Experimental setup for plasma treatment of disperse materials in the arc plasma jet

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Experimental setup for plasma treatment of disperse materials in the arc plasma jet

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Abstract. The experimental setup for the plasma treatment of particulate materials was created. Spend the processing of composite powder of chromium oxide with aluminium oxide.

1. Introduction

Thermophysical properties of plasma and the treated particulate material, the ratio of their mass spending, how is organized the process of mixing the dispersed phase with thermal plasma flow, that is the scheme of the reactor, as well as the structure and the parameters of the plasma stream formed by plasma installation, - all these parameters have a direct influence on the effectiveness of treatment of a dispersed material in a plasma device [1, 2]. From the chosen technological process, its nuances and principle, depend on the composition of the plasma gas and the nature of the processed material, the weight ratio, as well as the scheme of the reactor, in which the cellular process plasma will processing. In contrast, the parameters and structure of the plasma flow are more free and controlled parameters. Efficiency itself heterogeneous plasma processes, is ultimately determined by the heat exchange between the plasma and the dispersion particles of the processed material [3-5].

2. Experimental setup

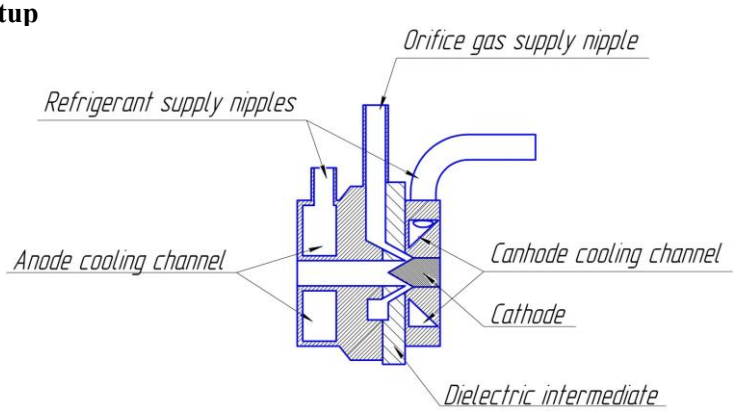

Figure 1. Schematic circuit of arc-plasmatron.

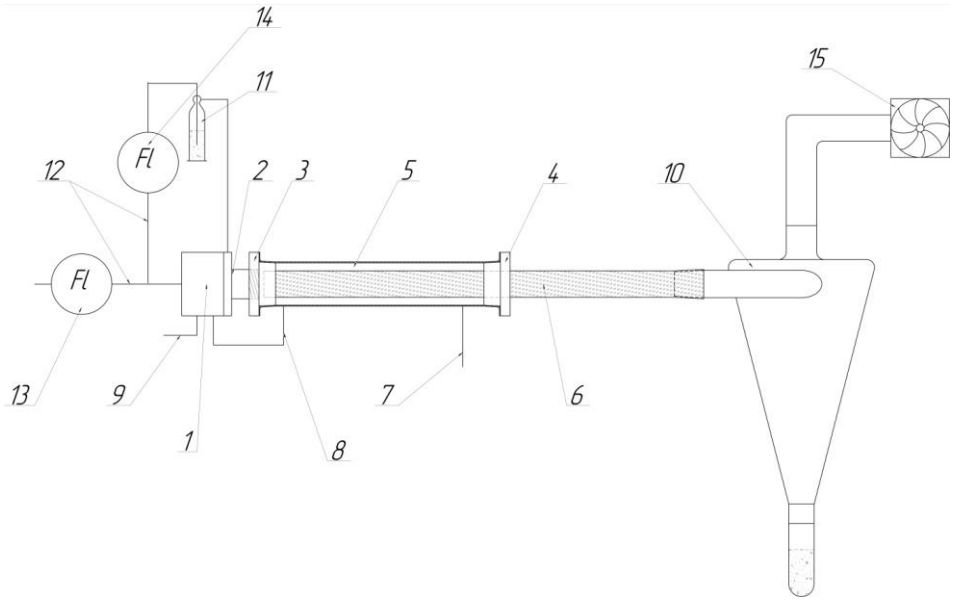

Figure 2. Schematic circuit of experimental setup.

