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Case Study

Optimize Tank Sizing

Installing More Storage than Necessary is Simply a Waste of Capital

Methodology

Opgrade Performance Study of an existing plant

50 Words or Less

Management wants only as much storage as is really necessary, yet operations always asserts that they need as much as storage as can get! Through our Opgrade methodology, our client's management team can show operations that only 50% of their planned asphaltene storage is truly beneficial to the bottom line.

Project Background

Our client, a Canadian energy company, has a facility in Alberta to recover and upgrade oil-sands (bitumen) reserves. When the bitumen arrives at the upgrading facility, it is first separated into distillate and residues through a process called distillation. The distillate is then sent to a Hydrocracking (HCR) Unit which uses hydrogen, heat and catalyst to upgrade longer hydrocarbon molecules (distillate) into shorter molecules (Premium Synthetic Crude), which are then pumped to a pipeline for sale at roughly the WTI (West Texas Intermediate) spot price for crude.

The stickiest, heaviest portion of the bitumen, the asphaltenes, are separated from the residues and are too thick to be transformed into Premium Synthetic Crude (PSC). Instead, this facility uses these asphaltenes as fuel for a gasification process that breaks down the asphaltenes into hydrogen and carbon monoxide in the presence of substoichiometric oxygen, high temperatures and catalyst. This process converts what would otherwise be a low-value byproduct into something with a much higher value, make-up hydrogen for the HCR.

Without the ability to optimize tank sizes, many facilities install more tanks than are necessary

To maximize production (and therefore profits) the HCR Unit needs a consistent and continuous input stream of both bitumen and make-up hydrogen to replace the hydrogen consumed by the process. Any reduction in either the distillate or make-up hydrogen roughly translates to a roughly equivalent reduction in HCR production. Unfortunately, nothing in a plant is perfectly reliable, so frequent and lengthy outages substantially reduce HCR production and therefore profits.

The Problem

To smooth out the input flows to the HCR, distillate tanks are in place to theoretically decouple distillation and the HCR allow the HCR to continue running if distillation has an outage, or to allow distillation to continue running if the HCR has an outage. The problem, however, is that the when distillation has an outage, the gasifiers lose their feed and must shutdown, thus forcing the HCR to shut down. Similarly, if the HCR shuts down, the gasifiers cannot send hydrogen to the HCR, which means they cannot accept feed, thus forcing distillation to shut down too.

Without a means to store asphaltenes, distillation and the HCR remain coupled, meaning the whole plant shuts down anytime any individual area experiences an outage. But how big should the tanks be? In industry, most calculations for tank sizes are based on either:

- Tribal knowledge (guessing)
- Single-point improvements (ignoring system effects)

Simulation provides an effective means to empirically evaluate plant performance to both improve confidence and reduce risk. Outside of our Opgrade methodology, however, there isn't a unified simulation method to both properly and empirically account for all of the complexity of the real world when evaluating how tank sizes affect plant performance.

Study Objectives

The natural goal of this study is to optimize the size of the new asphaltene storage tanks by calculating how variations on the design capacity will affect revenue. Specifically:

- **10%** of the tank design capacity
- **50%** of the tank design capacity
- **80%** of the tank design capacity
- **100%** of the tank design capacity
- **120%** of the tank design capacity

Where 100% design capacity is the size as calculated by our client's engineers.

Failure Data

With all reliability-based studies, good failure data is fundamental to providing meaningful results. As the adage goes, garbage in: garbage out. For all Opgrade studies, we prefer to use actual operational data, but when that data is not available, we use a combination of trusted failure data sources from industry and vendor databases.

Regardless, all data undergoes a thorough vetting process with the project team before it is used in any study.

An optimist says
"the glass is half full."
A pessimist says
"the glass is half empty."
Opgrade says
"the glass is oversized!"

