Industry
Pulp & Paper

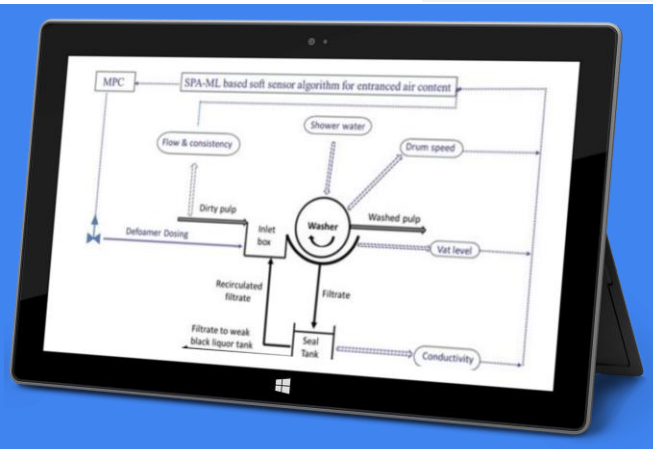
Applications
Statistics Pattern Analysis,
Machine Learning,
Model Predictive Control

Solutions
Energy Savings
Environmental Sustainability

CESMII
THE SMART MANUFACTURING INSTITUTE

PROJECT CASE STUDY

Smart Manufacturing of Pulp and Paper: Machine Learning Enabled Control of Brownstock Washing



PROJECT LEAD

Auburn University

PROJECT TEAM

Rayonier Advanced Materials

PROJECT OBJECTIVE

To develop a machine learning (ML) soft sensor to enable process controls for energy efficient brownstock washing.

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Smart Manufacturing Controls Drastically Reduce the Need for Toxic Chemicals in Pulp and Paper Washing

BENEFITS TO OUR NATION

- The technologies developed in this project will provide the pulp and paper industry with a unique opportunity to both reduce cost and improve environmental sustainability.
- The new control strategy developed in this project can be applied to other washing processes and will be reusable for modeling and control across a wide range of energy-intensive manufacturing processes.

BENEFITS TO INDUSTRY

- The technologies developed are reusable for modeling and control across a wide range of energy-intensive manufacturing processes in pulp and paper.
    - Potential savings of $180k per washer annually from defoamer usage reduction. Translating that savings to the >1,000 washers in operation nationally results in savings of $180 million annually for the pulp and paper industry.
    - Similarly, savings of $35k per washer annually from water and energy usage reduction translates to $35 million in energy and water savings for the industry.
- Train engineering students on Smart Manufacturing in the areas of advanced machine learning sensing, data analytics, and model-based control of manufacturing processes.

PROJECT DESCRIPTION

TECHNICAL APPROACH

A statistics pattern analysis (SPA) framework is used to build a statistics pattern analysis machine learning (SPA-ML) based soft sensor. Soft sensor algorithms are implemented to measure entrained air (foam) content.The data acquired via the soft sensor is then used to enable multi objective model predictive control for brown stock washing.

ACCOMPLISHMENTS

- Developed and deployed SM solutions for pulp and paper manufacturing that are reusable for modelling and control across a wide range of manufacturing processes.
- Reduced defoamer, water, and energy consumption in the pulp washing process.
    - Passive trials demonstrated 60% defoamer usage reduction by implementing machine learning based process controls. The controls enable a reduction in defoamer usage from 0.17 kg defoamer/ton pulp to 0.066 kg defoamer/ton pulp. This reduction in defoamer usage translates to a cost savings of $37.50/hour per washer.
    - Active trials demonstrated a 72% reduction in defoamer usage, which translates to a savings of $43.50/hour per washer.

DELIVERABLES

- Delivered Machine Learning enabled soft sensor algorithms to monitor entrained air content.
- Delivered multi-objective model predictive control solutions for brownstock washing.
- Tested and validated the effect of reducing defoamer flow while monitoring entrained air content and drum speed at Rayonier.

REUSEABLE OUTCOMES

- Developed and deployed a machine learning based soft sensor for entrained air content for pulp and paper manufacturing. The sensor is reusable for modelling and control across a range of manufacturing processes.
- Developed a soft sensor mathematical model and method for detecting entrained air content.

RESULTS

↓ -13.7k

Reduction in water usage will save 13.7k gallons of water per day per washer.

↓ $180k/yr

60% demonstrated reduction in defoamer usage will save $180k/year per washer.

↑ $35k/yr

Implementing machine learning model controls will save $35k/year in water and energy usage costs per washer.

PROJECT DETAIL
Budget Period: BP4
Submission Date: 1-31-22
Sub-Award (contract) Number:
4550 G YA079
SOPO: 2318

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This material is based upon work supported by the U.S. Department of Energy's Office of Energy Efficiency and Renewable Energy (EERE) under the Clean Energy Smart Manufacturing Innovation Institute (CESMII) Award Number DE-EE0007613.