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ARTIFICIAL INTELLIGENCE REVOLUTIONIZING PAPER MILLS TO ACHIEVE OPTIMIZATION AND SUSTAINABILITY

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Abstract:

Higher energy prices in recent months have highlighted a few key issues. It has made industries realise the scarcity and also how this drives down profitability. Thus there is a need to optimise consumption to tackle the issue at hand. Technology is seen as an aid in the given situation. With artificial intelligence disrupting different industries, in this paper we will explore how artificial intelligence can contribute to the paper industry. The study is supported by a trial Haber has run to explore the impact it particularly has on power consumption. This is achieved by bringing in visibility to the current consumption levels, identifying leakages and other loopholes, and planning corrective action. Preemptive action further supports the cause and improves the overall efficiency of the system.

Keywords:

Artificial Intelligence, Machine learning, electricity consumption, preemptive action.

Introduction:

The pulp and paper industry is a heavy electricity user, accounting for 6% of global energy usage. It is the 4th largest user of energy amongst other industries. This has caught the attention of several stakeholders. With the rising scarcity of resources and prices, both business owners, as well as environmentalists, are keen on making energy consumption more efficient. In other words, there is a constant drive to produce more using lesser energy.

With technology growing over years, they have had a significant impact on energy consumption levels across several industries. The addition of energy-efficient technology and regular maintenance has had major contributions in the past. The paper industry has been no exception. From 6,916 kilowatt hours used to produce one ton of paper in 1965, it reduced to 2,908-kilowatt hours in 2015. The question that now comes forward is can this be further reduced? Can the new wave of artificial intelligence-led transformation facilitate industries to optimise performance and resource consumption?

Energy consumption:

It has been found that across different countries, the energy consumption standards to produce 1 ton of paper have been different. In the Netherlands, the consumption of energy was around 14.7 GJ/ ton of paper, while in China it was 11 GJ/ ton of paper. These differences are majorly driven by the differences in the technology and practices adopted. Thus making space for optimising energy consumption further.

ARTIFICIAL INTELLIGENCE-driven energy conservation:

In some instances, artificial intelligence-driven energy conservation is all about turning off a switch when not in use, while in some places it has been able to identify leakages, machine inefficiency, and preempt breakdowns. Artificial intelligence with its ability to collect data, analyse and predict has been able to identify the bottlenecks. The ability to analyse huge sets of data has helped artificial intelligence to understand patterns and take preemptive measures.

Artificial Intelligence in action: Our study

Through our artificial intelligence-machine learning driven services, Haber has aimed at achieving both efficiency and sustainability. This when implemented across the plant has the potential to drive the profitability of the mills exponentially.

Our SaaS innovation for the pulp and paper industry brings instant visibility to machine data. Energy is one of the key raw materials and is also tracked closely. Along with consumption levels, its impact on unit economics is also looked into. This helps to understand the usage of electricity by paper machines, grades, etc. This way one can identify the heavy electricity users which is the starting step towards optimising usage. One can visualize in real-time and take corrective steps at the earliest.

In addition to monitoring the current condition, artificial intelligence/machine learning-driven services also have the capability to conduct predictive analysis. This helps to anticipate any future breakdowns or process deviations. Corrective action is also suggested, thereby helping to reduce the impact on output and efficiency

eLIXA®, our artificial intelligence/machine learning-driven device, has a particular focus on the mechanical, operational, and chemical aspects to drive production rate and product quality while ensuring optimal resource utilization. It helps to automate a wide range of processes in the pulp and paper industry. It begins with data collection via sensors in real-time, then analysing it using artificial intelligence-machine learning algorithms. Chemical dosing is then determined and the process is automated by controlling pumps. All the data is stored on a cloud platform, which is resilient to cyber-attacks. The performance can also be monitored remotely through dashboards.

Energy savings can be seen across different applications such as surface sizing, microbial control, scale control, RDA, and others through this technology of predictive control. The paper will explore in detail one of the instances of energy savings by eLIXA®.

Energy saving in Retention and Drainage

Retention and drainage (RDA) play a very important role in the entire paper production process. It is the key to cost-efficient paper making. It affects several aspects like production rate, product quality, yield, and system cleanliness. In the absence of an effective retention and drainage program, fines and fillers could pass through the wire during sheet formation resulting in low retention values. This would mean an inefficient use of resources as well as poor end-product quality. This further complicates the situation by resulting in machine deposits. Optimised retention and drainage can ensure improved paper machine efficiency and reduction in product quality variation.

When our artificial intelligence-machine learning-based solution was applied to Retention and Drainage Aid, artificial intelligence has achieved significant energy savings and cost reductions. The study conducted by Haber using artificial intelligence-machine learning solutions to optimize RDA has been explored in detail below.

Methodology:

The study was conducted in an agro-based mill, using bagasse, in India, which produces specialty paper in the range of 30 to 60 GSM. The study was for 20 days. The client was facing an issue with the drainage rate, which was impacting the production rate and overall energy consumption.

