Reduction of Hydrated Lime Consumption in a Bauxite Beneficiation Plant

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Abstract

Lime suspension is added to the bauxite slurry thickening process that occurs at Hydro Paragominas, leading to a better particle coagulation and, consequently, improving sedimentation. Hydrated lime $Ca(OH)_2$ dissociates in Ca^{2+} and $CaOH^+$, liberating OH^- ions. Because of this reaction, there is a pH change of the bauxite slurry and particle coagulation occurs, which improves the thickening process. This particle coagulation occurs due to neutralization of surface charges. In 2017, there was an increase of reagent consumption, which motivated the development of this project, with the objective to find alternatives to reduce lime consumption, adjusting it to the budget. Before implementing the improvement, hydrated lime preparation was done manually, which consequently made it difficult to control solution concentration. This variation contributed negatively to adequate dosage preparation, since the amount of hydrated lime contained in the solution was difficult to calculate. An opportunity was identified to standardize the procedure to determine lime dosage set point, since the quantity to be added depended on individual technician's evaluation. The work developed focused on automating the whole hydrated lime preparation process, assuring adequate solution concentration and standardizing dosage criteria. A system that automatically adds water to the preparation tank and activates the conveyor belt, screw feeder and bag filter accordingly to the level gauge was created, which allowed precise control of lime preparation and solution concentration. To standardize the dosage, a worksheet that calculates how much solution should be added to thickener feed, solution concentration and lime consumption budgeted was created. The result of this project was a 27 % reduction of reagent consumption if comparing the post-improvement period with the previous months.

Keywords: hydrated lime, coagulant, thickener, bauxite.

1. Introduction

One of the unit operations that takes place at Hydro Paragominas is the thickening process. In this operation, the thickener is fed with a bauxite slurry containing typically about 7 – 10 % and generates an underflow with approximately 40 – 45 % solid content. To reach this specification, it is necessary to add lime suspension to the slurry. The quantity of this reagent that should be added is proportional to the bauxite mass that feeds the thickener.

In presence of water, hydrated lime $Ca(OH)_2$ dissociates in Ca^{2+} and $CaOH^+$, liberating OH^- ions. Consequently, bauxite slurry pH changes and causes particles coagulation [1], which allows to achieve a thicker underflow.

This particle coagulation process occurs due to neutralization of surface charges [1]. Figure 1 shows the coagulation mechanism that happens after adding lime.

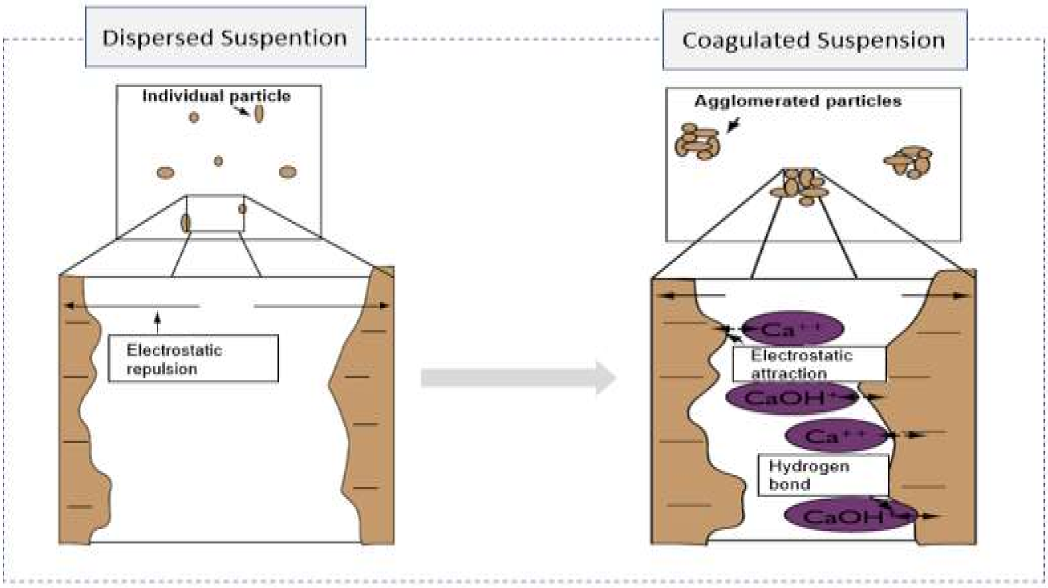


Figure 1. Forces acting on mineral particles in suspension without reagent and with lime addition.

