Artificial Intelligence in Pulp and Paper Industry

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Abstract: With industry 4.0 revolutionizing all industries, pulp, paper and packaging industry is no exception. With machine to machine communication, self-monitoring, machine learning and lot other features, smart automation is transforming industries. It can drastically improve the efficiency by intervening at each and every step of the value chain. In the pulp and paper industry the introduction of artificial intelligence can enable decision making to be proactive than to be reactive. Human intervention can be reduced and repetitive tasks can be automated. Overall equipment effectiveness can be improved and higher output can be achieved. Although AI has already been implemented for various applications in the industry, in this paper we would discuss control solutions for applications like microbial control, retention and drainage aid and wastewater treatment. In contrast to the traditional practice which involves revisiting chemical dosing at longer intervals and maintaining same dosing levels at multiple dosing points, AI can bring ahead a comprehensive solution. Real time monitoring and communication between machines can improve accuracy and reduces instances of over-dosing or under-dosing. It will help reduce the overall cost of the program and provides better results in terms of plant performance.

Key Words: Artificial Intelligence, Machine Learning, Process Improvement, IoT

Introduction: Artificial Intelligence:

As defined by Legg and Hutler (2007), Artificial intelligence refers to intelligence displayed by machines instead of intelligence demonstrated by any living being, like humans or animals.

AI has transcended from being good to have technology to a must-have technology over the past few years due to the compelling benefits that they bring along. It is one of the key technologies that are a part of Industry 4.0. Industry 4.0 in itself is set to create immense value for industries. As per a McKinsey report, by 2025 it is supposed to create a value of $3.7 trillion. The adoption of AI and value creation has been accelerated by the digitization wave in the post pandemic days, due to the ability of technology to facilitate businesses to navigate through the unknown.

AI in Manufacturing

In all this manufacturing industry has been no exception. Within the manufacturing sector, AI has mostly been adopted in the space of throughput, energy and yield optimization and in predictive maintenance. They have also reported an increase in revenue by more than 5% in most cases. Close to 52% have also cited a decrease in cost up to 20%. Some reports also suggest that AI can create a value of $1.2 to $2 trillion in manufacturing and supply chain management
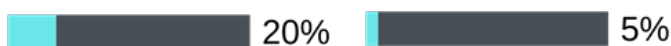

Fig 1: Decrease in cost due to AI   Fig 2: Increase in revenue due to AI

This increase in revenue or decrease in cost is driven by these key benefits which AI brings along:

- Visibility and tracking of KPIs such as production rate, OEE and others
- Predictive maintenance, which reduces the need for unplanned downtime
- Ensuring efficiency and reducing wastage of resources
- Self-optimizing machines which can automate the process

Even within the manufacturing industries, different manufacturers use AI for different purposes. Some have deployed AI in logistics to solve inventory stocking issues. AI-based robots to handle assembly lines are also one of the key applications. AI has also made its way through to designing. An AI-based software can help generate several efficient designs for a product.

MATERIAL AND METHOD

AI in Pulp and Paper Industry

The pulp and paper industry has been no exception to these advances. With increasing demand to replace non-recyclable packaging and the boom of e-commerce, the pulp, paper and packaging industry is growing like never before. In order to meet these growing demands, the industry must be functioning at its best efficiency. This is where AI can help the industry. The combination of artificial intelligence with IoT has enabled real-time monitoring. This not only gives huge volumes of data to facilitate decision making but also ensures easy and secure access to data, to enable remote functionality. Continuous monitoring and data-driven decision making improve precision. IoT enabled smart devices also help to reduce dependency on manual processes which are highly error-prone. Reducing dependence on manual processes also becomes critical at a time when subject matter

experts have become a scarce resource. There is a need to preserve and standardize human knowledge. We should automate processes that are repetitive in nature and divert labor hours towards tasks of higher strategic importance.

Artificial intelligence can automate different processes in the pulp and paper industry. AI-driven process automation can enable continuous monitoring of KPIs and other process parameters, take corrective actions on time and reduce errors. This improves production efficiency and product quality.

