Better energy efficiency and/or production following an Asset Performance Management workflow

AVEVA World 2022

14.11.22 to 17.11.22

Agenda:

1. About Suncor APM (RAW)
2. Fouling in Heat Exchangers and Fired Heaters
3. Case study

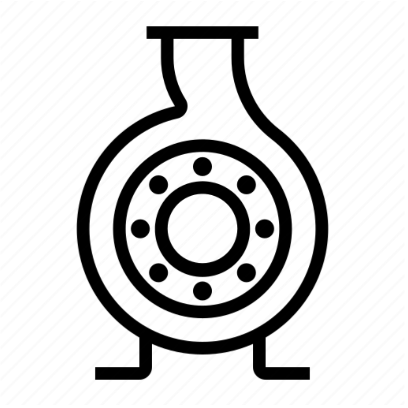
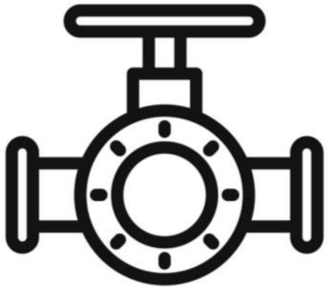
About Suncor APM (RAW)

- A globally competitive integrated energy company with a team of over 30,000 people, headquartered in Calgary, Alberta, Canada.
- Our operations include oil sands development, production and upgrading; offshore oil and gas; petroleum refining in Canada and the US; and our national Petro-Canada™ retail distribution network (now including our Electric Highway network of fast-charging EV stations).
- We care about responsibly developing our petroleum resources, while profitably growing a renewable energy portfolio and advancing the transition to a low-emissions future.

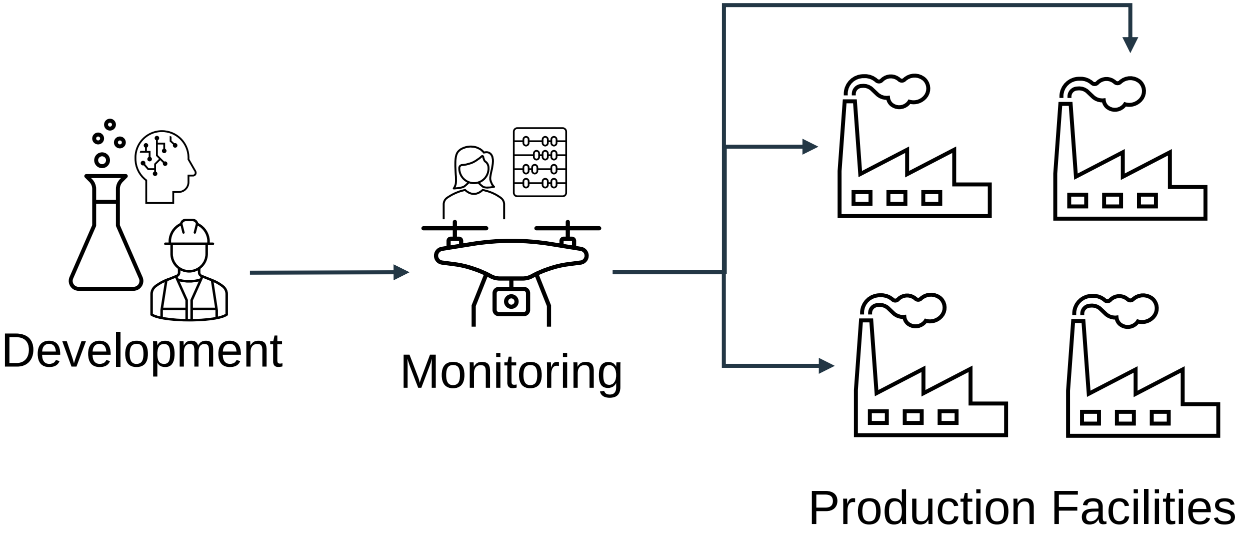
To provide trusted energy that enhances people's lives, while caring for each other and the earth.

About Suncor APM (RAW)

Asset Performance Management (APM) (RAW) is part of the overall Reliability Enablement journey. It leverages **R**emote monitoring, **A**dvanced analytics, and a collaborative **W**orkflow (RAW) to enable predictive asset maintenance and identification of risks to future asset performance.

