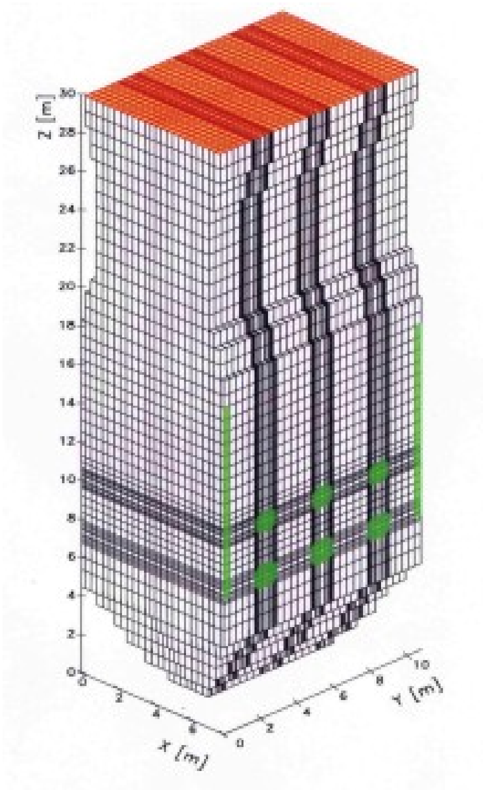


Figure 1 - Scheme of the furnace chamber PK-39

At the outlet of the furnace chamber for particles of greater diameter (d_p = 90 microns) the temperature slightly increases and this fact agrees with experimental data. The investigations done by authors *(6)* show that at the increase of average diameter of particles the temperature of the gases increases due to displacement of the body of flame at the outlet of the chamber. The analysis of experimental data represented in *(6)* shows that at the increase of particles diameters the location of body of flame is displaced, the extension of maximum temperature zone is increased. At the same time the increase of temperature of torch is slower at the combustion of larger particles. For example, the difference between temperatures of torch of fine and coarse dust is 300°C in section x/D_a = 0,8. Delaying of ignition, displacement and extension of flame body at the increase of diameter of particles lead to increase of temperature at the end of the torch and the difference between temperatures of gases at the outlet of model chamber is 50-80°C. This agrees with the results of the performed numerical modeling.

During the combustion of dust coal torch of particles with d=60 microns the body of flame shifts to the center of the furnace space in that section of the chamber and the region of high temperatures (T = 1395÷1800 ^{0}C) contracts to the center of symmetry of the furnace chamber. The mean temperature in this case increases up to T = 1258,7 ^{0} C meanwhile the average temperature is T = 1191,5 ^{0}C in the same section for the coal dust with diameter of solid particles d = 90 microns. Therefore, the combustion of smaller particles is more intensive and the heat generation is locally greater.

Figure 2 shows distribution of temperature in section of burners instalations for the upper level (z = 10.12 m). In the case of coal-dust torch burning with more thin grinding of coal particles (d=60 mkm) we see that the nucleus of a torch is displaced to the center of furnace space in this section of the chamber, and area of high temperatures (T = 1395÷1800^{0}C) is narrowed to the center of symmetry of chambers. The average temperature in this case increases up to T = 1258.7 ^{0}C. While the average temperature for coal combustion with diameter of solid particles (d = 90 mkm) is equal to T = 1191.5 ^{0}C. It shows that burning of fine particles occurs intensively and with more local heat evolution. In experimental research of burning of a separate coal particle it has been shown, that at increase of particle diameter reduction of its temperature is observed.

Figure 2 shows the distribution of concentrations of carbon monoxide CO (kg/kg) along the chamber for two studied dust coal flows. It can be seen that the maximum of concentration of carbon monoxide (CO) is observed in the center of the furnace chamber that is in the region of main gas formation. As we moving to the outlet of the chamber carbon oxide CO reacts with oxygen, the mixture burns down to carbon dioxide CO_2 and this process is less intensive for the particles of larger diameter. In both cases the concentration of CO at the outlet of the furnace space substantially reduces.

