

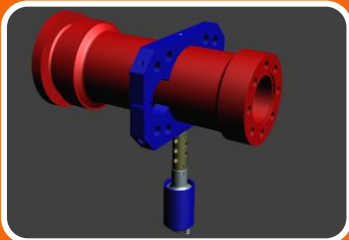
Ultrasonic Cleaning Baths

- Multiple sizes & configurations
- Variable powered units for purpose-built cleaning applications



Clean-in-Process Technologies

- USP [Ultrasonic Scale Prevention]
- M³ Technology



Fouling Mitigation & Process Improvement

- M³ Technology (clamp on) apparatus with pre-selected ultrasonic power output, to match with specified outcomes

The very first heat exchanger was
cleaned by ultrasonic bath in
November 2009, Fort McMurray,
Alberta Canada
SUNCOR





10m Ultrasonic Bath
2016



Before heat exchangers, we cleaned scaffolding.

Typically, the refinery would give us something that looked like this...

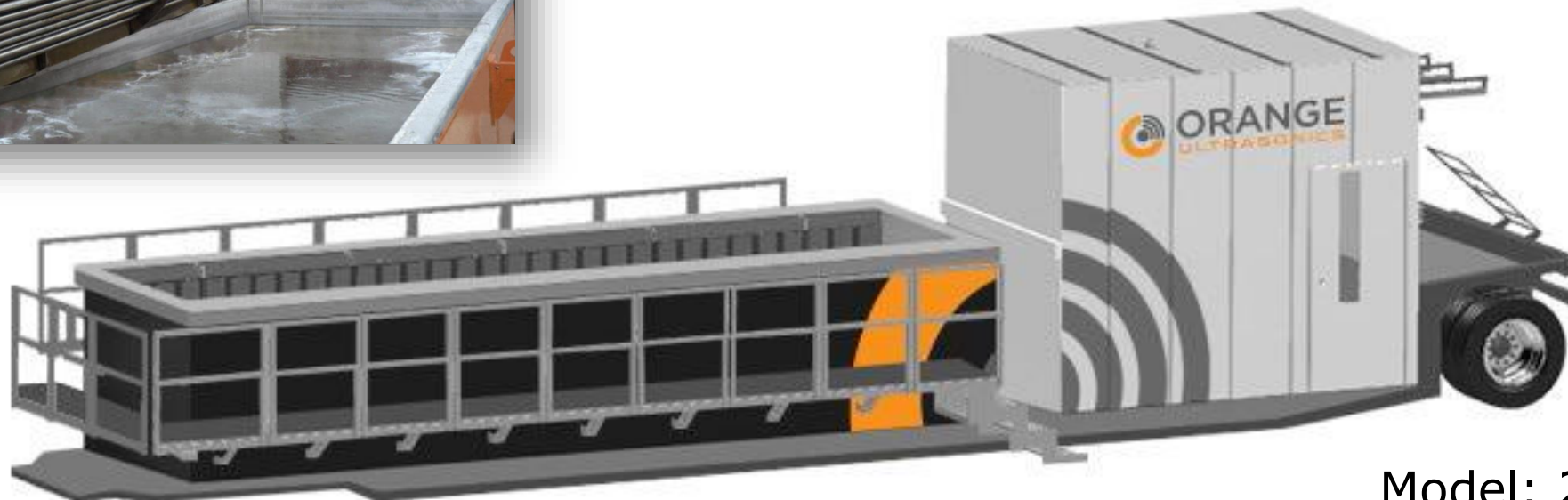


