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COST REDUCTION WITH SODIUM SULPHIDE IN EVAQUE THROUGH CHANGING THE PREPARATION CONCENTRATIONS

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Abstract: The sodium sulfide reagent is of great importance in the willemite mineral beneficiation process in Vazante, in addition to representing approximately 50% of the plant's total cost of inputs. Due to logistical difficulties due to the worsening of the COVID-19 pandemic, sodium sulfide had a price increase that significantly impacted the unit's input costs in 2021. In view of this scenario, the processes area evaluated viable options for reducing of the technical index of sodium sulfide in the Vazante unit and carried out more than 100 flotation tests on the bench to validate the proposals raised. After compiling and analyzing the results obtained, it was decided to carry out an industrial test implementing the new conditions for preparing sodium sulfide and sodium carbonate found (44g/L of sodium sulfide and 32g/L of sodium carbonate). The average consumption of sodium sulfide after project implementation was reduced by 16% compared to the average technical index for the initial period of 2021, demonstrating that the initiative was effective in achieving the proposed objective. This reduction enabled savings with sodium sulfide in the period from June 2021 to May 2022 of around 1 million reais.
Keywords: sodium sulfide, input costs, willemite flotation, Vazante plant

INTRODUCTION

The sodium sulfide reagent is of great importance in the mineral beneficiation process at the Vazante plant for the treatment of willemite ore. This reagent has two main functions in the zinc silicate flotation process: to form a zinc sulfide film on the mineral of interest, increasing its negative surface charge and allowing greater effectiveness of the cationic flotation process; and increase the alkalinity of the medium, which will provide greater solubility of the amine (collector of the oxidized zinc ore) in the later stage (BALTAR, 1980).

In addition to its great importance in terms of the process, sulfide also occupies an important position in terms of costs – in 2020, spending on sodium sulfide represented 57% of the total cost with inputs at the plant.

Historically, sodium sulfide consumption at the Vazante unit between 2016 and 2020 averaged 2.09kg of reagent per ton of ROM processed at the plant, as can be seen in figure 1 (the technical index refers to the reagent dosage, in kilos, per ton of ROM fed into the plant and has "kg/t" unit of measurement):

Due to logistical difficulties due to the worsening of the COVID-19 pandemic in 2021, sodium sulfide had a 60% price increase compared to that practiced in 2020, which significantly impacted the unit's input costs in the first Months of the year.

In this scenario, the processes area started evaluating viable options for reducing the technical index of sodium sulfide at the Vazante unit, with the premise of not negatively impacting the two main performance indicators of the beneficiation process: final concentrate content and recovery global metallurgy.

MATERIAL AND METHODS

Studies on the flotation of zinc silicate ore indicate that the increase in the concentration of sodium sulfide in solution increases the efficiency of the process only up to a certain limit, from which the increase in concentration does not result in significant effects (SALUM, 1992 apud MARTINS, 2007). Then, the possibility of testing different concentrations of sodium sulfide in bench flotations was raised.

The sodium sulfide solution used at the Vazante plant consists of a mixture of sodium sulfide and sodium carbonate. This mixture is interesting from an economic point of view,

