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CHOICE OF METHOD AND EQUIPMENT FOR WASTE GASES PURIFICATION FROM PROCESS OF ANODE SLIME DESELENIZATION

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ABSTRACT
Selenium is one of the RTB-Bor commercial products. Anode slime which is used as a raw material in the production process, contains even up to 60 mass % of selenium that exceeds the selenium content of max 20 mass % in anode slimes from other world refineries.
The purpose of this paper is a choice of method and equipment for waste gases purification, formed in the process of anode slime deselenization.
In order to define a type of polluters and their quantity, gas emission in the course of deselenization process has been measured. According to the qualitative and quantitative gas composition, wet purification of waste gases has been chosen. Experimental research has been done aimed to define the type and concentration of the most suitable absorption mean as well as the optimal absorption parameters. Equipment for purification of gases, formed in deselenization process, has been chosen. The suggested producer is favorable in two aspects.

- *It enables an effective polluters removal;*
- *It provides a circular flow of the solution from wet gas purification that eliminates the problem of waste solutions purification and increases selenium recovery.*

Keywords: anode slime, deselenization , gas purification,

1. INTRODUCTION
Strictly measures of protection the environment and working environment are required in work with selenium and its compounds. The selenium based gaseous products cause headache and irritation of bronchial tubes in insignificant quantities. The selenium compounds could cause allergic reaction and painful rashes in a contact with skin. Hard poisonings with selenium appears with its concentration in the air of a hundredth parts mg/dm^3 [1]. If a purification of waste gases is uneffective during selenium production, a considerable pollution of the environment and working environment appear [2].
Selenium is recovered by sulphating roasting of anode slime. Process includes a mixing of anode slime with a certain quantity sulphuric acid and roasting at temperature up to 600°C. The following reactions are developed during roasting process (1 - 4):

$$Ag_2S + 3H_2SO_4 = Ag_2SO_4 + SeSO_3 + SO_2 + 3H_2O \quad (1)$$
$$2CuAgSe + 10\,H_2SO_4 = 2CuSO_4 + Ag_2SO_4 + 2SeSO_3 + 2SO_2 + 10H_2O \quad (2)$$
$$SeSO_3 + H_2SO_4 = SeO_2 + 2SO_2 + 10H_2O \quad (3)$$
$$2SeSO_3 = SeO_2 + Se + SO_2 \quad (4)$$

Realized gases from roasting are absorbed into a diluted suphuric acid and selenium is reduced to the elementary state by sulphur dioxide. Contamination of environment and working environment by elementary selenium, selenium dioxide as well as sulphur dioxide appears in the process of selenium recovery. For the aim of selection a unit for waste gases purification from the deselenization process in industrial conditions, a type of polluters was defined as well as quantity and quality of waste gases and the specific techno-economical conditions, connected to the production process, were recognized. Technological layout of the plant for gas purification [3] was developed, based on the previous analysis.

2. EXPERIMENTAL DATA WITH RESULT DISCUSSION

In RTB Bor, a trend of selenium content increase in anode slime was noticed regarding to designed content of max.30% of plant for selenium recovery.

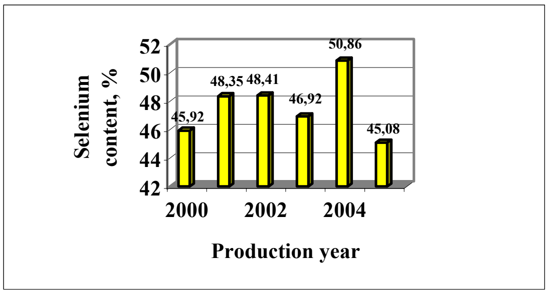

Figure 1. Presents selenium content last five year production in anode slime

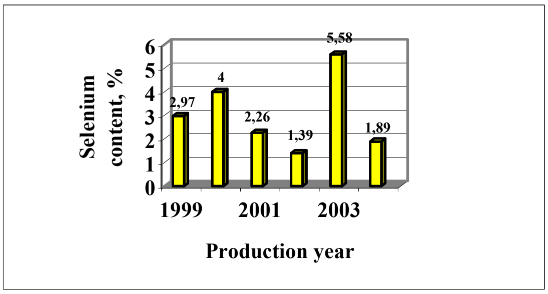

Figure 2. Selenium content last five year production in deselenized anode slime

Deselenization degree is near designed concentration of 1-3 mass.%, what imposes a conclusion that the reactions of degradation the selenium compounds to selenium dioxide, that evaporates from anode slime at roasting temperature, are developed in a deselenization furnace.

Figure 3 presents designed temperature regime in a deselenization furnace, and Figure 4 presents temperature regime, established by measurement in industrial conditions [4].

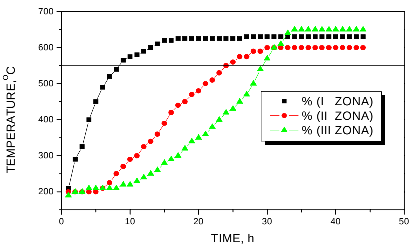

Figure 3. Designed temperature regime in a deselenization furnace

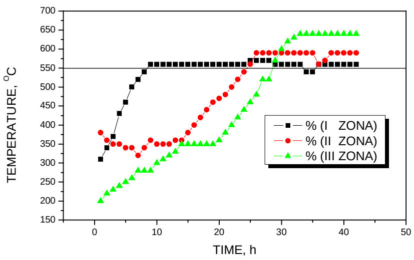

Figure 4. Measured temperature regime in a deselenization furnace

Monitored temperature regime in a furnace deviates from designed roasting regime. Temperature increase in temperature zones II and III was not enough timely moved, what cased a sudden separation of selenium dioxide. High concentration of SeO_2 and low temeperature on furnace outlet caused clogging of installation for gas exhausting.

