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Control of Harmful Emissions Concentration into the Atmosphere of Megacities of Kazakhstan Republic

Aliya Askarova¹, Saltanat Bolegenova¹, Valeryi Maximov², Aidyn Bekmukhamet³,
Zarina Gabitova³, Meruyert Beketayeva^{3,*}

1Dr. of phys.-math. Sc., Professor of al-Farabi Kazakh national university, Almaty, Kazakhstan

2PhD, Lecturer of al-Farabi Kazakh national university, Almaty, Kazakhstan

3, corresponding author, PhD Student of al-Farabi Kazakh national university, Almaty, Kazakhstan*

Abstract

Solid fuel plays significant role in the development of civilization as the main fuel source. Use of low-grade (ash content ~ 40-45%) coal is partially offset environmental problems also affect human health when it is burned. As the main industrial corporations use coal, in particular low-grade high-ash content coal from Ekibastuz coal basin because of its cheap cost the atmosphere of megacities like Almaty is polluted by noxious volatile. In this study were developed a mathematical model of turbulent heat and mass transfer process occurring in the combustion chamber of SB-39 of Aksusskaya TPP for control the concentration of volatile and to recommend the optimize methods for burning process. Based on 3D computer modeling investigated formation of harmful dust and gas emissions during the combustion of low-grade coal and offered cost-effective methods of burning.

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1. Main text

Currently in Kazakhstan, about 85% of electricity is generated by thermal power plants (TPP), which is the main fuel is coal. More than 80% of coal burned in these TPP is low grade ash content of about 50%. Burning

of low-grade coal fraught with difficulties in their fire, growth of mechanical unburning, increase of harmful dust and gas emissions (ash, carbon oxides, vanadium pentoxide, nitrogen and sulfur oxides, hydrocarbons). Emissions from industrial plants of Kazakhstan in the atmosphere are more than three million tons per year, of which 85% are 43 large enterprises. In the emissions from various sources of Unified Energy System dominated solids - 35%, sulfur dioxide - 31%, carbon monoxide, 19%, nitrogen oxides - 14% [1, Shabanova L.V., 2013].

Nomenclature

SB-39 Steam Boiler

TPP Thermal Power Plant

SNCR Selective Non-Catalytic Reduction

MPC Maximum Permissible Concentration

Basic transport variable;

Γ_ϕ Generalized exchange ratio;

S_ϕ The source term in the transport equations;

ρ Density, kg/m^3 ;

h Enthalpy, J/kg ;

$\sigma_k, \sigma_\epsilon$ Empirical constants in the turbulence model;

T Temperature, K ;

μ_{turb} Turbulent viscosity, $kg/m \cdot s$;

μ_{eff} Effective viscosity, $kg/m \cdot s$;

p Pressure, Pa ;

ϵ Dissipation rate of turbulent kinetic energy per unit mass, m^2/s^3 ;

k Turbulence kinetic energy per unit mass, m^2/s^3 ;

C_β Mass concentration, kg/kg ;

1. Study of pollutants of megacities

Condition of the air basin is the most important indicator of the ecological situation in the city. Air pollution in Almaty is an environmental problem that is complicated by climatic conditions. The city is located in the cavity, where often there is no wind, fog and ground inversions that inhibit dispersion of pollutants in space. In addition, an ill-conceived development of the city prevents the natural movement of air flow in the horizontal direction [2, Nurkeev S.S., etc., 2005]. According to long-term observations KAZHYDROMET, the main pollutants include dust (particulate matter), sulfur dioxide, carbon monoxide, nitrogen oxide and dioxide, phenol, formaldehyde.

High levels of air pollution recorded in 8 cities: Almaty, Uskemen, Kyzylorda, Chimkent, Karaganda, Temirtau, Taraz (Table 1) [3, Environmental situation on the territory of Kazakhstan in March, 2014].

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