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Smart diagnostics for continuous process improvements and optimization in forest industry

Keywords: Diagnostics, data analysis, pulp and paper industry

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1 Background

Today forest industry has a pressure to improve process performance and cost efficiency in a very competitive market. Process improvements are also required to reach tightening environmental regulations. At the same time, digitalization of processes generates more and more data 24/7 to be utilized in these challenging circumstances. Smart diagnostic tools have been developed for turning the massive amount of data into more understandable information. This information can be used for continuous chemistry and process improvements in pulp and paper industry.

2 Method

Smart diagnostic tools are available in a web-based platform. The platform contains versatile methods for data collection, data pretreatment, data analysis, feature extractions, visualization and results reporting. The platform enables remote and real time diagnostics by automated operations. Users can drill into a large data set to find the best explaining variables for a problem or diagnostic target.

Typical diagnostic study can be problem solving, chemical performance analysis or benchmarking of chemistries. Smart diagnostics is a combination of strong knowhow of chemical phenomena, application knowledge, chemistry specific data and advanced analysis methods.

Diagnostics is an iterative process starting with target definition, feature extractions and analysis (Figure 1). Observed findings, learnings and improvements proposal are reported and shared with process experts.

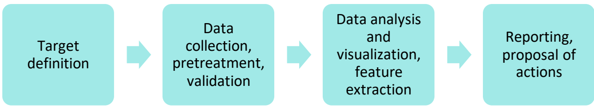

Figure 1. Diagnostic process.

3 Results

A typical work flow in a customer case is presented as a troubleshooting example in a paper machine. Target was to find reasons for the high number of paper defects (Figure 2). Diagnostic work started with data collection and pretreatment. Process data was merged with chemistry specific online measurements. Root causes for issues were analyzed by versatile statistical methods (e.g. t-test, best explaining set). Two data sets, a reference and a defect issues period, were compared by t-test (Figure 3). The best explaining set is based on a stepwise regression model. It defines the variable set which best explains the target variable (Figure 4).

Figure 2. Paper defects.

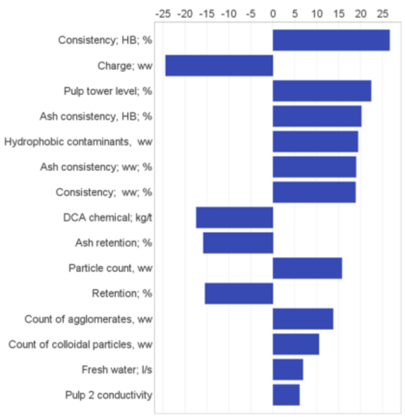

Figure 3. Diagnostic results (t-test).

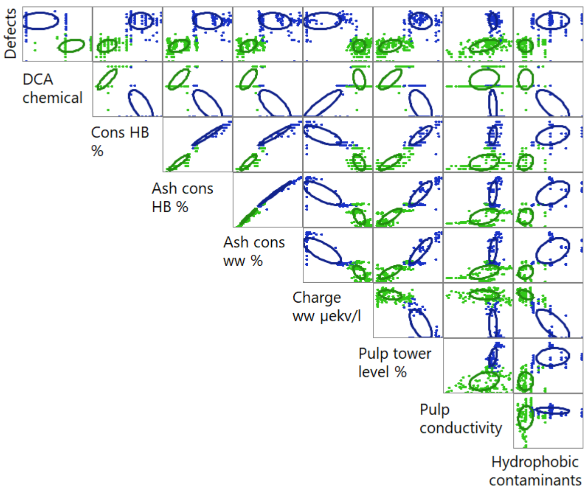

Figure 4. Diagnostic results.

Data analysis results indicate that there were two root causes for paper defects: The total and ash consistencies of the pulp suspension in the headbox were high and the quality of pulp was clearly weaker. Weak pulp quality was seen as the higher amount of dissolved anionic compounds (charge) and hydrophobic contaminants (wood pitch). Higher charge weakened the performance of cationic chemistry. Therefore, retention was lower. Weaker retention together with the high amount of colloidal wood pitch and high ash content caused the deposition of detrimental contaminants and further the higher number of paper defects.

Findings were reported, and several chemistry improvements were proposed to the customer. The efficient and optimized control of detrimental contaminants is a key factor for preventing product quality issues and loss of production. The paper mill could improve the process performance and reduce almost 20-40 % of paper defects by optimized chemistry.

4 Conclusions

Diagnostic studies have created proven value in hundreds of customer cases in pulp and paper industry. Smart diagnostics enables continuous performance and cost optimization, high quality chemical applications and proactive customer care. Solutions can be easily reused in new processes. The platform supports the creation of new customer services.