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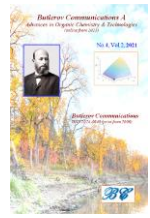

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Development of a unit for the absorption and catalytic purification of nitrogen oxides after the stage of denitration of spent acids for the Federal State Enterprise "Aleksinsky Chemical Plant"

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Abstract

In the process of denitration of waste acids from the production of cellulose nitrates, nitrous gases are formed, consisting of nitric acid vapors and nitrogen oxides. Currently, the absorption of nitrous gases is carried out by water, in an absorption system consisting of six nozzle towers. In this case, a weak 40-50% nitric acid is formed. The absorption efficiency is 94-96%. The exhaust gases after the absorption stage contain nitrogen oxides, the concentration of which exceeds the maximum permissible emission standards. We have developed a new system for the absorption of nitrous gases after the stage of denitration of waste acids and subsequent catalytic purification of waste gases from nitrogen oxides. The system consists of five vortex absorbers installed in series. Each vortex absorber is equipped with a heat exchanger, a circulation pump and a splash head with a filter element installed in the upper part of the absorber. Five plates with swirlers are installed inside the vortex absorber. The absorption system operates in a countercurrent mode of movement of the gas and liquid phases. Nitrous gases enter the first absorber along the gas flow, and water for the absorption of nitrogen oxides is supplied to the last absorber along the gas flow. The absorption of nitrogen oxides in the vortex absorber occurs in the downward mode of movement of gas and liquid flows. The liquid is supplied to the irrigation of the upper swirl absorber by a circulation pump. The flow of liquid between the stages is carried out by gravity. 40-50% nitric acid flows out of the first gas absorber along the course. Nitrous gases containing nitrogen oxides residues from the last absorber in the course of the gas are sent for final selective catalytic purification with ammonia. A layer of K-16U grade catalyst or in the form of carbon steel chips is poured into the reactor for the

catalytic reduction of nitrogen oxides. The purified gases after the reactor pass through the evaporator, where they give off heat for the evaporation of ammonia water and are then released through the gas emission pipe into the atmosphere.

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References

[1] R.A. Khalitov, A.F. Makhotkin. Technology of regeneration of waste acids in vortex apparatuses: monograph. *Kazan: KNITU Publishing House.* **2015**. 384p. (Russian)
[2] A.F. Makhotkin. Theoretical foundations of purification of gas emissions from the production of cellulose nitrates: monograph. *Kazan: Publishing House of Kazan University.* **2003**. 268p. (Russian)
[3] R.A. Khalitov, A.F. Makhotkin. Intensification of absorption and catalytic purification of nitrous gases: textbook manual. *Kazan: KNITU Publishing House.* **2015**. 382p. (Russian)
[4] R.A. Khalitov [et al.]. Development and results of the introduction of a vortex monohydrate absorber of sulfur trioxide in the production of sulfuric acid. *Herald of Technological University. Kazan.* **2010**. No.10. P.522-527. (Russian)
[5] Vortex apparatus for conducting physico-chemical processes with a descending flow of phases: *pat. 2287359 Rus. Federation* No. 2004134710/15. Makhotkin A.F. [et al.]; declared on 30.11.2004; published on 10.05.**2006**. Bul. No.32. 9p. (Russian)
[6] Alexey F. Makhotkin, Rifkat A. Khalitov, Rauf F. Karimov. Development of a unit for the absorption and catalytic purification of nitrogen oxides after the stage of denitration of spent acids for the Federal State Enterprise "Aleksinsky Chemical Plant". *Butlerov Communications.* **2021**. Vol.68. No.10. P.9-15. DOI: 10.37952/ROI-jbc-01/21-68-10-9 (Russian)