

## DEVELOPMENT OF METHOD FOR REMOVAL THE NITRIC OXIDES FROM PROCESS OF PRECIOUS METALS RECOVERY FROM ANODE SLIME

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### ABSTRACT

*Nitric compounds, especially nitric oxides, are extremely toxic with many unfavorable local effects, especially in the surrounding of great pollution sources.*

*This work contains the results of laboratory research for involving of the best absorption parameters (temperature, type and concentration of absorption liquid), as well as a selection of absorption system for completely removal the nitric oxides from process of hydrometallurgical recovery of precious metals from anode slime in Plant for Anode Slime Treatment.*

*The basic aim is decreasing of nitric oxides emission to the law approved concentration, both in working conditions and at gas emission point of the plant.*

**Keywords:** nitric oxides, absorption system, gas purification

### 1. INTRODUCTION

The environment pollution is much more intensive process that we could not be stopped, but we could consciously act on it. Nitric compounds, especially nitric oxides are extremely toxic.

Several oxides of nitrogen are found in the atmosphere but only nitric oxide (NO) and nitrogen dioxide (NO<sub>2</sub>) are important as air pollutants. The symbol NO<sub>x</sub> is frequently used to represent the composite of the two. The other nitrogen oxides seldom occur in appreciable quantities and then only under special conditions [1].

Limit emission values (LEV) of nitric oxides in the air of working environment are 500 mg/m<sup>3</sup>. (*Data for LEV values were taken from Official Gazette of Republic Serbia No. 30/97*).

Nitric monoxide, NO, is colorless gas, relatively weakly dissoluble in water. It is stable at normal conditions thanking to high slow of disintegration. It reacts with hemoglobin in blood where methemoglobin is formed that could not transport oxygen.

Nitric dioxide, NO<sub>2</sub>, is brown gas with characteristic smell. It belongs to fitotoxic substances because it causes unfavorable consequences in vegetation. Influence on people and animals is mainly related to respiratory track.

In recent time, an important increase of law regulations regarding to emission of nitric oxides from industrial processes were noticed [2,3]. When concentration of nitric oxides in gases, emitted into

atmosphere, is over adopted standards, measures for decrease of their emission are required [4,5]. For this purpose, the most often used method for gases absorption is in suitable absorption liquid.

## 2. EXPERIMENTAL INVESTIGATIONS

In Copper Institute, laboratory investigations [6] were carried out for the aim of the most favourable parameters of nitric oxides absorption. Investigations were directed to selection of type and concentration of absorption medium as well as temperature effect on efficiency the absorption process of NO<sub>x</sub> gases.

Experiments were carried out in apparatus that provides the closed flow of gases and efficient control of NO<sub>x</sub> absorption. Process of silver dissolution was controlled in stoichiometrical calculated quantity of nitric acid, at temperature of 90°C, according to chemical equation 1:



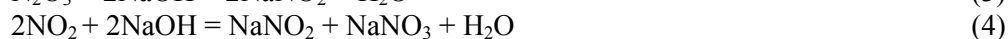
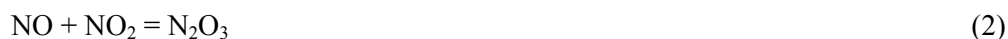
Experiments were carried out with per 20 g silver in powder. The liberated gases were absorbed into three series connected rinsers filled with certain quantity of absorption medium. The investigated absorption medium was in first and second rinser, and control absorption medium was in third rinser. By analysis of absorption medium, the quantity and concentration of absorbed NO<sub>x</sub> gases were determined, and the obtained results are presented in Table 1.

Table 1. Effect of absorption medium type on absorption of NO<sub>x</sub> gases

Absorption medium	Quantity of absorbed NO <sub>x</sub> , g			Concentration of absorbed NO <sub>x</sub> , g/m <sup>3</sup>	Rate NO <sub>x</sub> , m/s
	I rinser	II rinser	III rinser		
10% NaOH	7.34	5.91	12·10 <sup>-6</sup>	426.5	0.601
20% NaOH	10.72	10.04	13.5·10 <sup>-6</sup>	810.9	0.503
20% Na <sub>2</sub> CO <sub>3</sub>	6.65	3.80	22·10 <sup>-6</sup>	474.8	0.432
20% Ca(OH) <sub>2</sub>	11.81	7.76	8.5·10 <sup>-6</sup>	674.9	0.500

By analysis of the obtained laboratory investigations, it could be stated that the highest concentration of absorbed NO<sub>x</sub> gases was realized by the use of 20% NaOH as absorption medium in the analyzed process of silver dissolution.

Absorption of nitric oxides in NaOH solution [1] is developed according to the following chemical reactions (2-4):



Products of NaNO<sub>2</sub> and NaNO<sub>3</sub> absorption could be valorized into commercial products. Dependence of absorption degree of NO<sub>x</sub> on temperature of selected absorption medium (20% NaOH) was investigated, what is presented in Figure 1. The obtained results point out increase of absorption degree of NO<sub>x</sub> with temperature increase.