The slurry stability is a key factor to achieve adequate thickening performance. The solid particles must be properly agglomerated to achieve the thickening rate that meets process needs.

For many years, lime has been used as a coagulant in mineral processing. For each kind of ore and process, there is a proper dosage. The overdosage of this reagent is harmful to the particle coagulation process.

In 2017, an increase of specific lime consumption has been observed. Figure 2 shows this consumption, in percentage deviation from the target.

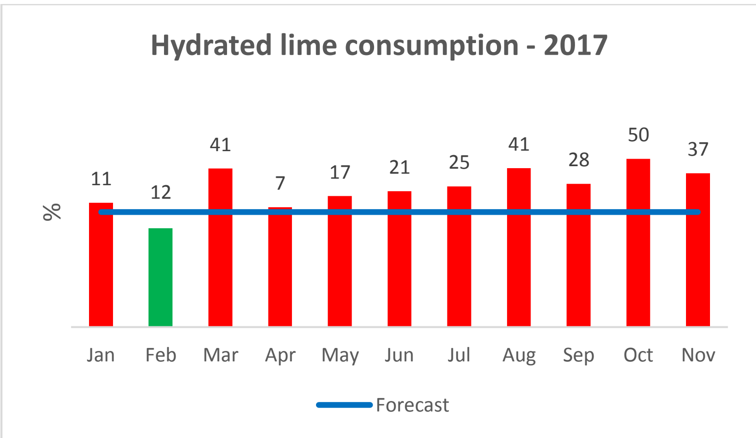


Figure 2. Hydrated lime consumption – 2017.

Taking the high reagent usage into account, an opportunity to reduce it was identified. Alternatives to not only achieve this condition, but also keep it below, forecast have been widely discussed. Figure 3 presents the gains that could be obtained if such scenario was achieved.

Before implementing the control measure, lime costs were increasing. After implementation, this trend has been interrupted and there has been a 30 % reduction of costs if compared to the previous months. Figure 8 shows lime consumption, comparing to the forecast.

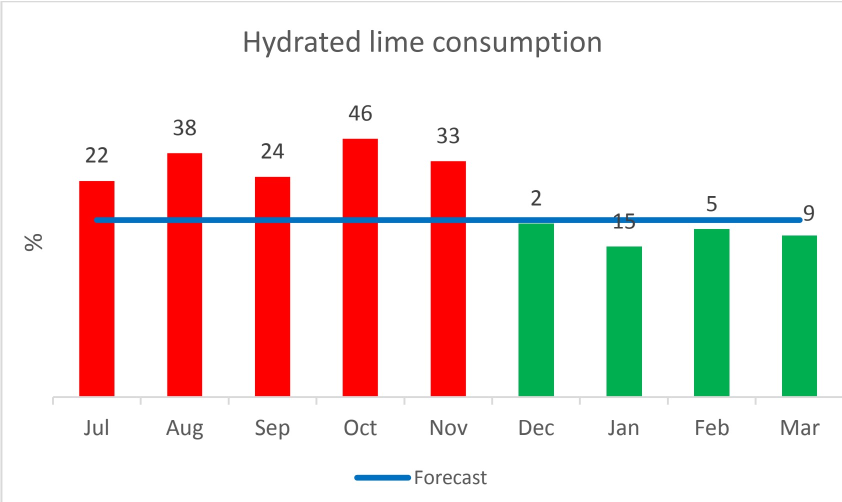


Figure 8. Hydrated lime consumption – before and after implementing the automation.