1. The goal of the program was to achieve optimal retention and drainage. The best retention levels are determined by comparing the quality, cost of fiber, and cost of retention aids. Very high retention can have a negative impact on formation, strength, opacity, and machine runnability and very low retention can result in deposition, sheet defects, and breaks.

2. The experiment began with recording data in real-time via sensors, for the parameters critical to RDA, such as pH, temperature, conductivity, and Total suspended solids (TSS).

3. In addition to real-time data, data collected from the DCS such as Grade, Grammage, Refining data, Production Rate, Press Loads, Vacuum box pressure, steam pressure, and offline data from the data book like Furnish, Filler loading and other wet-end analysis data like system charge demand, drainage, and Headbox Consistency was combined together.

4. The data collected was automatically analyzed and used to derive KPI metrics, FPR (First Pass Retention), and FPAR (First Pass Ash Retention) on a real-time basis.

5. The data was used to identify variables that have the maximum impact on the FPR values and chemical dosing thereof.

6. The relationship between these key variables was then understood to build a machine learning-based model and algorithm to predict the chemical dosing in real-time.

Results:

RDA programs when enabled with artificial intelligence-machine learning models, helped to control chemical dosing in real time and achieve optimal Retention/FPR values consistently. Deviations in Retention/FPR values were minimized in comparison to the FPR values that were achieved without the artificial intelligence-machine learning model i.e., through Manual control methods. This had the following significant impact on the process.

1. The FPR and FPAR values improved when the process was controlled via eLIXA®. FPR has moved from 63% to 70% and FPAR improved from 24% to 30%.

a. Optimal Retention meant that fibers and fines fraction was retained. This means better use of the costly fibers. Minimal wastage can help bring down costs.

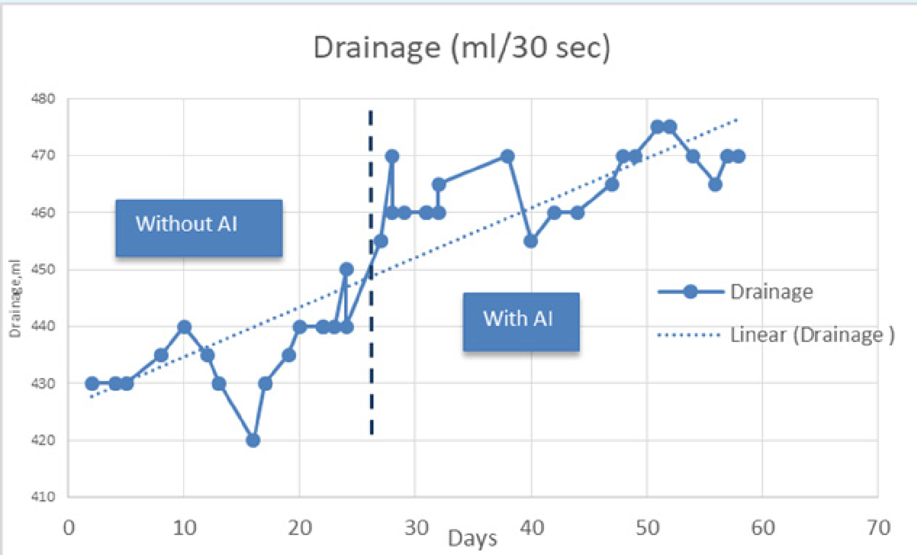
b. Optimal retention also meant that there is cleaner whitewater. The load on the unit operation of fiber recovery and water recycling such as sedicell/Krofta was reduced. This led to a reduction in running time of the sedicell/Krofta, which meant energy savings. The cost savings were thus obtained from both optimal retention and reduced energy usage.

c. Cleaner whitewater led to lesser deposits in the system, requiring lesser downtime. This ultimately added to the production rate. Thus the overall production rate of the plant improved.

2. Better drainage: The drainage of the system improved from 430 ml/30 seconds to 470 ml/30 seconds.

a. Better drainage meant a reduced vacuum load, which ultimately meant energy reduction.

b. It also lead to a decrease in steam consumption from 4.5 bar to 4.2 bar. Thus there is a reduction in steam usage.



3. Optimized RDA resulted in a decrease in quality defects. This resulted in a better ROI on the energy spent on the mill by reducing the costs associated with re-pulping and recycling the paper.

Conclusion

The artificial intelligence-based process control has helped improve productivity while ensuring sustainable use of resources. It has optimised retention while reducing electricity consumption, making it a win-win situation for the industry. Implementation of artificial intelligence to the process also brings along visibility thereby enabling better control. Artificial intelligence, with its capacity to handle huge sets of data, has also helped to predict and prevent deviations.

Abbreviations:

AI: Artificial Intelligence

ML: Machine Learning

RDA: Retention and Drainage Aid

TSS: Total suspended solids

FPR: First Pass Retention

FPAR: First Pass Ash Retention

KPI: Key Performance Indicator

ROI: Return on Investment

DCS: Distributed Control System

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