... and we would give them back a plank like this in about 25 minutes

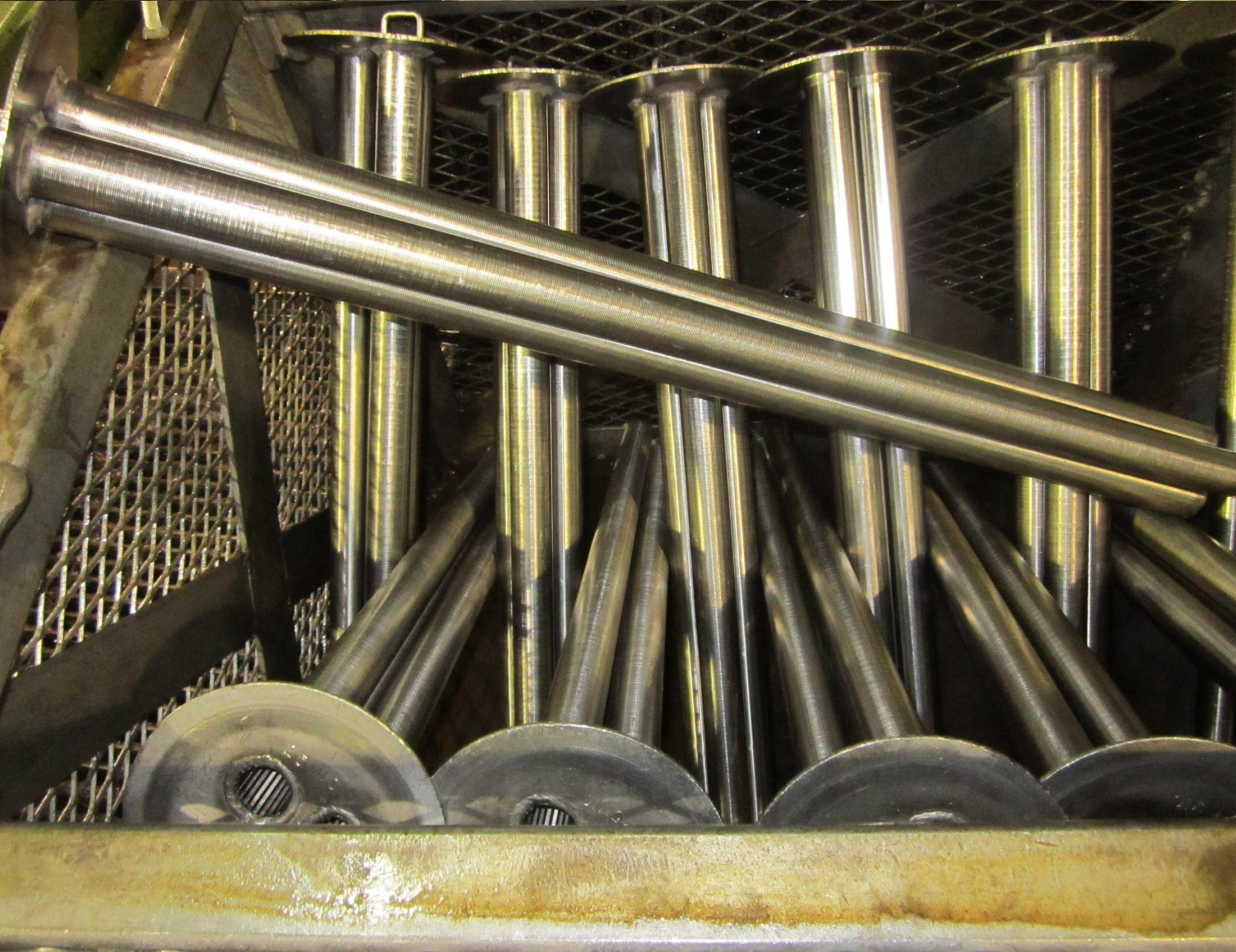
Acoustic Cleaning Baths



- Will accommodate Hx units up to 8m in length
- Axle allows for easy transport and set-up without needing a crane.
- Essential Wave Technology (EWT). Purpose built ultrasonic generators and transducers to work in extreme conditions and temperatures.



Model: 2764AXL



Sintered Metal filters
cleaned in batches

Previous cleaning with
high pressure water or
agressive chemicals
were damanging these
filters.



SONIC WAVE TP

CONCRETE
WARNING
NEVER SONIC HD

RDS019

2297163



04/02/2013 13:42



Rotor: SHELL,
Rheinland,
Raffinerie



Rotor: SHELL,
Rheinland
Raffinerie

Note the cleaning
time!