Rotating	Process	Instrumentation	Electrical
			

Centralized Monitoring Team



Multiple software platforms

AVEVA Process Optimization

Asset Framework

AVEVA™ PI Vision™

AVEVA™ Predictive Analytics

Monitoring team consists of:

- (4) Rotation Specialists
- (1) Cogeneration Specialist
- (1) Process Specialist
- (1) Instrumentation Specialist

About Suncor APM (RAW) Process Monitoring

APM (RAW) is complementing the monitoring systems that sites have and does not plan to replace anything. **The objectives is to detect anomalies (outside the typical maintenance cycle of 6 weeks) before it becomes a "defect".** APM (RAW) uses business and process data to run **advanced analytics** (e.g. Pattern Recognition models using Vector/Cluster analysis) on asset trains or system, "Investigate Anomalies" and **provide sites with advanced "Alerts"**. The decision to act upon these "Alerts" will continue to be with the site personnel. Of course, if APM (RAW) detects defects within 6 weeks cycle, the Specialist will check with the sites to ensure that the defect was detected at the site with their current monitoring systems. In addition, the program also aims to use engineering calculations and additive data (from wireless sensors) to guide key maintenance decisions (e.g. when is the best time to clean / pig equipment).

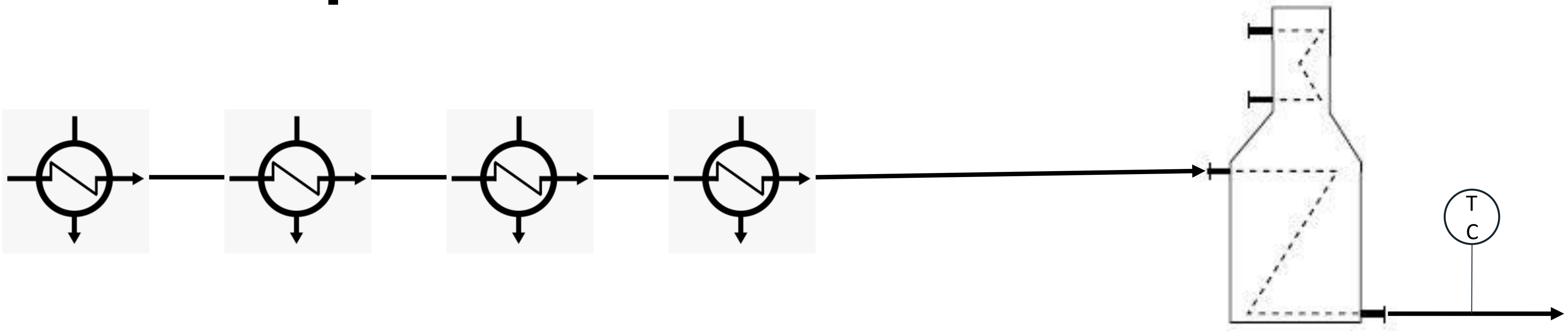
These are the types of questions we try to answer

- How long can I continue safely operating the equipment and will I reach the planned shutdown date?
- What is the expected impact on the end of run date if we run the equipment harder?
- What is the economic impact of continuing running equipment vs. performing maintenance activities?

Rotating	**Process**	Instrumentation	Electrical

Why is fouling in heat exchangers & fired heaters important?

Process Description:



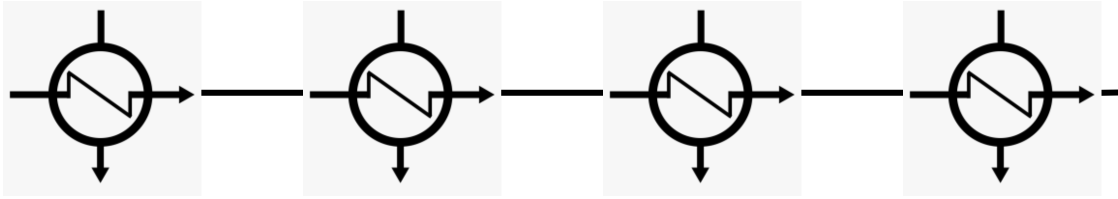
Heat Exchangers Network **Fired Heater**

- Typical arrangement for:
  - BFW system in SAGD
  - Crude units in refineries
  - Coker units in Upgrading

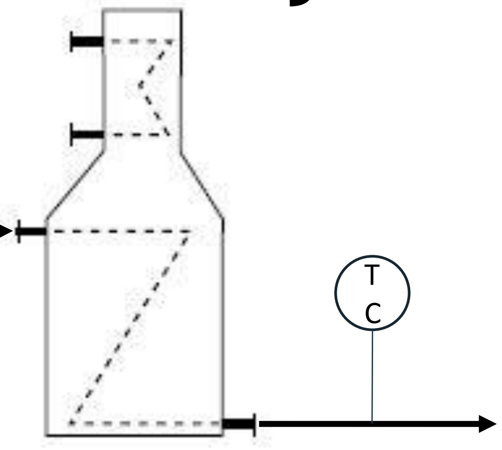
- **Heat Exchanger Network** synthesis is the heat integration between hot and cold process streams to reduce heating and cooling utility consumption in the process.

- **Fired Heaters** are used to further heat up the process fluid to reach its target processing temperature.

