Case Study: optimal renewal strategy for reactor catalyst

ASSET STRATEGY EVALUATOR

Problem description: ***When to replace an expensive process catalyst that is deteriorating in performance?***

There are a number of issues to consider when calculating the optimal renewal point for a reactor catalyst:

- The catalyst is costly and takes twelve days of process downtime to replace.
- In the first six months, a new catalyst often needs to be rectified, which can be costly.
- As catalyst deteriorates, operating costs increase as more energy is consumed to maintain process output.
- There also comes a time when the process throughput volumes are also affected, as the gas pressure cannot be safely increased further.
- The catalyst is presently replaced at a fixed interval every 32 months.

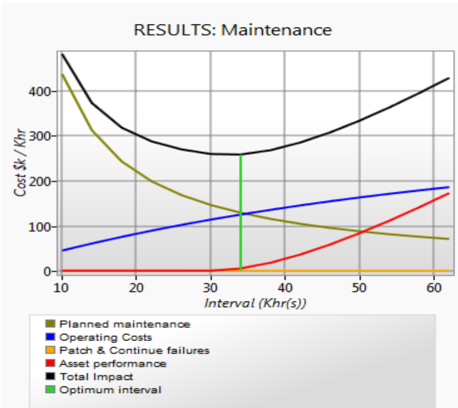
Results and benefits:

Using the DST ability to handle uncertain information, the studies revealed the variability in optimal time to renew the catalyst.

The optimal life of a catalyst that deteriorates quickly is c.25,000 hours and one that deteriorates slowly is c. 42,000 hours. The benefits of a flexible, case-by-case replacement timing (compared to the present fixed interval strategy), were calculated to be c.$130,000 per year. To achieve this, catalyst performance is monitored through incremental energy costs that reflect the degree of deterioration: the optimal replacement time triggered when such costs reach +$150/hour. This also gives adequate leadtime for planning the required shutdown and resources required.

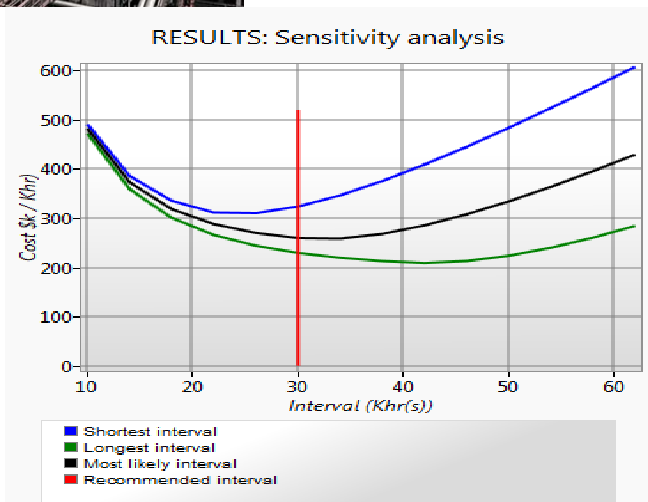
Chemical reactors in oil refineries and petrochemical plants rely on sophisticated, very expensive catalysts for their processes. However catalysts become 'poisoned' over time and their performance degrades. In some cases they can be recycled and 'washed' chemically, in others they simply have to be periodically replaced.

This DST case study addressed such as case-seeking the optimal time for catalyst change. It involved quantifying the (uncertain) degradation pattern, the risks introduced by the replacement, and the various costs of materials, labour, downtime etc.



DST Maintenance Evaluator was used to evaluate the optimal strategy, which showed that the optimal renewal interval for typical catalyst is 34 months, confirming that the current (32-month) interval is roughly right.

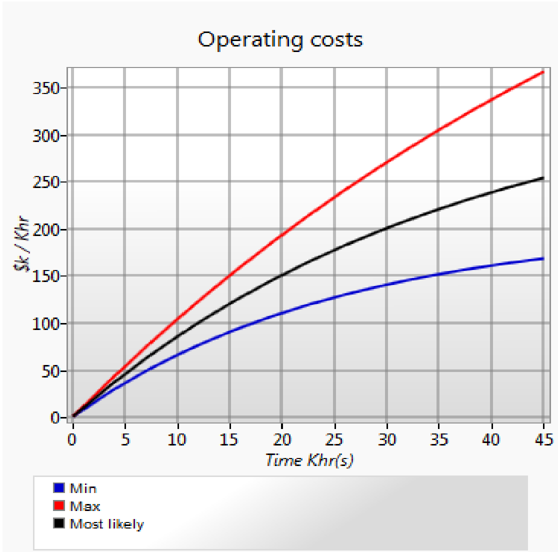
However, the DST study also revealed that a dynamic, condition-based replacement strategy would result in over $130,000/year benefits compared to the current fixed-interval approach.



Analysing the need to renew the catalyst:

The following decision factors were considered for modelling the need to renew the reactor catalyst in the **DST Maintenance Evaluator** software:

- Reliability deterioration
- Increasing operating costs
- Asset performance
- Prolonging asset life
- Compliance with legal requirements
- Shine factors (reputation, morale, image)



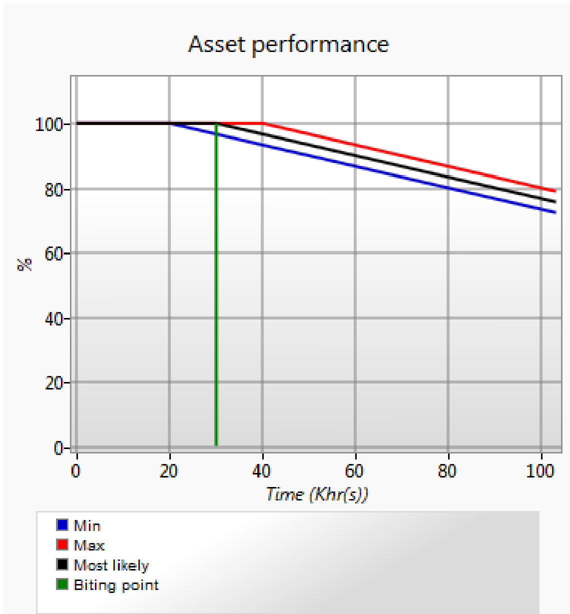
Reliability, Operating Costs and Asset Performance were identified by the company's team of experts as relevant to consider in this case. The team quantified their knowledge and assumptions, including the ranges of optimistic and pessimistic extremes, and the basis for their assumptions (creating an audit trail for the future).

Operating costs:

These are estimates of the rate at which energy costs increase as the catalysts age.

Asset Performance:

This illustrates the process throughput being constrained by the deterioration of the catalyst. The performance only starts to fall between 20,000 to 40,000 hours, as the initial effect is absorbed by increasing the operating pressure and throughput of the gas compressors. When additional compressor capacity can no longer compensate, however, the production process has to be throttled back to sustain production quality.



Variability in all factors. The catalysts very seldom perform in repeatable patterns, as some deteriorate faster than others. This can be put down to varying quality of the catalyst, environmental differences in the weather and seasonal patterns and feedstock variability in the process. To accommodate this variability, the minimum, most likely and maximum estimates were entered and illustrated here. Details of the costs estimates were entered in the study record.

For further information about DST Inspection Evaluator, and the SALVO processes, please contact:

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