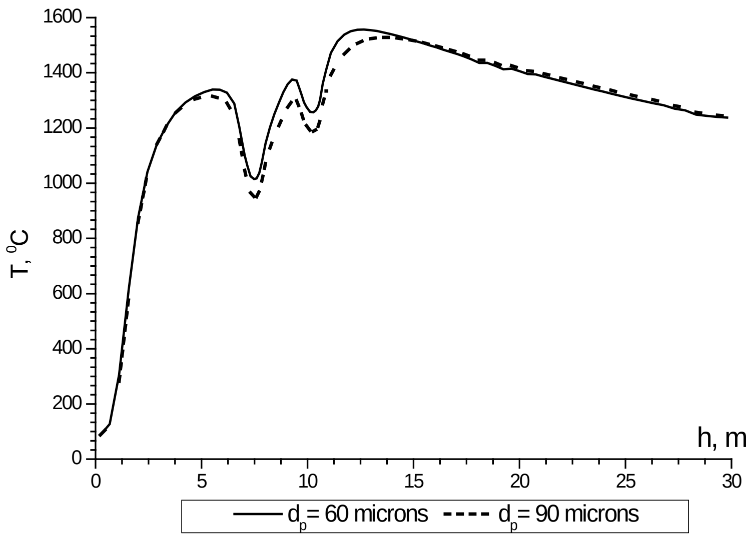
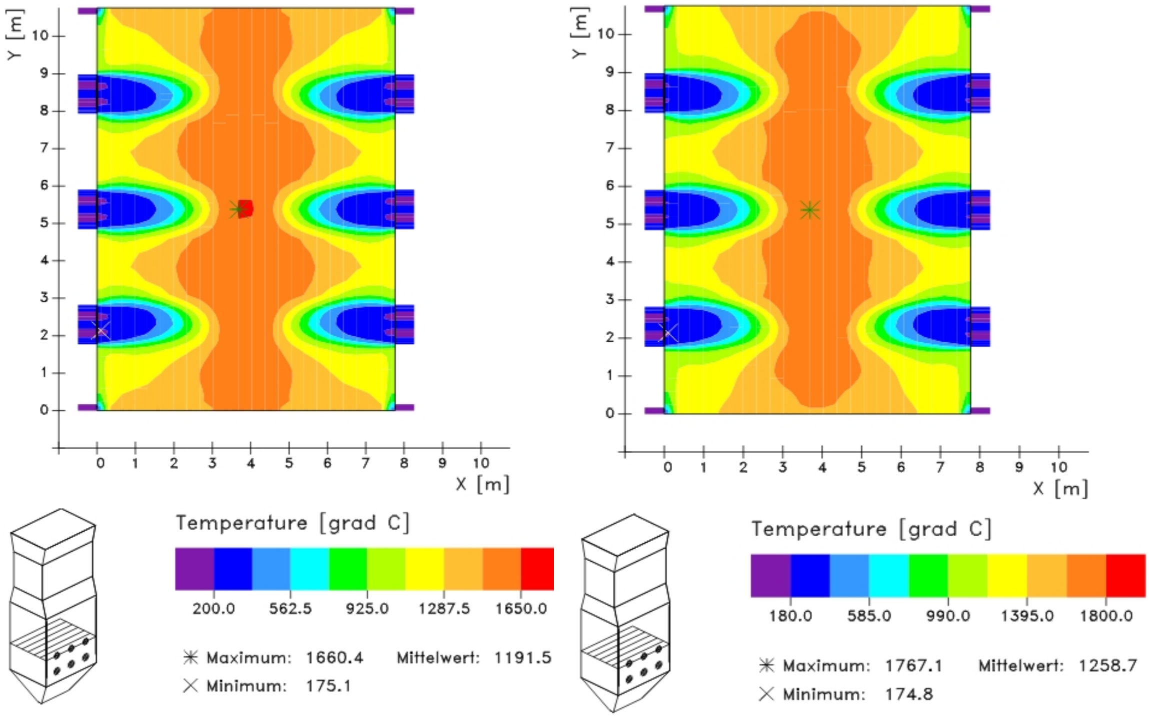


Figure 2 - Temperature distribution along the height of the furnace chamber for d_p = 60 microns and d_p = 90 microns



d_p =90 мкм d_p =60 мкм

Figure 3 - Temperature distribution in the burners crossection of the furnace chamber z = 10.12 m for d_p = 60 microns and d_p = 90 microns

As the diameter of coal particles decreases, the intensity of formation of CO increases in the center of the chamber. However at the approaching to the outlet the concentration of CO reduces in comparison with combustion of larger particles. This fact shows the positive influence of powdering the coal dust because the reduction of carbon monoxide at the outlet of the furnace chamber is one of ecological problems facing the present power engineering.

The distribution of concentration of carbon dioxide CO_2 (Figure 3) along the height of the furnace chamber essentially differs from the distribution of carbon monoxide CO. The comparison of the results of numerical experiment for two cases shows that the main formation of CO_2 at the combustion of coal-dust flows with particle diameters 60 and 90 microns is observed in the field of burners that is in the field of maximum amount of fuel and oxidant.

Concentration of CO_2 reduces in the field of burners' location and then it continue growing. The difference between concentrations of CO_2 at the outlet of the furnace chamber during the combustion of particles with various diameters is practically imperceptible. Nevertheless the concentration of CO_2 is greater for combustion of coal dust with smaller particles. In this case the most part of CO burns down to CO_2 .

