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Optimization of bleaching process

Abstract

In Kraft Process, after the Cooking, Washing and Delignification, there is the Bleaching Process which is an important method to reach a whiter and brighter pulp. It is a process based on chemical reactions mainly with Chlorine Dioxide, Hydrogen Peroxide and Oxygen to assist in the removal of lignin according to the Kappa Number (that indicates the lignin residual in pulp) and other components related to the Wood species. Optimization of the Bleaching Process consist in the optimization of conditions and chemical reactions for better results such as a more stable brightness closed to the desired Setpoint and an overall reduction in chemical consumption.

Introduction

In Kraft Process, after the Cooking, Washing and Delignification, there is the Bleaching Process which is an important method to reach a whiter and brighter pulp. It is a process based on chemical reactions mainly with Chlorine Dioxide, Hydrogen Peroxide and Oxygen to assist in the removal of lignin according to the Kappa Number (that indicates the lignin residual in pulp) and other components related to the Wood species. Optimization of the Bleaching Process consist in the optimization of conditions and chemical reactions for better results such as a more stable brightness closed to the desired Setpoint and an overall reduction in chemical consumption.

Figure 1: Celbi Bleaching Photo

Methodology and Work

The objective is to gradually increase the brightness of the pulp among the stages before sending it to the Drying Machine.

Advanced controls considering area production, process reaction time and chemicals concentration have been implemented at each stage to improve bleaching and chemical reaction efficiency and to optimize chemical consumption. The focus is on Bleaching and pH Controls for each step, totaling eight developed Advanced Process Controls (2 for each stage).

Each APC (Advanced Process Control) is based on a specific Predictive Model Control with Feedforward strategies and was implemented using the Metris Software Tool developed by ANDRITZ.

For the Bleaching Controls, process variables are related with the brightness measurements, setpoints are provided by operators and manipulated variables are connected to the specific dosage of the chemical used for bleaching in each stage (Chlorine Dioxide or Hydrogen Peroxide). For the specific dosage calculation, it is considered the stage production, pulp consistency and chemical concentration.

For the pH Controls, process variables consider the pH measurements, setpoints are defined by operators and manipulated variables are also connected to the specific dosage of the chemical used for pH Control in each stage (Sulfuric acid, Spent acid, Caustic Soda).

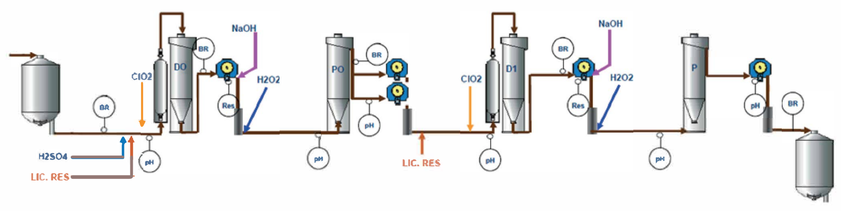

Figure 2: Bleaching Layout

Figure 3: Brightness Control Layout

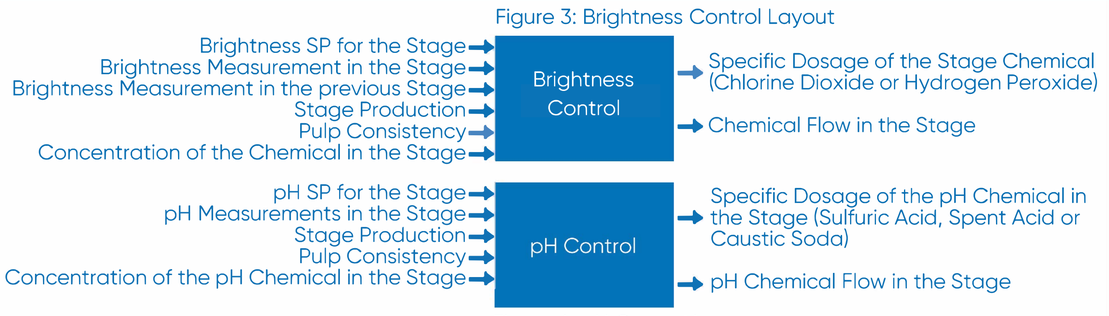

Figure 4: pH Control Layout

Results

Interesting results can be expressed with a more stable brightness not only at the end of each stage where controls are acting but mainly at the final pulp with a reduction on standard deviation close to 27% keeping the same quality (Average of Final Pulp Brightness).

Figure 5: StdDev of Final Pulp Brightness

Considering Specific Total Dosage of Chlorine Dioxide, Hydrogen Peroxide and Caustic Soda, results are correlated to the process conditions like Kappa Number and Brightness at the beginning of the Bleaching Process and the Brightness Setpoints for each stage.

Also, for a comparative baseline, it is important to evaluate the mill situation and procedures for those chemicals before the APC implemented. In the first months, we can verify a reduction close to 4.5% of Chlorine Dioxide, 15% of Hydrogen Peroxide and 12% of Caustic Soda. Results are related with the mill strategy that prioritize Chlorine Dioxide over Peroxide

Hydrogen for bleaching.

Figure 6: Specific Total Dosage of ClO2

Figure 7: Specific Total Dosage of NaOH

Figure 8: Specific Total Dosage of H2O2

Conclusion

The Bleaching Process with ANDRITZ optimization can automatically deal with dailies process disturbances and reach the Setpoint for Pulp Brightness in each stage with a lower standard deviation. Then, it is close to achieve the final product quality or Final Pulp Brightness Target after the Drying Machine process with a lower Chemical Consumption.

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