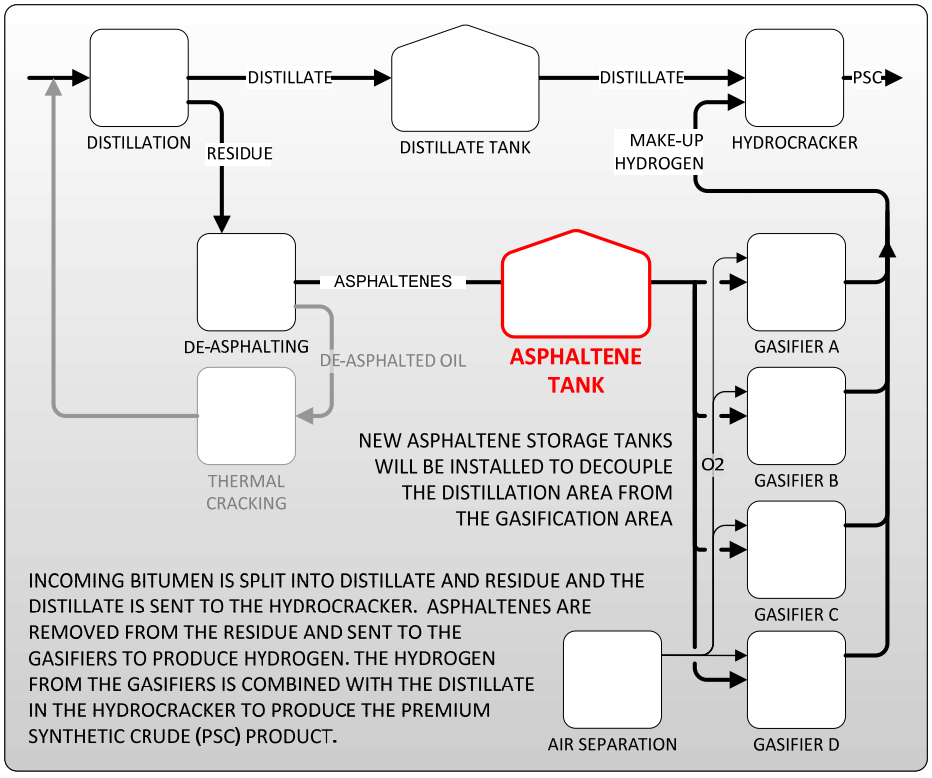


Figure 1 – A simplified Block Flow Diagram of the facility with new capital in red

System Description

Figure 1 above is a simplified Block Flow Diagram (BFD) of the modeled system. Though the actual model includes many more elements than are shown here, including upstream bitumen recovery units and certain utility or support units, this figure represents the configuration of the critical units in the system.

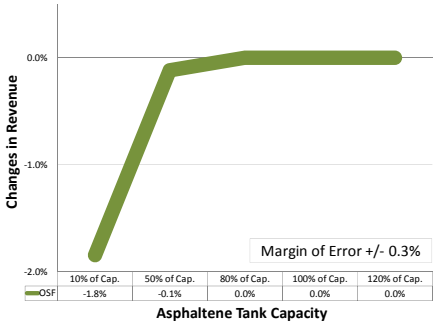
Tank Volume Work-Off Ability

To maximize the utility of any tank, it is imperative to retain or create the ability to work-off accumulated volumes of a full tank, or refill an empty tank, during normal operations. Waiting for an upstream or downstream outage to cause a tank to empty or fill is never the best use of that tank. For this study, tanks can fill or empty at 10% over normal operations.

Results Summary

To evaluate the possible tank capacities, sensitivity experiments were run that varied the size of the tank. As illustrated in the chart below, the changes in revenue generate a curve of diminishing returns. If PSC sells for $100 per barrel, a 50% capacity tank only reduces average annual revenues by 0.1% or $1.6 million.

Chart 1 – Diminishing Returns



Since a 100% capacity tank would really be two 50% capacity tanks physically costing about $20 million each, deleting one of the 50% tanks will significantly improve the ROI of this capital project.

Maximize Return on Investment

Now that Opgrade can more accurately predict how tank sizes affect revenue our clients can allocate tankage with confidence and maximize their expected ROI like never before.

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