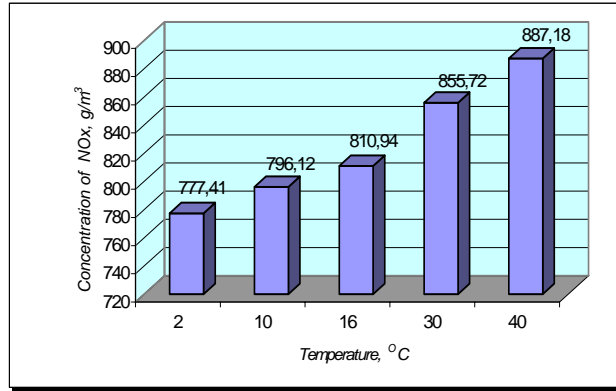


Figure 1. Effect of absorption medium temperature on absorption of NOx gases

Experimental laboratory investigations were used for the aim of defining the technological method and absorption system for NOx gases purification, formed in the process of hydrometallurgical treatment the anode slime, which is based on reactions of gas absorption in basic absorption liquid, 20% NaOH.

### 3. SELECTION OF ABSORPTION SYSTEM FOR NOx GASES PURIFICATION

Based on detail recognition total hydrometallurgical process of recovery the precious metals from anode slime and having in mind the sources and quantities of NOx gases as well as the available area in the existing object (Anode Slime Treatment Plant), it was decided to direct the all liberated process NOx gases into a classic system for purification of gases (Figure 2) that consists of two absorption columns and associated aggregates:

- First absorption column with filler is used for absorption the majority part of liberated NOx gas,
- Second absorption column is used for additional purification of residual NO<sub>2</sub> gas upon absorption in first column,
- Preparation tank, for preparation of absorption medium,
- Two receiving tanks,
- Centrifugal pump,
- Ejecting system for drawing of gas mixture and transport of gas flow through columns,
- Gas analyzer, for purified gas control.

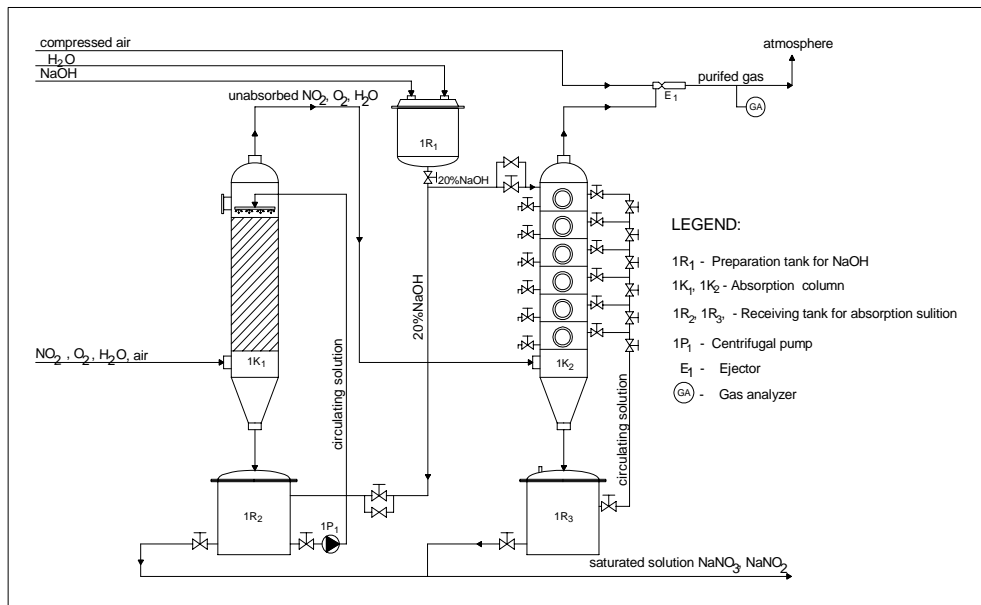


Figure 2. Technological layout of absorption process of NOx gases formed in hydrometallurgical process for precious metals recovery from anode slime

#### **4. CONCLUSION**

Based on the obtained experimental results, it could be stated that the most effective for absorption of nitric oxides is solution of 20% NaOH. Having in mind that temperature of liberated reaction gases is about 40°C, the additional heating of absorption medium is not necessary. The proposed system for absorption of liberated NO<sub>x</sub> gases, from the process of hydrometallurgical treatment of anode slime, consists of two absorption columns. Solution of this problem is very important due to a fact that proposed absorption system could be completely used in majority of chemical processes with emission of NO<sub>x</sub> gases.

#### **5. ACKNOWLEDGEMENT**

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