Experimental setup consists of arc-plasmatron (1 and Fig.1) with self-setting arc, fastened with inch thread steel nozzle adapter (2), two flanges (3,4) for glass refrigerator (5) and a heat-resistant quartz tube (6), which is the flow of thermal dusty plasma. Through the fridge through the pipes (7, 8) circulates the water. The plasma torch has water cooled too (8, 9). The quartz tube is connected with a cyclone collector (10), intended for collecting the treated plasma powder (dust phase). As a plasma-forming gas is helium. The arc in the plasma torch is ignited by means of electric pulse oscillator. Power to the plasma torch is supplied by the Larionov's Scheme from the three-phase network (380 V). The pressure of plasma gas at the inlet to the plasmatron is 1.5 from the weather. The powder supply is carried out using the Drexel bottle (11), connected in parallel with the gas supply system to the plasma torch (12). For flow measurement gas is connected through the rotameters on the common entrance (13) and separately for gas passing through the Drexel bottle (14). The outlet gas from the cyclone dust collector is carried out using forced ventilation systems (15).

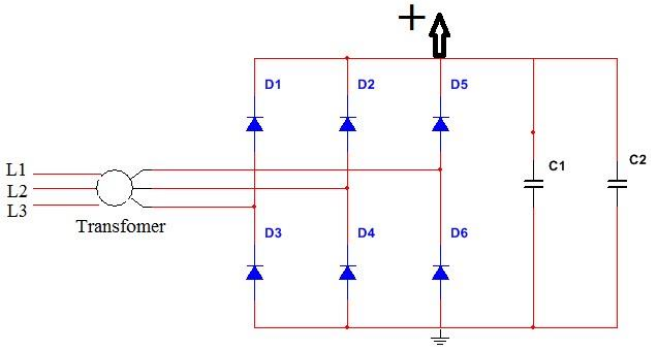

Figure 3. Schematic circuit of experimental setup's power supply.

3. Results

Catalytic tests of plasma treated samples showed that with the increase of plasma processing time in the dehydrogenation activity passes through a maximum (at 55 seconds A = 40.0%). Further increase plazmoobrabotki time leads to a decrease in catalytic activity due to sintering of the active component in the three-dimensional crystals of the less active α-Cr_2O_3.

time, sec	energy, W	Activity, %
45	1000	37,0
45	800	33,4
55	1000	40,0
65	1000	33,0
zero point (heat-treated sample)		43,1

4. Conclusions

Thus, the plasma treatment boehmite support coated with chromic anhydride at 45-55 seconds accompanied with the formation of a catalytically active phase CrO_3 Cr_2O_3, however, the plasma energy is not enough to boehmite alumina, resulting in a smaller surface and thus plasma treatment dehydrogenation activity of the catalysts. With increasing duration of plasma treatment there is no complete phase transition γ-AlOOH → γ-Al_2O_3, however, observed catalyst deactivation due to agglomeration of X-ray amorphous to crystalline Cr_2O_3 α-$Cr2O_3$.

Acknowledgments

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References

[1] Dautov G Yu, Sazonov M I 1971 *Journal of Applied Mechanics and Technical Physics.* **4** 86
[2] An'shakov A S, Dautov G Yu, Timoshevskii A N 1973 *Journal of Applied Mechanics and Technical Physics.* **5** 867
[3] Kornienko E E, Lapushkina E J, Kuzmin, V I, Vaschenko S P, Gulyaev I P, Kartaev E V, Sergachev D S, Kashapov N, Sharifullin S, Fayrushin I 2014 *Journal of Physics: Conf. Series* **567** 012010
[4] Fayrushin I , Dautov I, Shamsutdinov A 2014 *Journal of Physics: Conf. Series* **567** 012007
[5] Fayrushin I, Kashapov N, Dautov I 2014 *Journal of Physics: Conf. Series* **567** 012009