Pollution sources in the process of deselenization plant for anode slime treatment in Bor are:

- gases from deselenization furnace
- gases from settling tank for selenium reduction.

In order to define a type of polluters as well as their quantity and quality, the emission of gases was measured during deselenization process in industrial conditions. The measurements were carried out at two places:

- hood discharge, installed over furnace
- discharge from settling tank.

Measurement results (Table 1), classified as starting data, were used for selection of plant for waste gases purification from deselenization process.

Table 1. Characteristics and content of waste gases

	Average values of gas concentrations, (g/m^3)	
POLLUTERS	Hood over furnace	Settling tank
a) selenium dioxide	5.0	
b) sulphur dioxide	2.8	3.0
c) selenium acid		9.5
d) solid particles	0.25 x 10^{-3}	
CHARACTERISTICS OF GASES		
a) temperature	32 - 43^{o}C	40 - 50^{o}C
b) relative humidity	13 - 34%	100%
c) combustion	non-combustible	non-combustible
d) toxicity	toxical	toxical
GASES CONTENT	SeO_2, H_2SeO_3, SO_2, Se, CO_2	

Quantities of selenium dioxide and sulphur dioxide were significantly variable during deselenization process. Figure 5 and 6 give the values of those polluters emission depending on time.

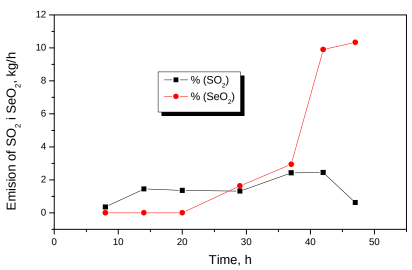

Figure 5. Emission of gases from settling tank over roasting furnace

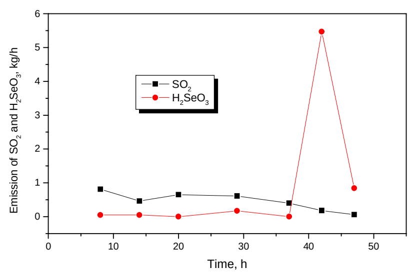

Figure 6. Emission of gases from hood over roasting furnace

Based on gases quality (humidity and chemical content - Table 1), the wet purification of waste gases was selected. Laboratory analyses were carried out for the aim of selection the absorption medium. The conditions of roasting the anode slime in tube furnace were simulated, and gases were absorbed in a system of rinsers. The following absorption media were analyzed: water, dissolved sulphuric acid and solution of calcium hydroxide.

Water, as an absorption medium, satisfied for the absorption the all turbe gaseous components: SO_2, H_2SeO_3, Se and SeO_2. Solution of selenium acid with suspended selenium particles was obtained as the end product in absorption of waste gases from the water deselenization process. Such solution could be combined with solution from the existing deselenization process. That could close a circle flow of liquid and eliminate the expensive purification of waste solutions from the process of wet gases purification.

Upon definition of content, quality of polluters as well as a medium for absorption, a selection of unit for gases purification was carried out.

Figure 7 shows a technological layout of plant for purification the waste from deselenization process.

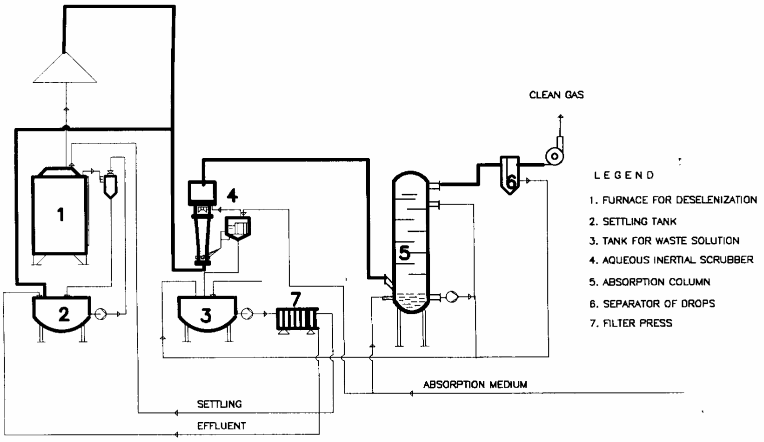

Figure 7. Technological Layout of Plant for Gases Purification from the Deselenization Process of Anode Slime

Venturi wet scrubber was selected as a primary unit for purification for removal the coarser particles from gas stream and absorption a part of components [4,5]. Selenium is easy evaporable metal, and it is condensated at lower temperatures in particles less than 1 μm what also points out the analysis on particle size of selenium: 80% < 5 μm. Therefore, an absorption column with partitions, where absorption medium is injected into gas stream, was selected as a secondary unit for gases purification. Foamy zone, i.e. a region of extreme turbulence with very high percentage of surface regeneration, is formed during that. By this, the both conditions are satisfied: removal of submicron particles and good gases absorption. Upon purification in a column with partitions, the waste gas in emitted into the atmosphere over electrostatical precipitator.

3. CONCLUSION

Analysis of quantity and content the waste gases from deselenization process points out a necessity of their effective purification. Wet purification plant was proposed. The selected units include high drops of pressure what cause higher power of unit for gas stage drive, and also high energy consumption. The proposed procedure for gases purification attains the following:

- effective removal of pollutants
- circle flow of solution from wet purification, what eliminates the expensive waste water treatment, as a result of wet gas purification.

4. ACKNOWLEDGEMENT

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