

ANALYSIS OF THE POSSIBILITY OF USING CATALYSTS FOR OXIDATION OF NITROGEN (II) OXIDE TO OPTIMISE THE COMPOSITION OF NITROGEN GAS AT THE INLET TO THE ABSORPTION COLUMN FOR THE PRODUCTION OF NONCONCENTRATED NITRIC ACID

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The article shows that the search for optimal operating conditions of an absorption column in the production of nitric acid remains an urgent issue.

The process of absorption of nitrogen oxides by water in the production of nitric acid is known to be the most important stage in the technological process and is determined by the equilibrium of the interaction reaction of nitrogen (IV) oxide with water. It has been established that the absorption process is directly affected by the ratio of NO and NO₂, whereas the influence of N₂O₄ under industrial conditions at process temperatures is unlikely. Therefore, the search for optimal operating conditions of the absorption column in the production of nitric acid remains an urgent issue.

The study revealed that the presence of NO and H₂O in the nitrous gas significantly affects the concentration of the production nitric acid in the column bottom; the decrease in the concentration of nitric acid on the first two lower trays of the absorption column occurs due to the reaction moisture and due to the NO content due to the incomplete oxidation of the nitrous gas. It is shown that moisture may be present in the nitrous gas at the inlet to the absorption column due to insufficient removal of reaction moisture from the gas system in the condenser-refrigerator and due to incomplete oxidation of NO in the nitrous gas. Methods for improving the conditions for the separation of reaction water from the gas medium are proposed.

Comprehensive research of gas transformations in a system of units operating under a single elevated pressure of 0.716 MPa were conducted and the composition of the gas phase was analyzed for the presence of NO, NO₂, N₂O, O₂, H₂O on the equipment of shop industrial laboratories, aggregate gas analyzers and equipment of central laboratories of enterprises. It was established that the maximum efficiency in the oxidation of nitrogen (II) oxide into nitrogen (IV) oxide occurs in the waste heat boiler and oxidizer (more than 60% in each apparatus), and the NO/NO₂ ratio remains almost constant along the gas flow from the oxidizer to the absorption column.

The use of catalysts for the full oxidation of NO to NO₂ is proposed as a method for reducing the NO content at the inlet to the absorption column. The analysis of catalysts of the supported type, multicomponent oxide catalysts, perovskite-type catalysts and catalysts based on activated carbon was carried out. The features of their placement in technological equipment and operation in industrial conditions have been established. Calculations have been made and it has been established that in modern technological schemes, for the use of deposited catalysts in the areas between the volumetric apparatuses - the oxidizer and the condenser-refrigerator, it is necessary to install another apparatus where the catalyst will be placed, which is economically inexpedient. The classification of catalysts according to their operating temperature is given and recommendations are given for their placement in technological equipment.

Based on the conducted research the paper establishes that in order to oxidize NO more completely, it is necessary to use schemes with the installation of a nitrogen (II) oxide oxidizer reactor in the area where two flows of nitrous gas are combined. It was concluded that the most promising is the use of a complex, multicomponent catalyst of the Mn-Ce-O_x or Mn-Ce-Co composition, which operates stably at temperatures from 100 to 250 °C.

Keywords: nitric acid, nitrogen (II) oxide, oxidation, absorption of nitrogen (IV) oxide, catalyst, nitrous gas, absorber.

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