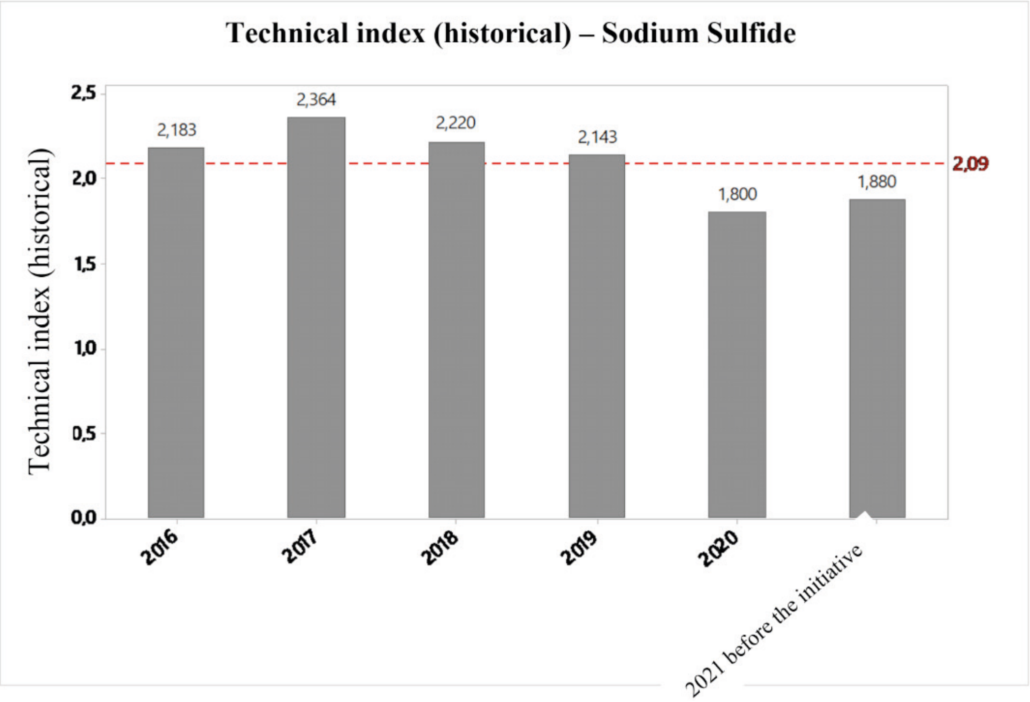

Figure 1: Consumption of sodium sulfide at the Vazante plant between 2016 and 2021 (in kg/t)

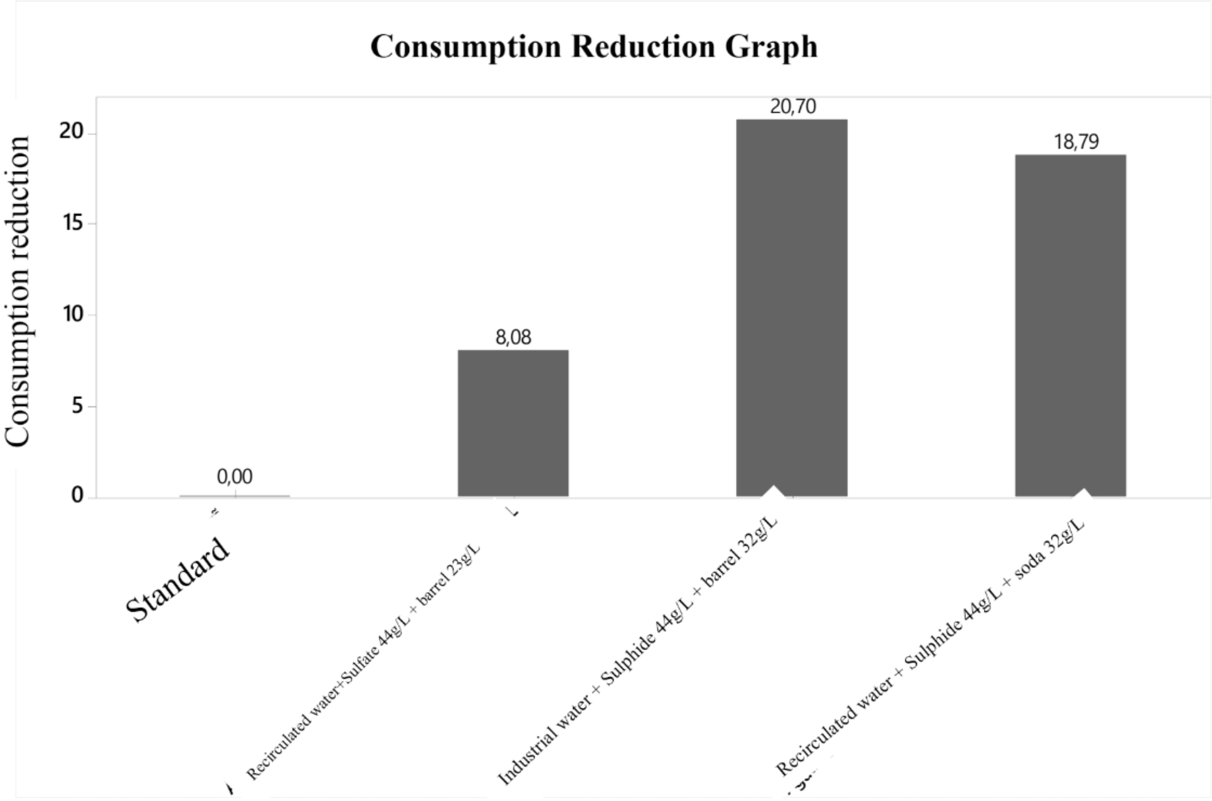

Figure 2: Average reduction in sodium sulfide consumption obtained in bench tests

since sodium carbonate helps the sulfide function as a pH regulator and has a lower cost (the price of sodium carbonate corresponds to approximately 30% of the value of sodium sulfide). Thus, the possibility of changing the concentration of sodium carbonate in bench tests was also raised.