04/02/2013 14:59



03/20/2013 11:27

What Can You Clean ?

- Scaffolding
- Pumps
- Valves
- Spools
- Barrels
- Elbows
- Pipe
- Nozzles
- Filters – every kind including DPF's
- Tools
- Exchangers

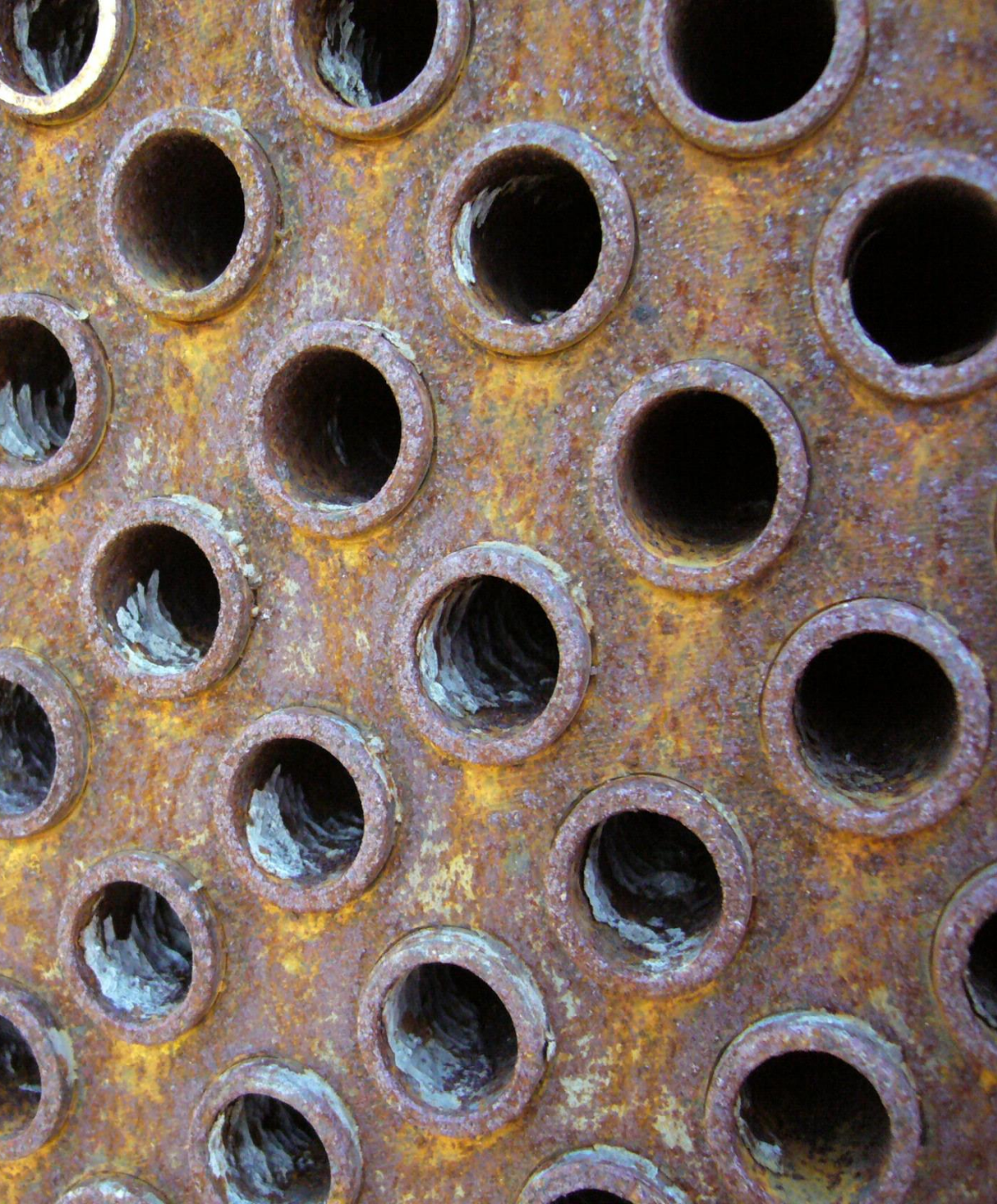


THE CLEANING PROCESS:

How does it work?

