

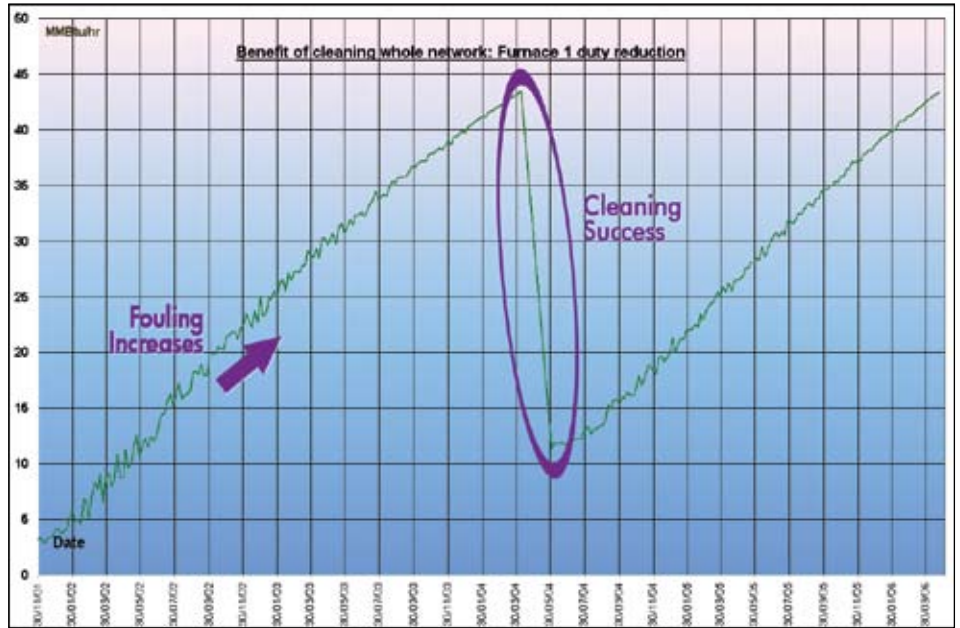


Persimmon™

Heat Exchanger Fouling Monitoring

Heat exchanger fouling results in many issues, including increased energy cost, lost production, and increased pressure drop. Studies have shown that after 1 year an atmospheric distillation unit on a refinery may be using 10% more energy due to fouling. If a heater is the bottleneck, this causes a similar loss in throughput - a huge cost in today's economic climate. All of these issues can be mitigated by cleaning; however, deciding which exchanger to clean is a difficult task given the many existing operating constraints.

Persimmon™, the proprietary KBC energy software which analyses the performance of a heat exchanger network, calculates fouling, and quantifies the benefit of cleaning, helps with this task.



Benefit of Cleaning a Good Key Performance Indicator for Fouling Monitoring

BENEFITS

The main benefits Persimmon can provide are:

- Performance Monitoring – Export data to databases and plant data historian
- Make Better Exchanger Cleaning Decisions
 - Which exchangers to clean and when
 - Best exchangers to clean during an unscheduled shutdown
- Lower Energy Costs
- Increase Throughput (especially when the heater is the bottleneck) and Yield

Other benefits include:

- Turnaround Planning – Create a priority list of exchangers to clean during a turnaround
- Fouling Monitoring
 - Monitor the amount and cost of fouling over time for each exchanger and across the entire network
 - Identify sudden fouling events as they occur
- Exchanger Performance Diagnosis – Identify operating problems in individual exchangers
- What If Analysis – Use the simulation capability to answer “What If” questions about operating changes

- Performance Trending – Display performance history using results that have been exported to a database
- Time Savings – Operations and technical services engineers can rationalise preheat train performance much more rapidly than by other methods.
- Ease of Use – Persimmon is spreadsheet-based, driven by command buttons, forms, and dialog windows
- Automated Operation – Persimmon links to plant data historians for rapid data collection and can be automated to facilitate frequent analyses

Overall, Persimmon users can expect lower energy costs and increased throughput as a result of better analysis and decision making capabilities.

MAIN FEATURES

Persimmon contains several interlinked components:

- Data Bridge – For connecting to plant data historian
- Data Reconciliation – For rapid development of a consistent heat and material balance
- Network Rating – To analyse the current network performance and calculate the fouling
- Network Simulation – To simulate the benefit of cleaning; for what if analyses

