



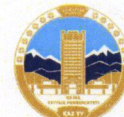
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Second International Scientific Conference

ALTERNATIVE ENERGY SOURCES, MATERIALS AND TECHNOLOGIES

AESMT '19

Proceedings of short papers
Volume 1



Sofia, Bulgaria, 3 - 4 June 2019



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Influence of beam processing of accelerated electrons on the composition of coal

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In this article, we studied the effect of accelerated electrons generated by an electron accelerator on the composition and indicators of the structure of coal. It has been shown that the effects of ionizing effects are largely determined by the exposure conditions. Coals show resistance to the action of the electron beam, their composition, ability to swell and the yield of soluble substances change little when irradiated with doses up to 200 Mrad. This may be due to the fact that the composition of these coals contains derivatives of polycondensed aromatic compounds, which have a high electron affinity and trapping slow electrons, lead to the attenuation of radical reactions in the organic mass.

Keywords: thermal power plants, high ash coal, maximum one-time emissions, electron-beam processing

INTRODUCTION

The level of development of any country can be seen as three major interrelated factors: social, economic and environmental. It should be noted that the state should pay equal attention to, and provide equal support to these areas without a priority one at the expense of others. This balance will help to ensure a balanced development of any country. Decisions and actions aimed at protecting the environment should be based on a scientific basis and be based on objective indicators.

In this article, using the software package "Era-Air", designed to solve a wide range in the field of air protection tasks designed integrated indicators of average annual air pollution, the maximum one-time emission of ash, sulfur oxides, carbon, and nitrogen from the combustion coal to thermal power plant [1-5].

We have proposed a new way to reduce greenhouse gas emissions. The development of electronic technology has allowed obtaining powerful electron beams, the energy of which is sufficient for production processes in various fields of national economy. This was the basis for the creation of an entire technology industry, dubbed "e-beam technology" that can be successfully applied to improve the ecological state of natural ecosystems [6-7].

MATERIALS AND METHODS

To modify the quality of the coal, experiments on the radiation treatment of coal were carried out,

carried out on the electronic accelerator ILU-6. The general view of accelerator ILU-6 is shown in the Figure 1. The main characteristics of the burned Karaganda coal and coal that has passed the electron-beam processing are shown in Table 1.

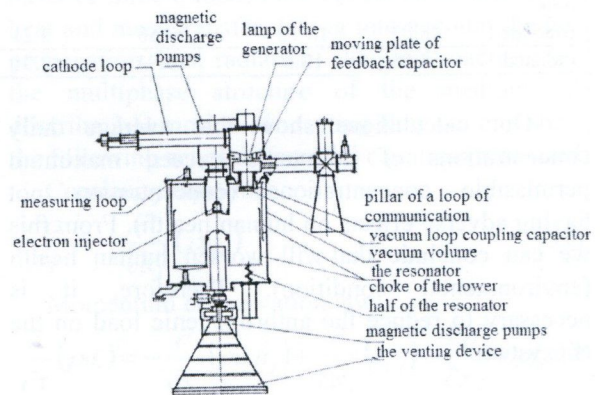


Fig.1. The general view of the ILU-6 accelerator

The accelerator generated electrons with energy of 1.3 MeV, the dose rate varied from 0.19 to 0.33 Mrad/s, the total absorbed dose varied from 10 to 200 Mrad. The temperature of the coal layer thickness 7 mm was controlled using thermocouples and supported between 60-70 and 250-260°C. Gaseous products released during radiolysis were collected in a gasometer and analyzed on a chromatograph.

RESULTS AND DISCUSSION

The main characteristics of the burned coal and coal that has passed the electron-beam processing are shown in Table 1. The results of the calculation maximum one-time emissions of pollutants are given in the Table 2. When burning fossil fuels in an atmosphere are thrown out carbon oxides, nitrogen oxides and sulfur dioxide.

Table 1. Fuel characteristics

Coal composition, %	Fuel	
	non-irradiated	radiated
W	10.6	8.43
S	1.04	0.7
A	35	43
C	43.21	0.79
H	3.6	2.64
N	1.21	0.79
O	5.24	6.07
Q	18.56	16.83

Table 2. Calculated maximum one-time emissions

Fuel	Maximum one-time emissions, g/s			
	Ashes, M_s	Sulfur dioxide, SO_2	Carbon monoxide, M_{CO}	Nitric oxide, NO
non-irradiated	48.03	18.72	17.58	3.21
radiated	54.08	12.6	15.94	2.91

Our calculations show that average daily concentrations of pollutants exceed maximum permissible concentrations (concentration not having adverse effects on human health). From this we can conclude that will worsen human health (environmental condition). Therefore, it is necessary to reduce the anthropogenic load on the ecosystem.

CONCLUSIONS

The following conclusions can be made from the research:

– Preliminary electron beam processing of coal leads to decrease in emissions in an atmosphere, decrease in emissions in an atmosphere, and reduces maximum-one-time emissions (see Tables 1, 2) at least from 0.6% up to 9% for different greenhouse gases.

– Electron beam processing is an environmentally friendly non-reagent way to control the quality of the burned fuel. To obtain a significant technological effect, treatment with doses up to 50 Mrad is necessary. The given doses

can be recruited for 4-5 seconds. The environmental purity of electron-beam processing is due to the fact that the irradiated coal does not have induced radioactivity, because the energy of accelerated electrons are ten times less energy electrons provoking the occurrence of nuclear chemical transformation in the irradiated material. When exposed to electrons of this energy, there are processes associated with the excitation of valence electrons, and unusual valence states can occur, chemically active particles, ions, and other.

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The training set of 1000 samples of different parameters configurations is obtained by using the following method:

1. The training data have been collected in a one-year period from January 2013 to November 2014 on the thermal.

2. The RMSE (Root Mean Square Error), the MAE (Mean Absolute Error) and Mean Squared Error are used as the measuring experiments.

CONCLUSION AND DISCUSSION

The performance of LSTM network with different parameters using two models (Model 1 and Model 2) is obvious that the performance of Model 2 is better than Model 1. This shows that the different parameters can improve accuracy in work experiment. It also can be seen that the prediction accuracy will not be greatly improved when the value range parameter reaches 6 hours. In this network, the network architecture includes 1 input layer, 2 LSTM layer (30, 20 neurons respectively), 2 hidden layer (25, 15 neurons respectively) and 1 output layer have been designed for Model 2.

Fig. 1 shows the result of one hour ahead prediction for test data using Model 1 with different parameters. It can be seen that the difference between actual and predicted values were not too large, and the prediction line follows the actual line in the experiment. The predicted values of the next 6 hours have good agreement with the actual values. The root mean square error (RMSE) is 0.0012, the Mean Squared Error (MSE) is 0.00000144.

Table 1. Testing results of 1-h ahead prediction with parameters for 1-h hour forecast using two models (Model 1 and Model 2) during the experiment.

Model	RMSE	MAE	MSE
Model 1	0.0012	0.0001	0.00000144
Model 2	0.0008	0.0001	0.00000064



Fig. 1. The result of one-hour-ahead prediction for test data using Model 1 with different parameters. It can be seen that the difference between actual and predicted values were not too large, and the prediction line follows the actual line in the experiment. The predicted values of the next 6 hours have good agreement with the actual values.

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