The graph above clearly shows that after implementing the control measures, there has been an overall consumption reduction (and consequently costs reduction), obtaining a 40 % saving when compared to the budget. It is important to highlight that even though hydrated lime usage was greatly reduced, all the process requisites were kept constant, as underflow density, sedimentation rate and overflow turbidity had visibly improved.

4. Conclusion

It has been observed that the main reasons that led to a high lime consumption were:

- Manual preparation of lime slurry, which limited control of solution concentration;
- No standard lime solution dosage procedure.

To tackle these problems, the main changes were:

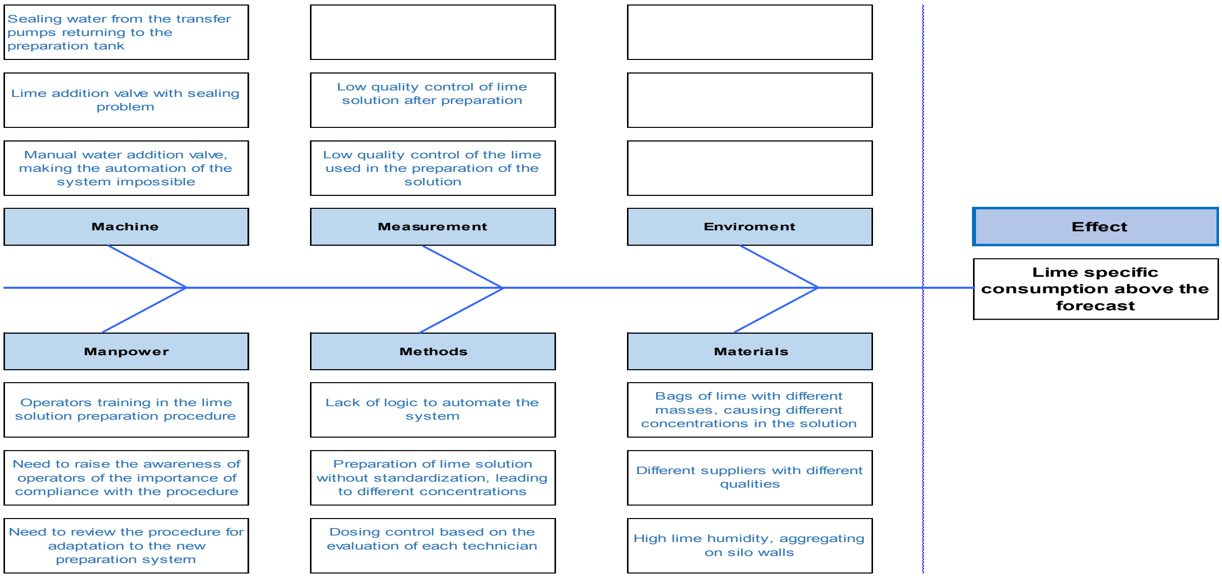
- Automating the lime slurry preparation procedure, ensuring solution concentration;
- Standardizing dosage criteria.

The automation implemented led to a lime consumption decrease, keeping it below budget. As well as a reduction in lime consumption, there has also been improvement of water quality that returns to the beneficiation plant.

5. References

1. Henrique Dias Gatti Turrer et al., Uso de coagulantes para manutenção do desempenho da filtragem de minério de ferro *Tecnol. Metal. Mater. Miner.*, São Paulo, v. 7, n. 1-2, p. 42-48, jul.-dez. 2010

6. Appendix


Sealing water from the transfer pumps returning to the preparation tank
Lime addition valve with sealing problem
Manual water addition valve, making the automation of the system impossible
Machine
Low quality control of lime solution after preparation
Low quality control of the lime used in the preparation of the solution
Measurement
Enviroment
Effect
Lime specific consumption above the forecast
Manpower
Operators training in the lime solution preparation procedure
Need to raise the awareness of operators of the importance of compliance with the procedure
Need to review the procedure for adaptation to the new preparation system
Methods
Lack of logic to automate the system
Preparation of lime solution without standardization, leading to different concentrations
Dosing control based on the evaluation of each technician
Materials
Bags of lime with different masses, causing different concentrations in the solution
Different suppliers with different qualities
High lime humidity, aggregating on silo walls