EVALUATION OF THE EFFICIENCY OF SLUDGE LIGNIN PLASMA DISPOSAL PROCESS

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This article shows the review and analysis of literature on methods of sludge lignin utilization. It is the product obtained after processing of cellulose. As a result of the calculations the optimal compositions of water, organic materials with mechanical impurities with adiabatic combustion temperature of about 1200 K were determined. With the help of obtained results experimental studies were carried out in a plasma catalytic reactor and the reactor operation was optimized. The results can be used to build industrial plants on the basis of plasma catalytic reactors for utilization of sludge lignin.

INTRODUCTION

Lignin aa a component of wood is the hardest waste, which is formed in chemical processing of wood at paper plants and hydrolysis plants [1].

On the other hand it is a potential raw material resource for many countries. According to the International Institute of lignin (International Lignin Institute) annually in the world would be about 70 million tons of technical lignin but not more than 2% of it is used for industrial, agricultural and other purposes. The rest is burned in power plants or disposed of in the cemeteries as sludge lignin [2]. There is currently no comprehensive technical solutions for waste sludge lignin, although a review of the scientific literature demonstrates the growing interest of researchers to this raw material resources.

EXPERIMENTAL

Efficient and environmentally safe disposal of such waste can be achieved by plasma utilization of combustible organic water-based compositions based on sludge lignin having adiabatic combustion temperature Tad ≈ 1200 ° C.

Figure 1 shows the effect of sulfite lignin content and solids (ash) on the adiabatic combustion temperature of different aqueous-organic compositions.

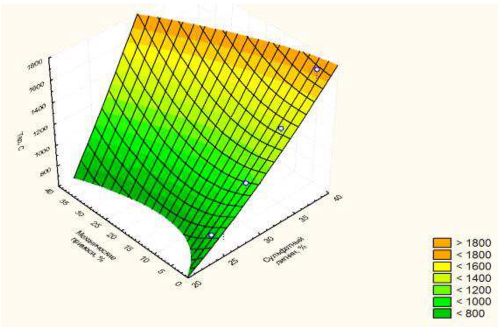

Figure 1. Effect of lignin and sulfite solids adiabatic combustion temperature on the water-organic compositions based on lignin slurry.

The calculations determine the optimum composition, aqueous-organic compositions based on sludge - lignin Thad ≈ 1200 ° C. with different initial solids content (ash).

As a result of these calculations the optimal water-organic composition having an adiabatic combustion temperature of 1200 ° C and Thad ≈ is determined providing environmentally safe disposal of sludge lignin: water organic composition (70% water: 30% sludge - lignin) .

To determine the optimal mode of the process under investigation equilibrium compositions of gaseous and condensed products of plasma utilization of optimal water-organic compositions based on lignin slurry were calculated. The licensed program TERRA was used for this purpose.

Calculations were carried out at a pressure of 0.1 MPa, a wide temperature range (300 ÷ 4000 K) and for different mass fractions of air plasma coolant (0,1 ÷ 0,95).

Figures 2 and 3 show the equilibrium compositions of gaseous and condensed products of optimum utilization of plasma composition water organic composition air plasma with a mass fraction of air plasma coolant 64%.

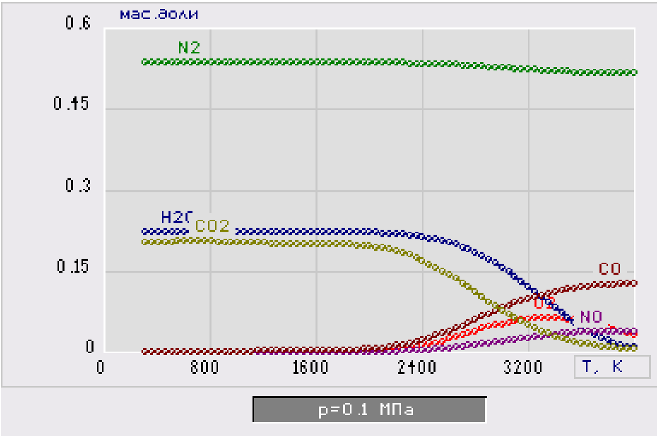

Figure 1. The equilibrium composition of gaseous products of the process of plasma utilization of water-organic compositions based on sludge lignin in air plasma (64 % of air, 36% of water organic composition).

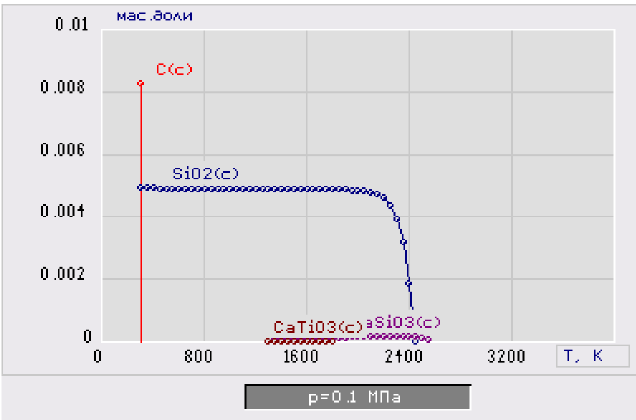

Figure 3. The equilibrium composition of condensed products of plasma recycling process of water-organic compositions based on sludge lignin in air plasma (64% air: 36% water organic composition).

