Reusable Simulation Package for Potash Plant Design

Mechanical & Industrial Engineering
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Introduction

•Potash refinery plants have never been fully simulated due to their complexity. Many experts in the field believe that the cost of the complex modeling outweighs the benefit.

•Experimenting with a simulation model could capture more efficient designs, trace bottlenecks, and result in large savings.

Objectives

•Create a set of reusable simulation building blocks that can be used as a tool to model existing and future potash plants.

•Develop an end to end simulation model using the building blocks package, and verify that the tool can be used to accurately represent the potash refinement process.

•Identify bottlenecks in the plant processes, alleviate flow issues, and determine if the ROI of the potential solutions justifies the capital costs of a process improvement.

Analysis

1. **Component Creation:** Analyzed flow diagrams of potash plants and constructed SIMUL8 components to accurately represent plant equipment and flow.

Figure 1: SIMUL8 component (Primary Deslime Screen)

2. **Data Collection:** Collected flow rate data from METSIM model and populated components with inputs. Cleaned raw efficiency data from dryer and compactor sensors.

3. **Distribution Fitting:** Fit the MTBF and MTTR of dryer and compactor components with combination distributions.

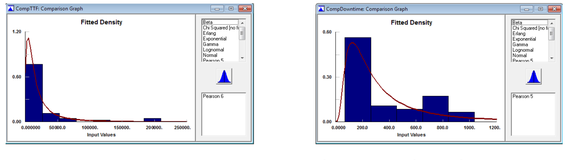


Figure 2: Compactor MTBF and MTTR distributions

4. **Component Testing:** Tested SIMUL8 components individually and in series to assure accurate flow.

5. **End to End (ETE):** Developed an ETE model to verify component model throughput against real production.

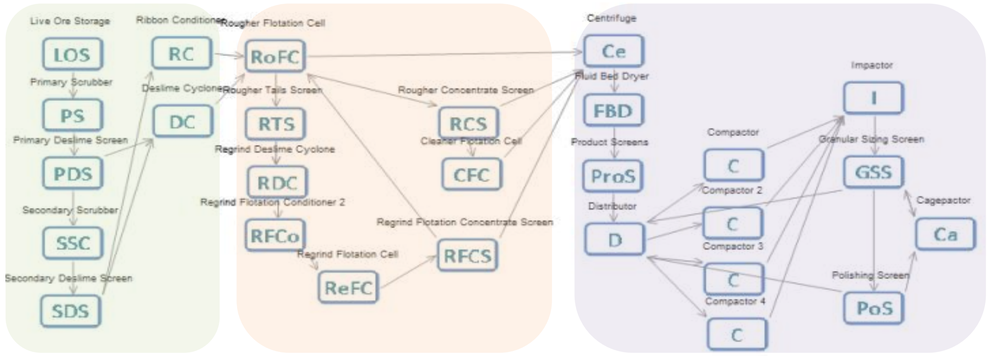


Figure 3: High level overview of End to End SIMUL8 model

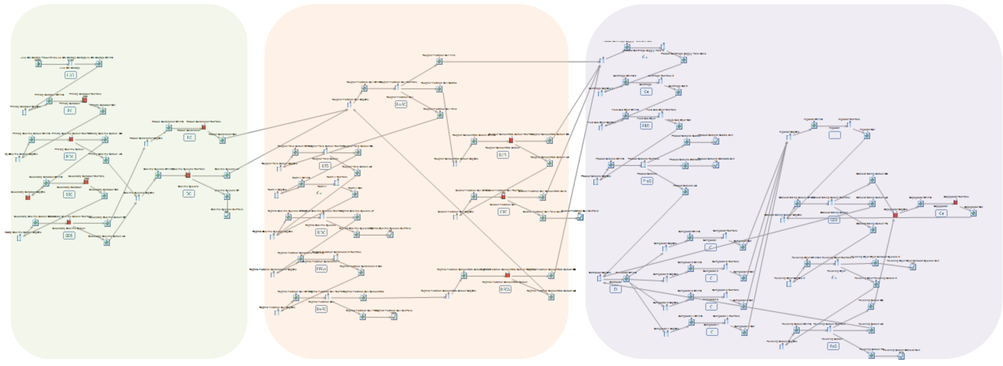


Figure 4: Detailed component level view of End to End SIMUL8 model

Scrubbing Flotation Refinement

Results

•27 reusable components were created in the potash component package.

•An ETE model was developed based on the process flow of a green-field potash plant, and flow rate data from a METSIM input model.

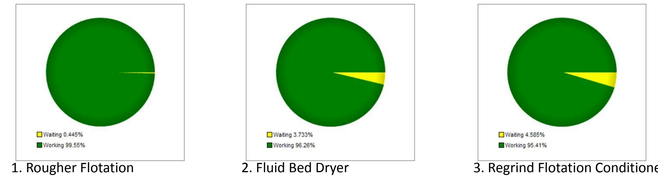
•Daily output of the SIMUL8 ETE model resembled the output of the 2.0561 MTPY plant, with a 95% C.I. of 2.0554 and 2.0568 MTPY.

•Bottle necks in the process flow were identified for future refinement of resource allocation and flow design strategies.

•Sensitivity analyses were performed at all bottleneck locations using various component configurations to determine which combinations of equipment would provide the greatest improvements to overall daily yield.

Recommendations

•The following component areas were the highest bottleneck issues in the ETE model. It is recommended that resources be focused here by placing components in parallel process:



1. Rougher Flotation 2. Fluid Bed Dryer 3. Regrind Flotation Conditioner

Figure 5: Percent Utilization by Component

•The costs of purchasing the components above should be determined, and the increase to production as a result of bottleneck alleviation should be estimated.

•Difference in cost between green-field construction and brown-field modification should be compared using an ROI strategy.

Future Work

•Potash *wet* process have not been considered (treatment of tails and process brine) based on client request. In future iterations these processes could be modeled to improve the accuracy of the component package.

•Flow rate data should be gathered from a single plant for input into the simulation components instead of pooling information from several sources.

•The MTBF and MTTR should be sampled for each component and a distribution developed to increase efficiency accuracy.

Conclusions

•The developed simulation building blocks can be used to quickly generate simulation models to continuously identify process improvement strategies, improve yield, and reduce plant footprints by designing and efficient plant with minimal waste/excess equipment.

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