Statement of the Problem – Fired Heater Fouling

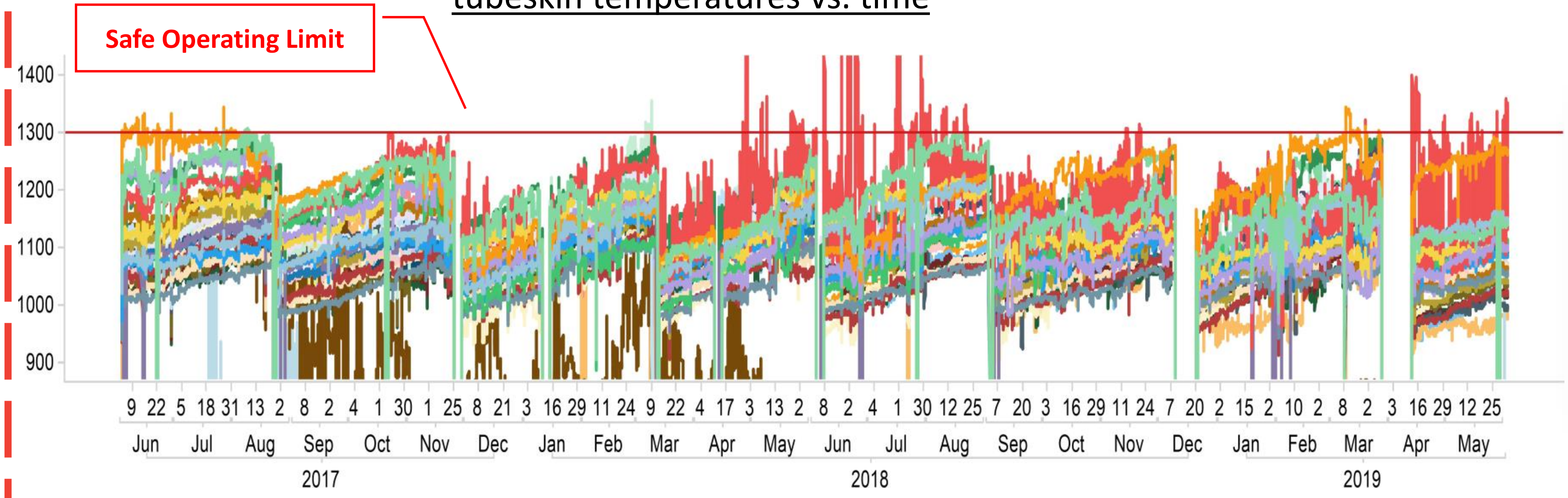


Heat Exchangers Network



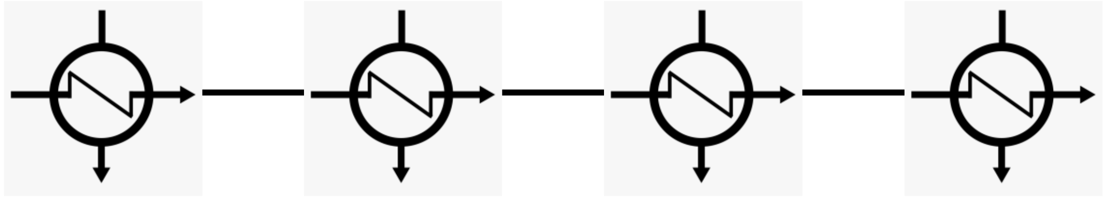
Fired Heater

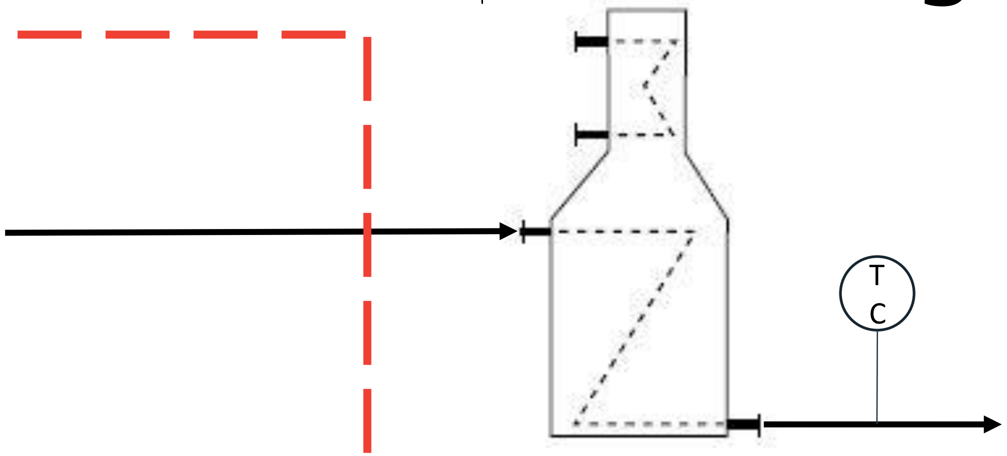
tubeskin temperatures vs. time



Statement of the Problem – Heat Exchanger Fouling

