CATALYST FOR LOW-TEMPERATURE DECOMPOSITION OF DINITROGEN OXIDE IN TAIL GASES FROM A NITRIC ACID PLANT

(TECHNOLOGY OFFER P-114)

Subject of the offer is a catalyst based on cobalt oxide doped with nickel and zinc ions, for the low-temperature decomposition of dinitrogen oxide in tail gases from nitric acid plants,reducing greenhouse gas emissions. Catalyst does not require the use of additional reducing agents.

Dinitrogen oxide (N_2O) is formed as a by-product of inter alia the catalytic oxidation of ammonia in nitric acid manufacture plants. N_2O emissions can significantly contribute to the greenhouse effect, because it accumulates heat about 310 times more efficiently than CO_2. In addition, it can affect the destruction of the stratospheric ozone layer. Therefore, it is necessary to ensure their efficient elimination of exhaust gases, both for stationary sources (industrial plants) and mobile (vehicles with combustion engines).

Catalytic decomposition of dinitrogen oxide in nitric acid plants may be carried out at high or low temperatures. In the high temperature (800 ÷ 940°C), the catalyst is placed in the ammonia oxidation reactor, directly under the catalytic gauzes. In the low temperature process (200 ÷ 450°C) the catalyst is placed in a special reactor, in the residual gas stream. Currently the most popular technology for N_2O decomposition offered on the market is the high temperature process while the low temperature removal of dinitrogen oxide by selective catalytic reduction is possible only when the additional reducing agents are used.

CENTRE FOR INNOVATION, TECHNOLOGY TRANSFER AND UNIVERSITY DEVELOPMENT

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The subject of the technological offer is the catalyst for the low-temperature decomposition of dinitrogen oxide in the tail gases from the nitric acid plant. Active ingredient of the catalyst is mixed oxide of cobalt, zinc and nickel, promoted by alkali metals (sodium and potassium) affecting the increase of catalytic activity, and by alkaline -earth metals (magnesium and calcium) added to facilitate the shaping, while providing appropriate structure and strength at the same time. The catalyst is active already at 50°C and the 90% N_2O conversion is obtained below 350°C.

Low-temperature catalytic decomposition of dinitrogen oxide, carried out by the developed catalytic system which is the subject of the offer, **is much more favorable in comparison with other solutions** because of:

- no need for using any reducing agents;
- relatively low operating temperature;
- high catalytic activity in the presence of other components of tail gases (oxygen, water and other oxides of nitrogen).

Experimental studies, both in the laboratory scale and in the pilot plant at the Fertilizers Research Institute in Puławy, **carried out for several prototype catalysts confirmed the high catalytic activity of materials offered.**

These studies consisted of:

- passing a mixture of nitrous oxide and helium through the bed of a catalyst placed in a quartz reactor,
- passing a tail gases from the pilot plant of nitric acid manufacturing, characterized by the same composition as the tail gases in the real industrial plant, through the catalytic system,

and then determining the tail composition after reaction.
The degree of decomposition of dinitrogen oxide in a mixture of N_2O and He, at a temperature of 300°C was 95%, while decomposition products were only molecular nitrogen and oxygen. The pilot plant at a temperature of 350°C revealed the degree of decomposition of dinitrogen oxide was higher than 90%.

Describe catalyst is the subject of two patent applications, which provide both the catalyst composition and method of its preparation. The research and development efforts concerning this technology are continued at the Faculty of Chemistry of the Jagiellonian University in cooperation with the Fertilizer Research Institute in Pulawy. Currently the **Centre for Innovation, Technology Transfer and University Development (CITTRU), together with the Fertilizer Research Institute are looking for industry stakeholders interested in catalyst implementing**, in particular in plants for the nitric acid manufacturing.

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