The different ideas raised that could reduce the consumption of sodium sulfide at the plant were:

1) Tests with variation of sodium sulfide concentration;

2) Tests with variation in sodium carbonate concentration*;

3) Recirculation of process water that already contained part of the sodium sulfide and therefore a higher pH.

4) Conducting bench flotation tests with variations in the percentage of solids in the pulp at the time of conditioning the sodium sulfide;

5) Testing of different amines, which have maximum solubilization at a lower pH than currently used;

Due to the fact that the first two tests are faster to execute and, in case of success, easier to implement to carry out an industrial test, we chose to prioritize them. Bench tests were also carried out with the option of water recirculation.

Exploratory tests were performed in each of the conditions, namely:

Tests with variation of sodium sulfide concentration: the standard condition used until 2021 was a concentration of 48g/L in the preparation of sodium sulfide. Different concentrations were tested in bench flotation tests and the best concentration found was 44g/L, which represented a reduction of 8.33%;

Tests with variation of sodium carbonate concentration: the standard condition used until 2021 was a concentration of 23g/L in the preparation of sodium carbonate. Different concentrations were tested in bench flotation tests and the best concentration found was 32g/L, which represented an increase of 39%;

Process water recirculation: flotation tests were carried out with process water on different days and with different initial pHs. Using new treated water, the initial pH of the pulp varies on average between 8.5 and 9.0; already using recirculated water the initial pH varies between 9.0 and 9.5.

After carrying out the initial exploratory tests, in which each of the changes was made individually in a test, the best conditions were selected to be carried out in combination. Four conditions were tested below in 6 different ore blends:

- C1: standard (treated water, prepared sulfide at 48g/L, prepared sodium carbonate at 23g/L);
- C2: recirculated process water, prepared sulfide at 44g/L, prepared sodium carbonate at 23g/L;
- C3: treated water, prepared sulfide at 44g/L, prepared sodium carbonate at 32g/L;
- C4: recirculated process water, 44g/L prepared sulfide, 32g/L prepared sodium carbonate.

RESULTS AND DISCUSSION

In all the tests carried out, there was a reduction in the consumption of sodium sulfide, measured at each test by the consumption in g/t of ROM. The average reduction in sodium sulfide consumption obtained in the 6 tests for each of the above conditions are summarized in figure 2:

It was observed that in the first two series of tests, 2 proposed conditions and a standard condition were used. In the first series (which obtained an average reduction of 8.08% in the consumption of sulfide), the proposed conditions were the use of recirculated water and the change in the preparation of sodium sulfide, maintaining the standard concentration of ash (23g/L). In the second series of tests (which obtained an average reduction of 20.70%) the use of sulfide at 44f/L and soda ash at 32g/L was proposed, but maintaining the industrial water already used in the plant, therefore, a condition standard. In the last series of tests, recirculated water, sulphide at 44g/L and soda at 32g/L were used, therefore, no standard condition.

It is also important to point out that none of the tests showed any loss of quality in the final concentrate produced or damage to metallurgical recovery, as can be seen in Figure 3:

After compiling and analyzing the bench results, it was decided to carry out an industrial test implementing the new conditions for preparing sodium sulfide and sodium carbonate (44g/L of sulfide and 32g/L of carbonate, using industrial water), replicating the condition 3 of bench tests. The industrial test started on 06/23/2021 and the average consumption of sodium sulfide from that date until the end of 2021 was 1.58kg/t of ROM fed into the plant (figure 4), which represents a reduction of 16% compared to the average technical index for the initial period of 2021.

This reduction enabled savings with sodium sulfide in the period from June 2021 to May 2022 of around 1 million reais.

CONCLUSIONS

The challenge presented in 2021 was big and urgent: if sodium sulfide consumption was not reduced, the Vazante unit would end the year with the cost of this input 26.3% above budget. More than 100 bench flotation tests were carried out to arrive at the optimal conditions and enable the start of the industrial test 3 days after the compilation and presentation of the results of the laboratory tests.

The assertiveness of the bench tests made it possible to carry out an industrial test with the change in the preparation concentration of sodium sulfide from 48 g/L to 44 g/L and that of sodium carbonate from 23 g/L to 32 g/L, obtaining results of reduction in sodium sulfide consumption very close to what was expected and which brought enormous financial savings to Nexa and the Vazante unit in 2021.