Heat Exchangers Network

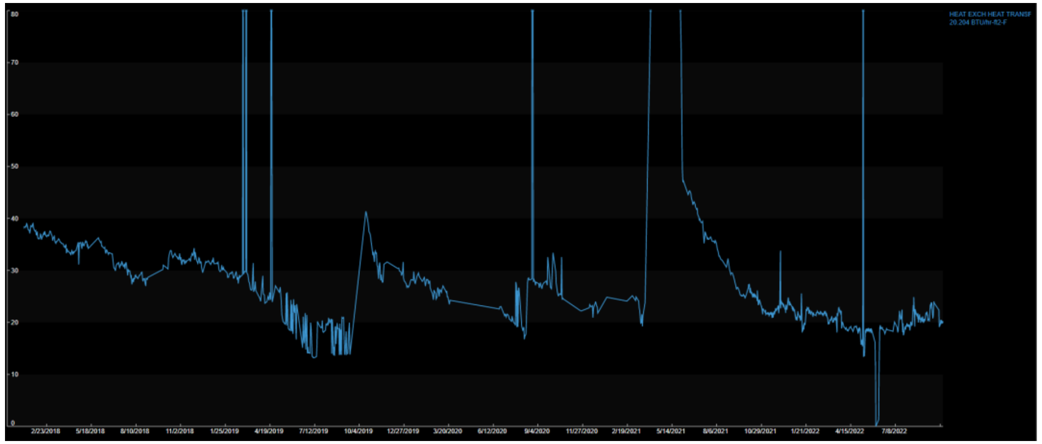




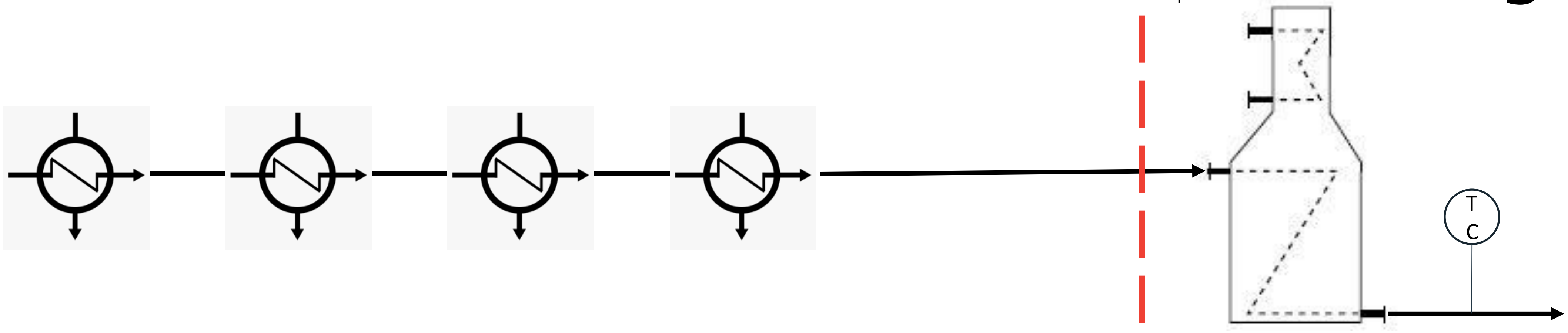
Fired Heater

Heat Exchangers Fouling in the File

Heat Exchangers Heat Transfer Coefficient Trend

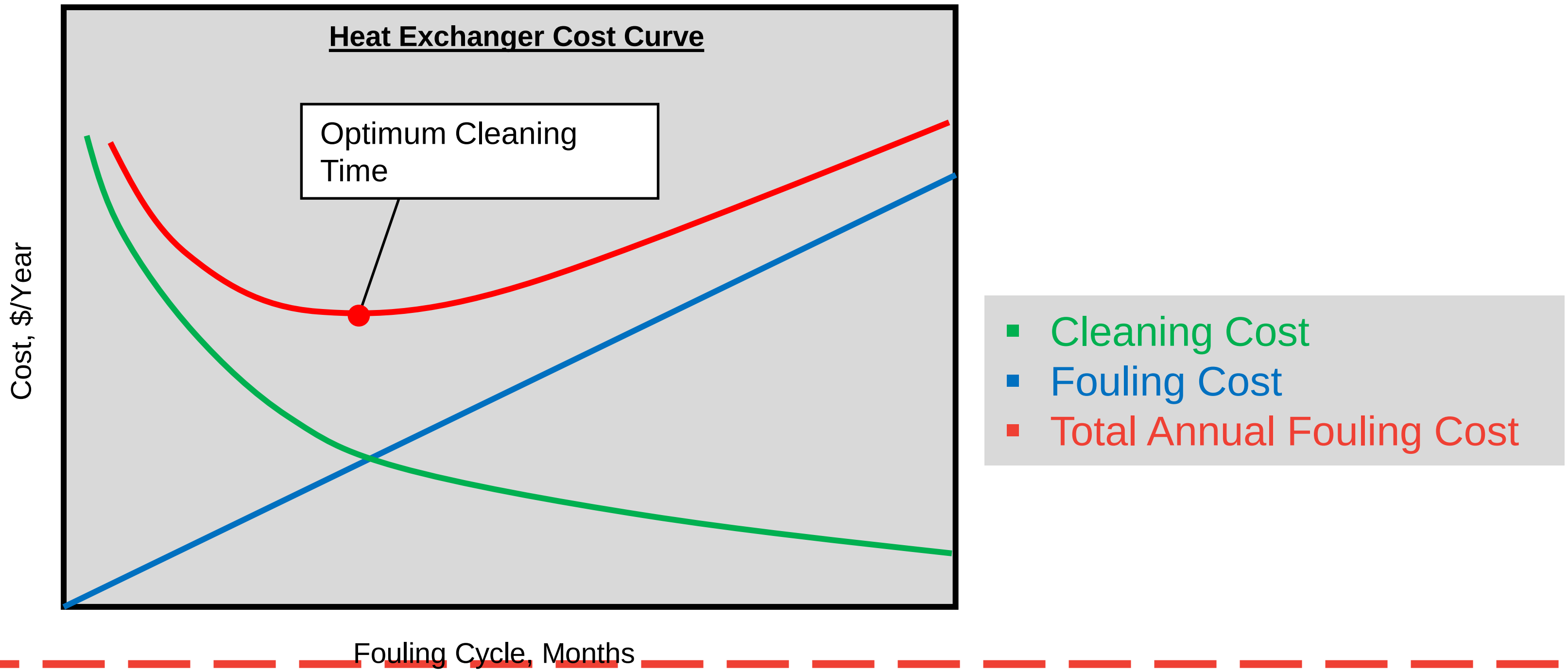


