ABSORPTION OF WASTE NITROSE GASES USING A SUSPENSION OF BROWN COAL

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The most serious environmental problem of the chemical industry is the emission of waste gases containing toxic substances, including nitrogen oxides. The chemical industry makes a significant contribution to the progress of the development of our country. The most serious environmental problem of the industry is the emission of exhaust gases containing toxic substances, including nitrogen oxides. The maximum allowable average daily content of nitrogen oxides in terms of N_2O_5 in the atmospheric air of populated areas should not exceed 0.1 mg/m^3 while meeting the requirement for a one-time maximum content of nitrogen oxides of not more than 0.3 mg/m^3. It is known that in the production of nitric acid the main problem is the emission of nitrous gases and the development of methods to reduce their emission and utilization of these gases.

At present, there are various ways to neutralize the exhaust nitrous gases: purification of gases from nitrogen oxides in an equal-flow hollow tower; purification of gases from nitrogen oxides in combined type apparatuses; purification of gases from weakly oxidized nitrogen oxides, absorption of nitrogen oxide by solutions of ferrous sulphate; absorption of nitric oxide by ammonium sulfite solutions; oxidation and absorption of nitrogen oxides by aqueous solutions of oxidizers; purification of gases from nitrogen oxides with aqueous solutions of hydrogen peroxide; absorption of slightly oxidized nitrogen oxides by aqueous solutions of potassium permanganate; absorption of highly oxidized nitrogen oxides; studies of the absorption of nitrogen oxides by organic sorbents; adsorption of nitrogen oxides by solid sorbents; purification of gases from nitrogen oxides and other impurities with peat-alkaline sorbents to obtain peat-nitrogen fertilizers [1].

However, this problem has not yet found its exhaustive solution. A detailed study and analysis of the methods of absorption of nitrogen oxides by water is a chemisorption process leading to the formation of a multicomponent system containing the initial NO, N_2O_4, NO_2, N_2O_3 and the final products H_3O^+, NO_3^-, NO_2^- consists of the following stages: diffusion of nitrogen oxides (NO, NO_2) from the gas phase into the liquid through a two-layer film at the gas-liquid interface; the formation of nitric and nitrous acids as products of the interaction of nitrogen oxides with water; decomposition, or rather the disproportionation of nitrous acid and the return of the formed nitric oxide to the gas phase [2].

In this work, for the study, an aqueous suspension obtained on the basis of brown coal from the Angren deposit was used, which, after drying to an air-dry state and grinding in a ball mill to a particle size of 0.25 mm, has the following composition (wt.%): moisture 14.1; ash 13.7; organic 72.2; humic acids 4.1% by organic mass. Theoretically, when nitrous gases are absorbed by an aqueous suspension of brown coal, the following sequential and parallel reactions occur:

$$4HNO_3 + 2[C\ ] = 4HNO_2 + 2CO_2 \quad (1)$$

$$4HNO_2 + [C] = 4NO + 2H_2O + CO_2 \quad (2)$$

$$HNO_3 + 2NO + H_2O = 3HNO_2 \quad (3)$$

$$2HNO_2 = NO + NO_2 + H_2O \quad (4)$$

However, the purpose of this work is not only the absorption of nitrous gases, but also to increase the yield of humic acids. For the experiments, a laboratory setup was used, consisting of five reaction vessels, the first reactor for producing nitrogen oxides, and four main reactors - absorbers of nitrogen oxides. In the first reactor, a mixture of nitric oxide is formed by the interaction of copper with non-concentrated nitric acid (59%). The rest of the reactors absorb the incoming nitrogen oxide from the first reactor and chemically interact the products of absorption of nitrous gases with coal. For the experiment, 5.0 g of crushed brown coal was placed in four reactors (the volume of the absorber was 50 ml) and 15 ml of H_2O were poured. Nitrogen oxides obtained in the first reactor were passed through the resulting suspension using a water jet pump. After the end of the experiment, all solutions were collected together, brought to the mark of 100 ml, from which an aliquot was taken to determine nitrogen, as well as to determine the increase in the yield of humic acids in brown coal. In addition, the residue of nitric acid in the first reactor was determined. Chemical analyzes of the suspension obtained at various stages of the experiment established a change in the content of the initial components and products of their interaction. Preliminary results of the analysis and calculations showed that using a suspension of brown coal for the absorption of nitrogen oxides in four absorbers, it is possible to extinguish up to 92.74% of nitrogen oxides and increase the content of humic acids in brown coal to 54.81%.

1. Rogozhnikov D.A., Karelov S.V., Mamyachenkov S.V., Anisimova O.S. Methods for the disposal of waste nitrous gases // Modern problems of science and education. 2011. No. 6, - p. 29-34.
2. Atroshchenko V.I., Kargin S.I. Nitric acid technology. M.: Goshimizdat , 1969. p. 302-312.