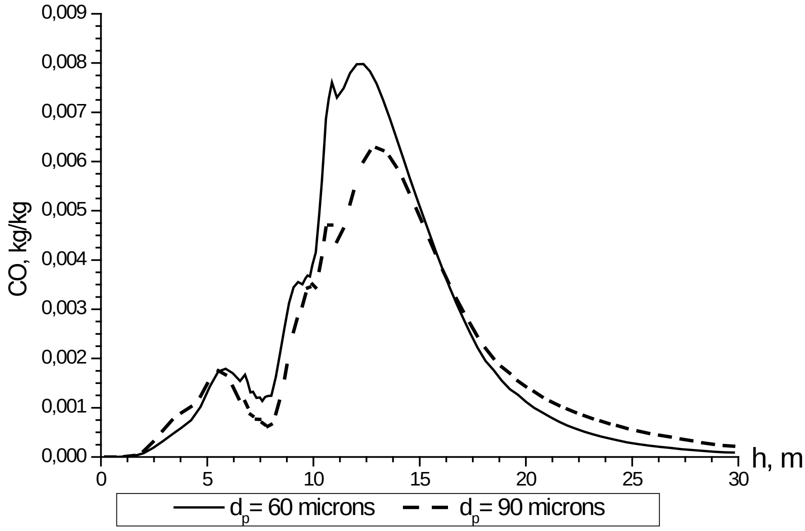


Figure 4 - Comparative analysis of distributions of carbon monoxide (CO) concentration along the height of the furnace chamber for d_p = 60 microns and

d_p = 90 microns

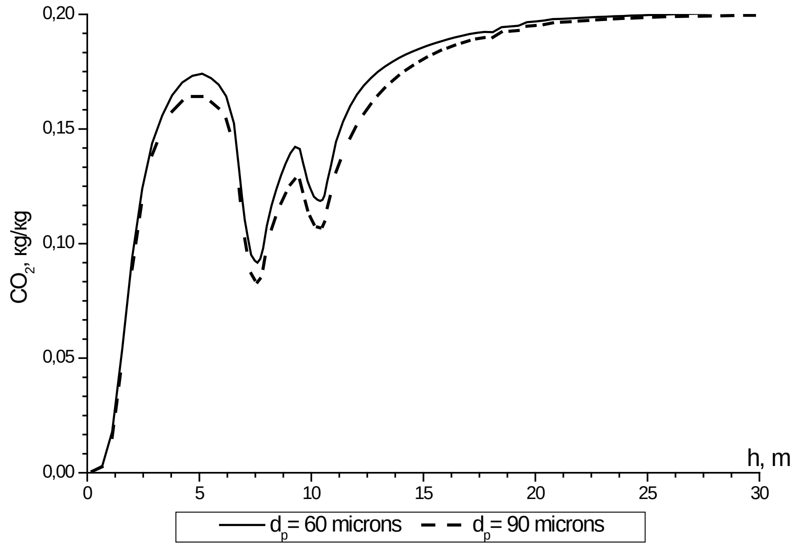


Figure 5 - Comparative analysis of distributions of concentrations of carbon dioxide CO_2 aling the height of the furnace chamber for d_p = 60 microns and d_p = 90 microns

According to the results of modeling a conclusion may be made that favorable conditions are created in the chamber with the opposite position of vortical burners when the torch is strongly twisted, provided a stable torch ignition and intensive combustion of coal dust. Agreement with the experimental data shows the reliability of the chosen model.

Obtained results allow evaluating the influence of coal particles size on the ignition, combustion rate of the coal-dust torch and formation of harmful powder-gas emissions in the atmosphere. Obtained data allow giving recommendations about development of new methods with maximum effectiveness in organization of furnace coal combustion in order to increase efficiency of power objects and to decrease pollutant emissions in the environment.

References:

1. *Leithner R, Askarova A, Bolegenova S, et al. Computational modeling of heat and mass transfer processes in combustion chamber at power plant of Kazakhstan: MATEC Web of Conferences, 2016; 5.*
2. *Askarova A, Bolegenova S, Maximov V, et al. 3D modelling of heat and mass transfer processes during the combustion of liquid fuel: Bulgarian Chemical Communications, 2016, Vol. 48, Special Issue E; 229-235.*
3. *Bolegenova S, Bolegenova Sy, Maximov V, et al. Application of 3D modelling for solving the problem of combustion coal-dust flame: Bulgarian Chemical Communications, 2016, Vol. 48, Special Issue E; 236-241.*
4. *Heierle E, Bolegenova S, Maximov V, et al. CFD study of harmful substances production in coal-fired power plant of Kazakhstan: Bulgarian Chemical Communications, 2016, Vol. 48, Special Issue E; 260-265.*
5. *Maximov V, Beketayeva M, Shortanbayeva Zh. On the effect of the temperature boundary conditions on the walls for the processes of heat and mass transfer: International Journal of Mechanics, 2016, Vol.10; 349-355.*
6. *Askarova AS, Bolegenova SA, Bolegenova S, Maximov VYu, et al. Mathematical modeling of heat and mass transfer in the presence of physical-chemical processes: Bulgarian Chemical Communications, 2016, Vol. 48, Special Issue E; 272-277.*