Statement of the Problem – Heat Exchanger Fouling



Heat Exchangers Network

Fired Heater



Predictive HX fouling cost

OHTC prediction

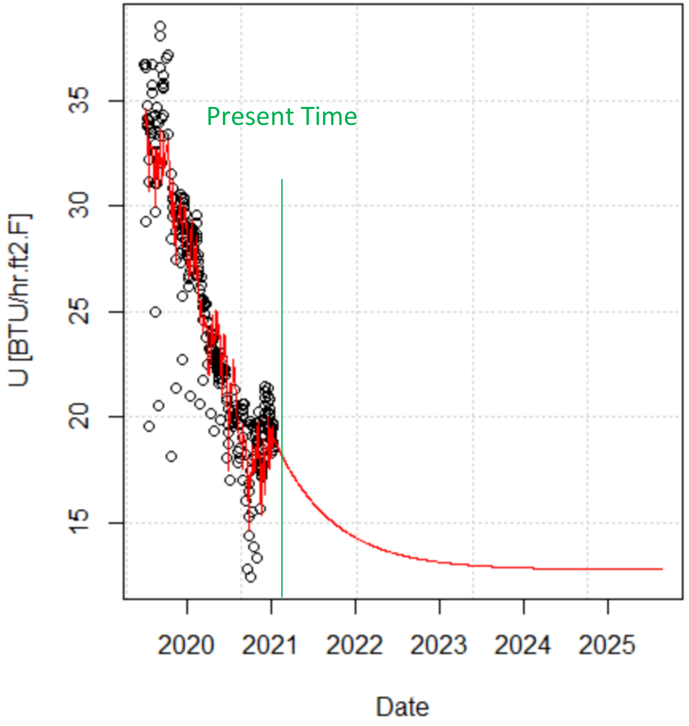
- *U = f(t, Tci, Thi, Fc, Fh)*

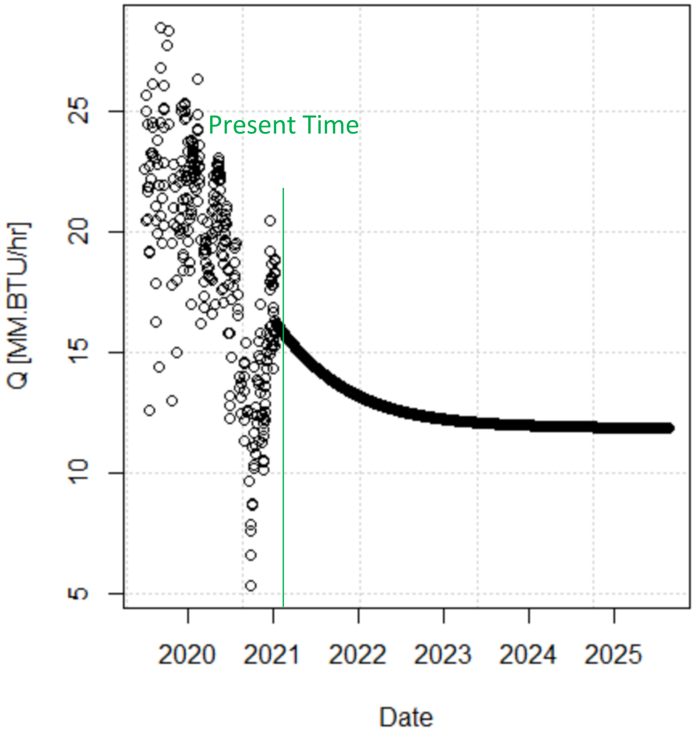
Duty calculation