THANKS

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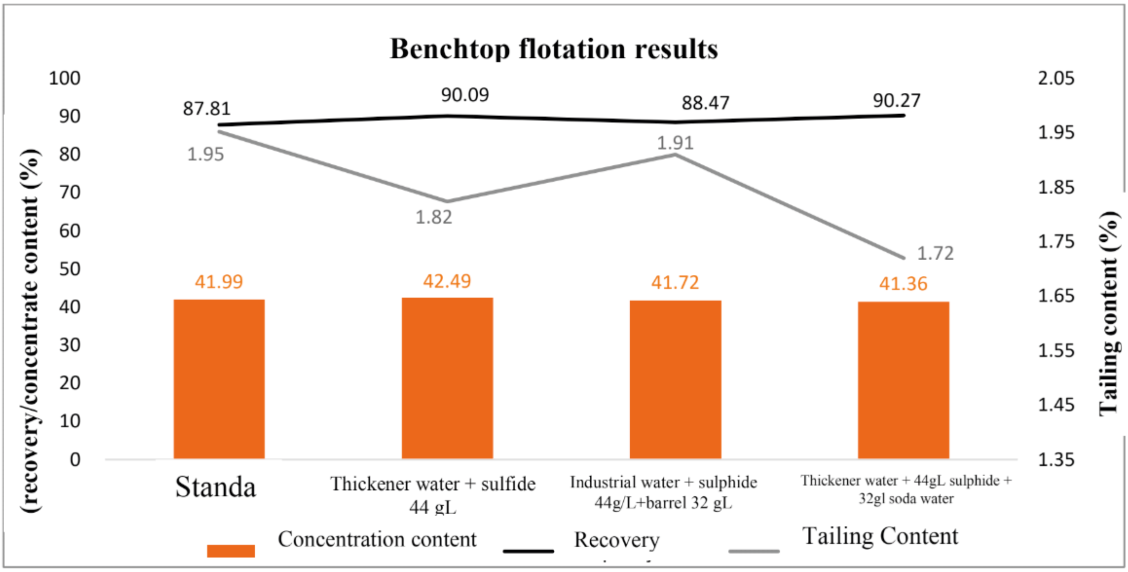

Figure 3: Average concentrate content and metallurgical recovery results obtained in bench tests

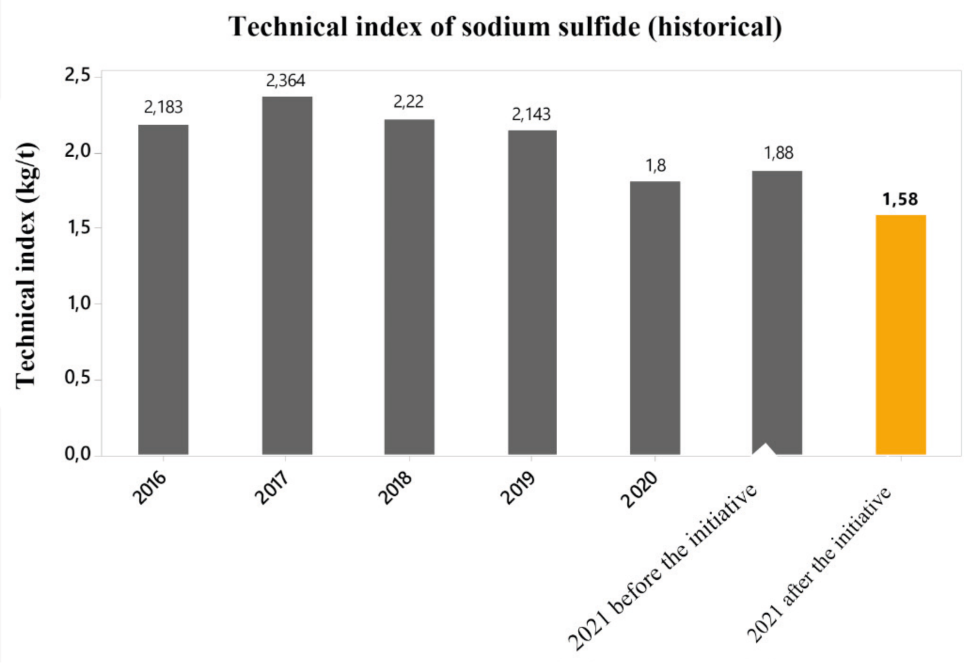

Figure 4: Technical index of sodium sulfide (kg/t) after implementation of the proposed new reagent preparation

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