Artificial Intelligence in Action

HABER has developed an AI-driven technology called eLIXA® to automate a wide range of processes in the pulp and paper industry. eLIXA® combines the tasks of data collection, data analysis and intervention. It starts with sensor-based real-time data generation. ML-driven algorithms determine the process optimization/chemical addition by taking into consideration data provided by the sensors as well other offline parameters. Process optimization/Chemical addition is automated through eLIXA®. All the data is stored on a cloud platform, which is resilient to cyber-attacks. The performance can also be monitored remotely through dashboards. eLIXA® can control several processes.

HABER evaluated the performance of its AI-driven device deployed across several paper mills across different processes to understand the impact AI has created. The paper would explore some of the processes and understand the impact it has created.

MICROBIAL CONTROL

eLIXA® controlled Microbial Control Program is aimed at reducing the downtime and production rejects due to poor quality. The program was run at a specialty paper manufacturer who was facing issues like holes in paper, odour in wet end etc. eLIXA® measures parameters like ORP, temperature, pH and other parameters in real-time and calculates the required chemical addition in real-time.

It brings around a strict control over the Total Bacterial Count (TBC) thereby reducing sheet defects and improved machine efficiency.
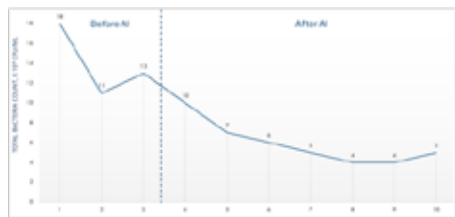

Fig 3: Decrease in total bacterial count due to AI

The introduction of AI has changed the process a lot. From taking 48 hours to receive test results to changing to real-time monitoring which gives readings every 15 minutes, the process can be monitored better. The dosing of chemicals can also be altered at different points, no need to maintain the same addition levels.
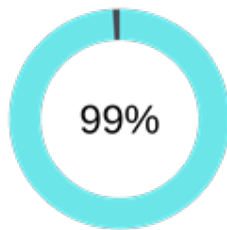

Fig 4: Decrease in time taken to test the samples due to AI

It resulted in a 22% increase in production levels due to a decrease in downtime and a 95% decrease in sheet defects.
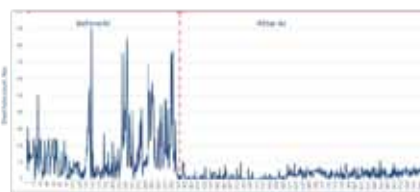

Fig 5: Decrease in Sheet holes count after AI implementation

AI provides a much more comprehensive solution to the problem as compared to the manual solution/linear automation which is driven purely by the existing bacterial count.

RETENTION AND DRAINAGE AID

Retention and Drainage Aids are critical to increase efficiency and improve the quality of the finished sheet. It affects several aspects like production rate, product quality, yield, system cleanliness and overall costs of the papermaking process. An AI-controlled RDA program measures several parameters like pH, temperature, whitewater consistency and other parameters in real-time. The ML-driven automated pump control based on real-time readings improved the program performance. The whitewater consistency was 21% better than the manual process and the production rate improved by 5% due to a decrease in steam demand. The downtime was also reduced by 95%.

Fig 6: Improvement in whitewater consistency
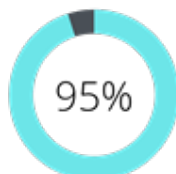

Fig 7: Increase in production rate after AI implementation

Fig 8: Decrease in downtime after AI implementation

WATER TREATMENT

A wide range of water treatment processes like raw water treatment, cooling water treatment, boiler water treatment, wastewater treatment and membrane treatment can be automated. It would include a comprehensive solution for controlling different target parameters based on application. Improving water/wastewater treatment does not only help in getting better results in terms of production but also helps the industry meet environmental regulations set by the government. Automating water/wastewater treatment is not only restricted to the pulp and paper industry. It can be replicated in any industry, as most of them do resort to water/wastewater treatment.

CONCLUSION

The AI-driven solutions have certainly made the processes faster and provided results with higher precision and lower scope for errors. It has reduced the dependency on manual processes and provided better results. It has also resulted in environmental benefits, by reducing water usage and reducing carbon footprint. It ensures that the machines are working at the best efficiency. Hence we can see the benefits AI can drive for the pulp and paper industry.

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