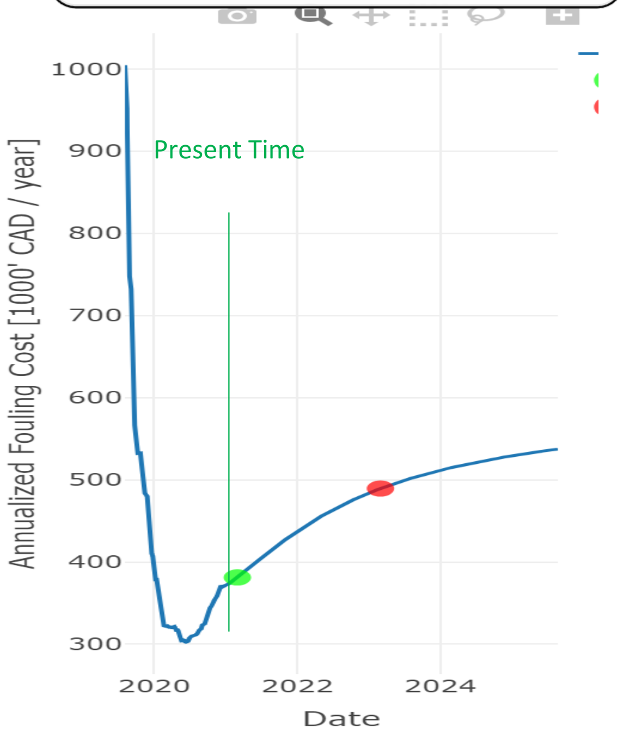
- *Q = f(U, Tci, Thi, Fc, Fh)*

Annualized fouling cost

- Energy & CO_2 cost vs. maintenance cost
- Proposed vs. deferred date







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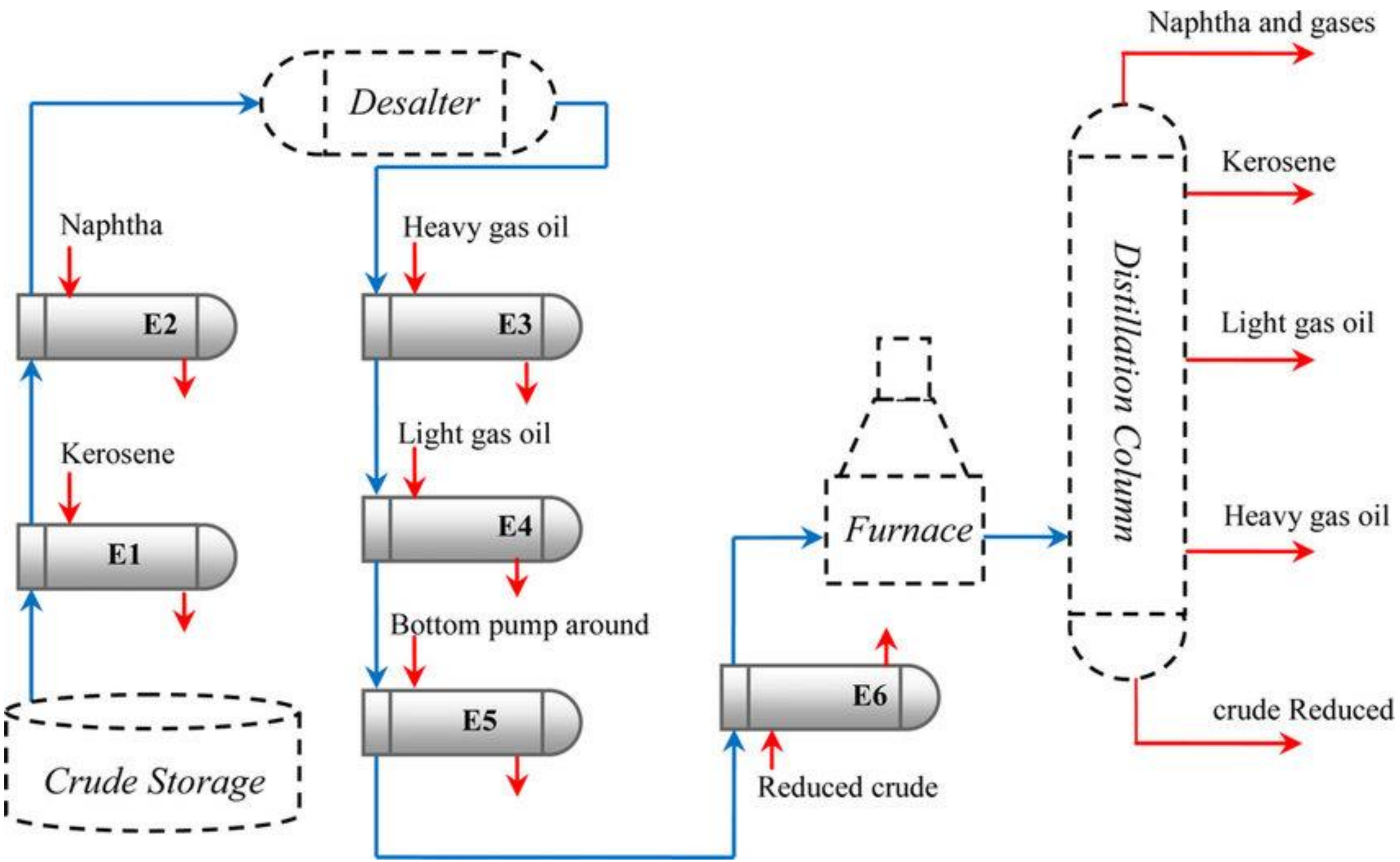
Patent pending