The analysis of compounds in Figures 2 and 3 shows that when the mass concentration of the air plasma coolant is 64% and the operating temperature is 1200 ± 100 K, gaseous N_2, CO_2 and H_2O are formed. SiO_2 (c) is formed in the condensed phase. The presence of soot and CO indicate that the process of plasma utilization of the optimal water organic composition in air plasma with a mass fraction of air plasma coolant 64 % proceeds in a non-optimal mode.

Increasing the mass fraction of air of 64% (Fig. 3) to 66 % (Fig. 4) resuls in the disappearance of C (c), CO and NO, which indicates that the process of recycling sludge lignin in the form of water organic composition plasma with a mass fraction of air plasma coolant 66 % proceeds in the optimal mode.

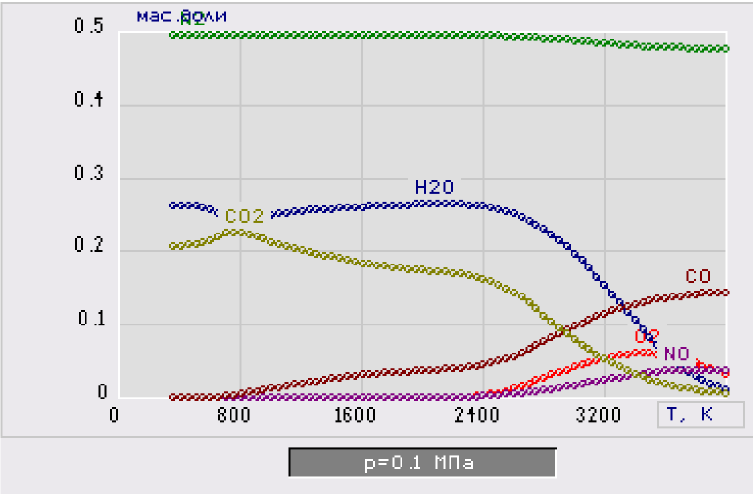

Figure. 4. The equilibrium composition of the gaseous products of the process of plasma disposal of water-organic composition based on sludge lignin in air plasma (66 % air: 34% water organic composition).

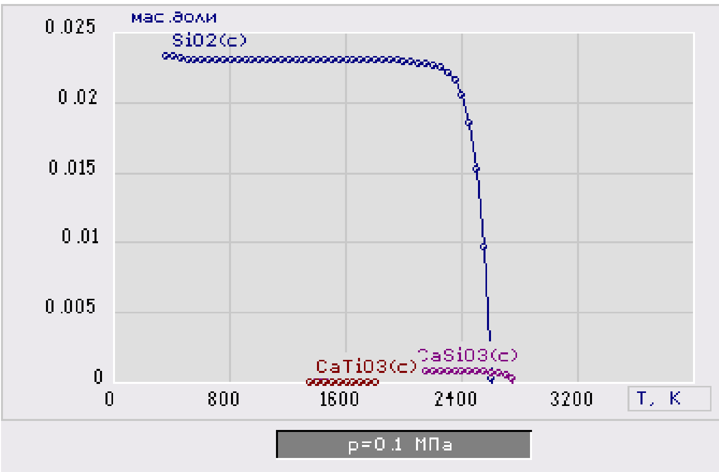

Figure 5. The equilibrium composition of condensed products of plasma recycling of water-organic compositions based on sludge lignin in air plasma (66% air: 34% water organic composition).

Figure 6 shows the effect of operating temperature and the content of lignin slurry on specific energy consumption for plasma recycling 1 kg SHL

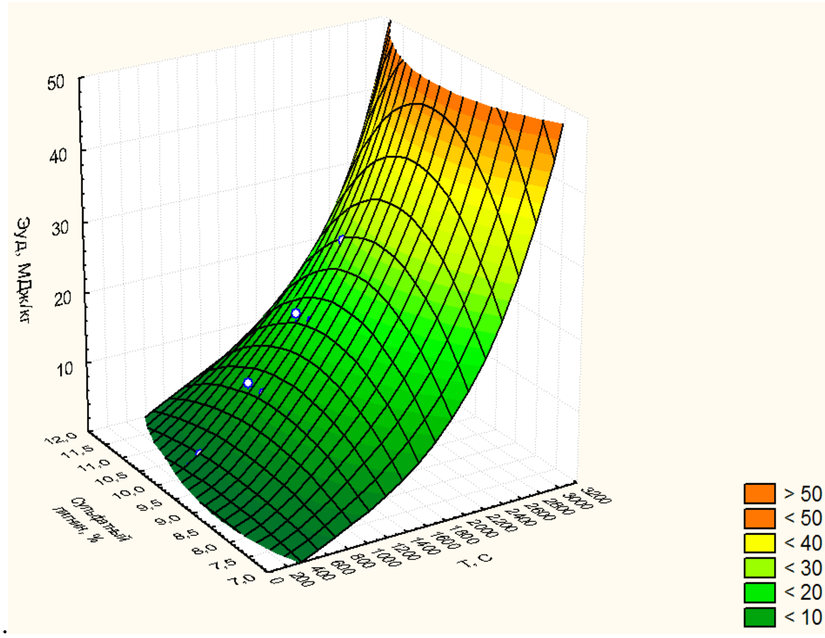

Figure 6. The influence of sludge – lignin content and process operating temperature on specific energy consumption for plasma recycling of 1 kilo of sludge lignin .

CONCLUSION

Taking into account the results obtained the following parameters can be recommended for practical implementation:

• The composition of the aqueous-organic composition must be as follows: 70% of water and 30% of sludge - lignin;

• The weight ratio of phases (66% of air : 34% of water organic composition);

• Operating temperature of the process should be 1200 ± 100 ° C.

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