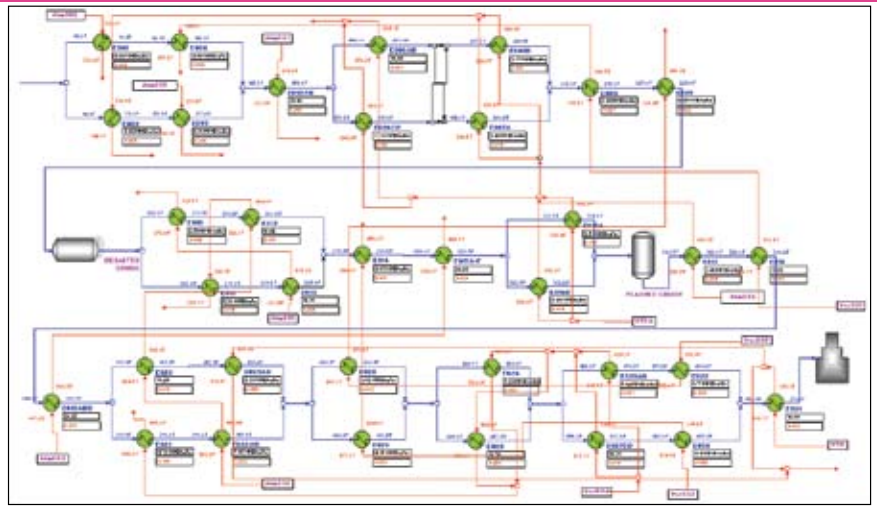
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NETWORK RATING

The rating program calculates heat duties from temperatures, usually after automatic data reconciliation. From this it calculates the fouling implied by the geometry and operating conditions of each exchanger.

The results are in both graphical and tabular formats:

- Fouling factors
- Heat balances
- Exchanger operating characteristics: Velocity, Reynolds Number, film coefficients, tubewall temperatures, pressure drop
- An Economic Summary of the hourly operating cost of the unit, including credits for steam generation

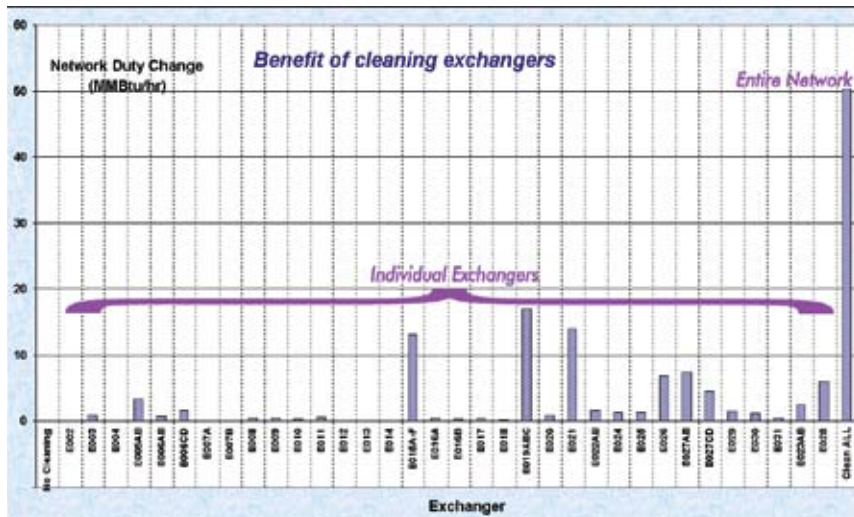


Network Diagram Showing Details of Current Operation

You can also perform "What If" case studies by changing fouling factors, product draw temperatures, feed and product rates, split fractions and so on. You can even change the network structure for revamp or taking an exchanger out of service.

CLEANING ANALYSIS AND SIMULATION

The simulation program is used to predict the benefit of cleaning individual exchangers or the whole network. Various levels of cleaning analysis are available, including the top 5 sequential cleaning candidates, in order of economic benefit.



Above: Graph Shows Benefits of Cleaning Various Exchangers

Right: Table Shows Top 5 Exchangers to Clean in Terms of Benefits

CASE STUDY

A Canadian refinery experienced a sudden fouling event following start-up after an unscheduled shutdown. The KBC fouling monitoring software quickly caught this event, and it pinpointed which exchangers needed cleaning.

As a result, the refinery planned for an opportunity cleaning of the 3 exchangers during a refinery slow-down 12 weeks later. The estimated savings were US\$2MM/yr of energy costs and an even greater value based on increased throughput or product recovery.

Exchanger	Time Since Last Cng. Class	Network Duty Change if Cleaned (MMBtu/hr)	Average Dng Income (\$/Day)	Cleaning Cost (\$K)	Projected Benefit over 90 Days (\$K)	Payback Period (Days)	Benefit to Ratio Over 90 Days
E004C	336	16.94	478.04	43,312.46	118,123.26	14.9	3.4
E021	335	11.29	659.31	41,125.71	106,987.57	21.2	4.4
E004A	324	11.15	58.98	41,125.71	140,308.26	33.2	2.2
E001	325	2.42	354.70	41,125.71	41,125.71	61.2	1.1
E004B	328	1.75	386.27	41,125.71	47,028.11	71.5	1.1

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