Case study, refinery turnaround strategy

Sarnia Refinery Plant 2 Crude Pre-Heat Train Model



**Typical Crude train shown (Panchal and Huangfu, 2000) actual configuration may be different*

Sarnia Refinery Plant 2 Crude Pre-Heat Train Case Study

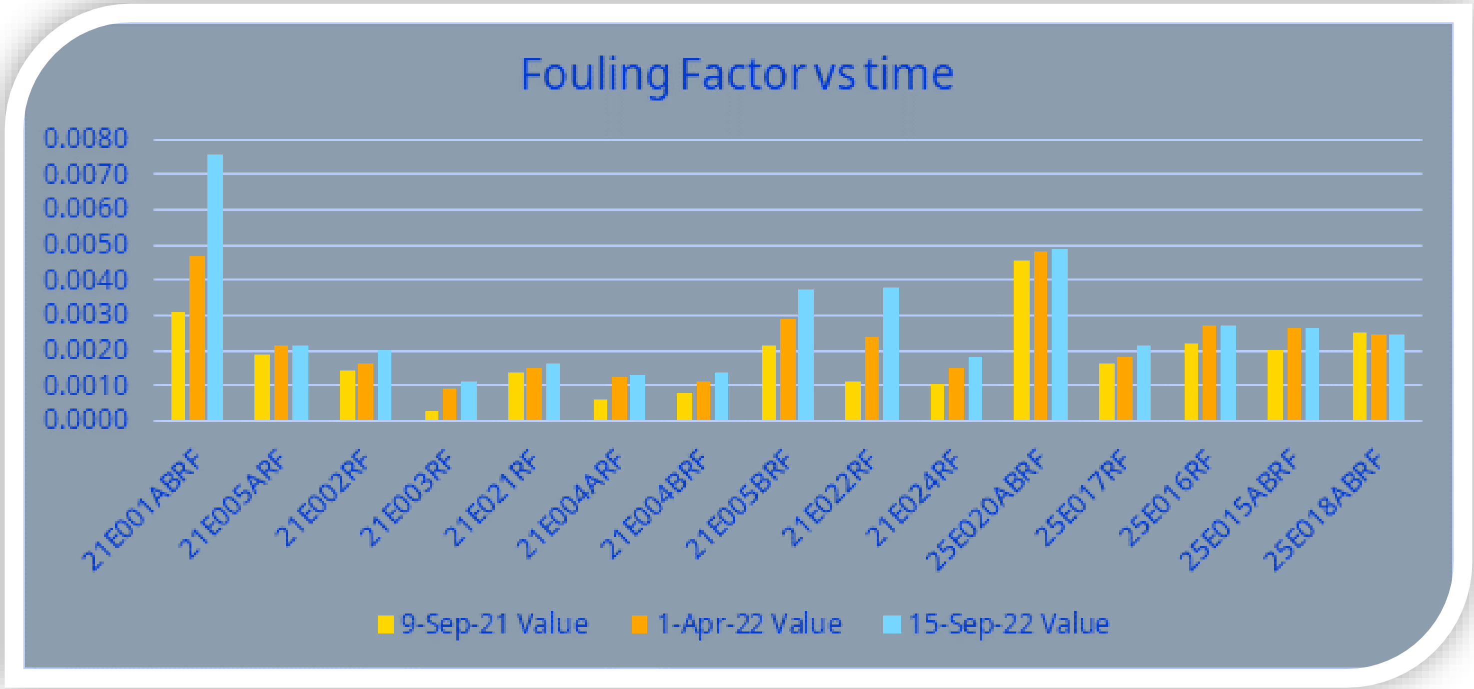
- Site had the plan to delay the scheduled turnaround from April to September.
- A case study was conducted utilizing the Process Optimization (ROMeo) model built for real-time monitoring and predictive analytics model.
- This case study quantifies the impact of delayed turnaround on the performance of the crude pre-heat heat exchangers and furnace, and ultimately impacts the refinery's ability to run to their production plan. Meeting this plan within the facility's operating envelope reduces risk and contributes toward safe operation.

Typical heat exchanger maintenance activities

AVEVA Process Optimization

Sarnia Refinery Plant 2 Crude Pre-Heat Train Case Study

- The future fouling factor of each heat exchanger was predicted using the analytics model, for April and for September. In most cases, fouling factor increases as time moves further into the future. This means heat exchangers will be more fouled with the delayed turnaround.
- With each set of fouling factors for the crude pre-heat heat exchangers, the inlet temperature of downstream crude furnace can be calculated. Thus, the duty required from the furnace to meet outlet temperature setpoint is estimated.



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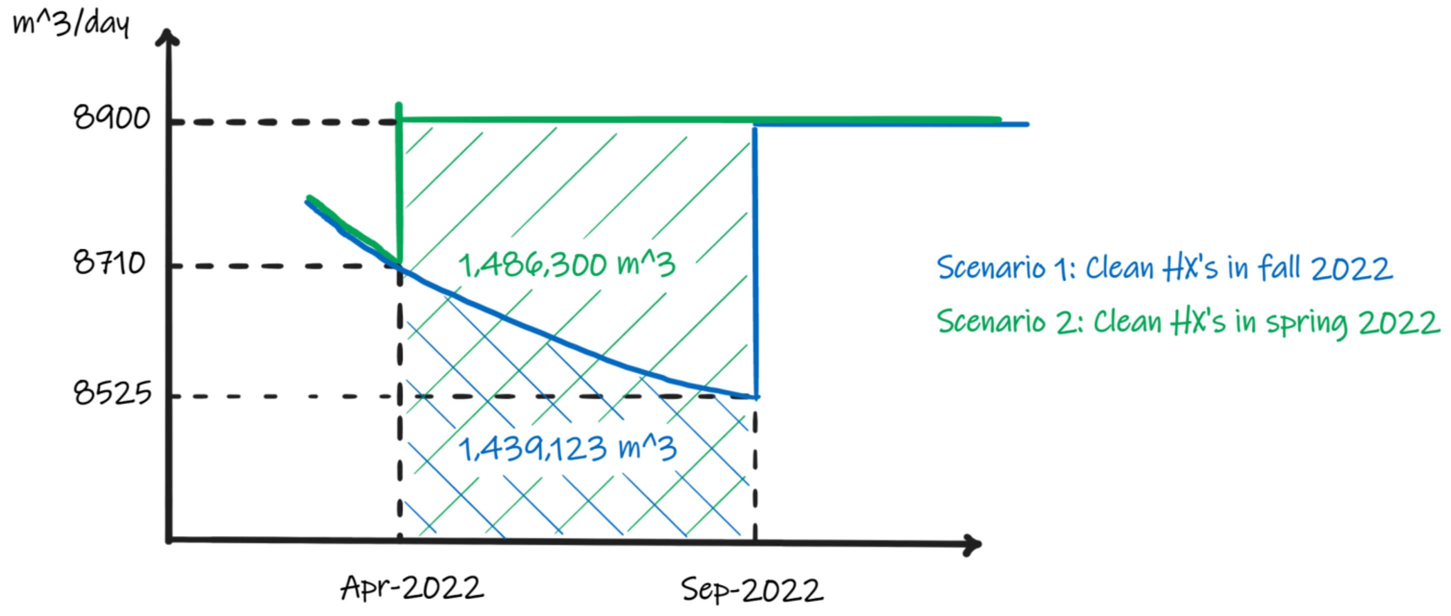
Sarnia Refinery Plant 2 Crude Pre-Heat Train Case Study



- With the constant crude flow, when pre-heat heat exchangers get more fouled the furnace is required to fire more fuel gas to generate more duty and meet outlet temperature.
- With the delayed turnaround, the furnace becomes more bottlenecked and crude flow needs to be reduced further.
- It was clear that the delayed turnaround could have caused a production impact and potential financial loss. After completing this case study, the site eventually went with the earlier turnaround.

World-class upstream/downstream operations

Challenge

- Providing state-of-the-art real-time monitoring and analytics capabilities for upstream oil extraction plants and downstream refineries to make informed maintenance decisions.

Solution

- Deployed AVEVA Process Optimization, Azure Machine Learning technologies, as well as PI AF and PI Vision as an advanced foundation for Process Monitoring, Condition Based Maintenance & Advanced Analytics

Benefits

- Increased production and operational efficiency, reduced costs, mobile inspections, exception-based surveillance, significantly accelerated 'Time to Value'.

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