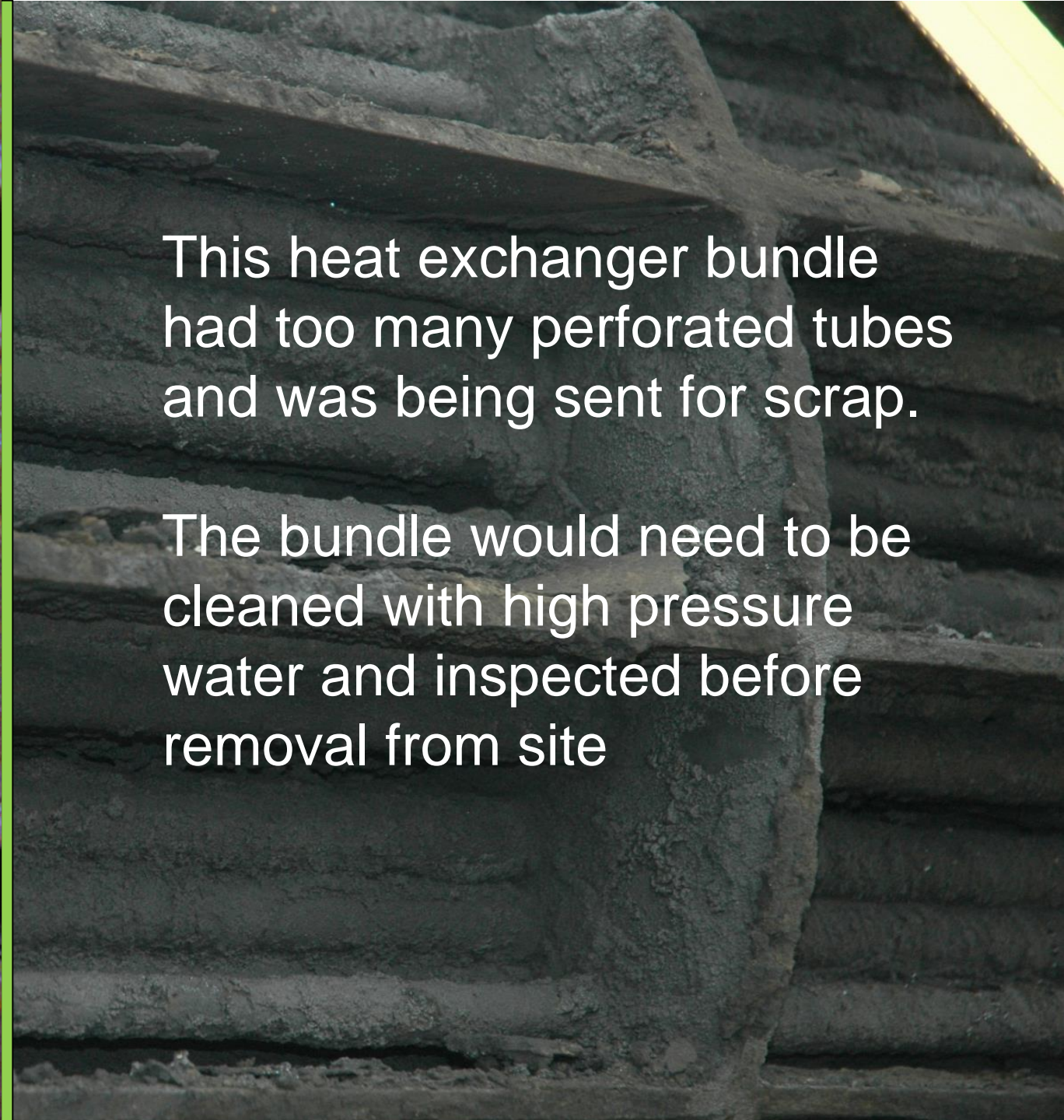


Other types of deposits remain,
but no longer adhere to the
tubes.



This heat exchanger bundle had too many perforated tubes and was being sent for scrap.

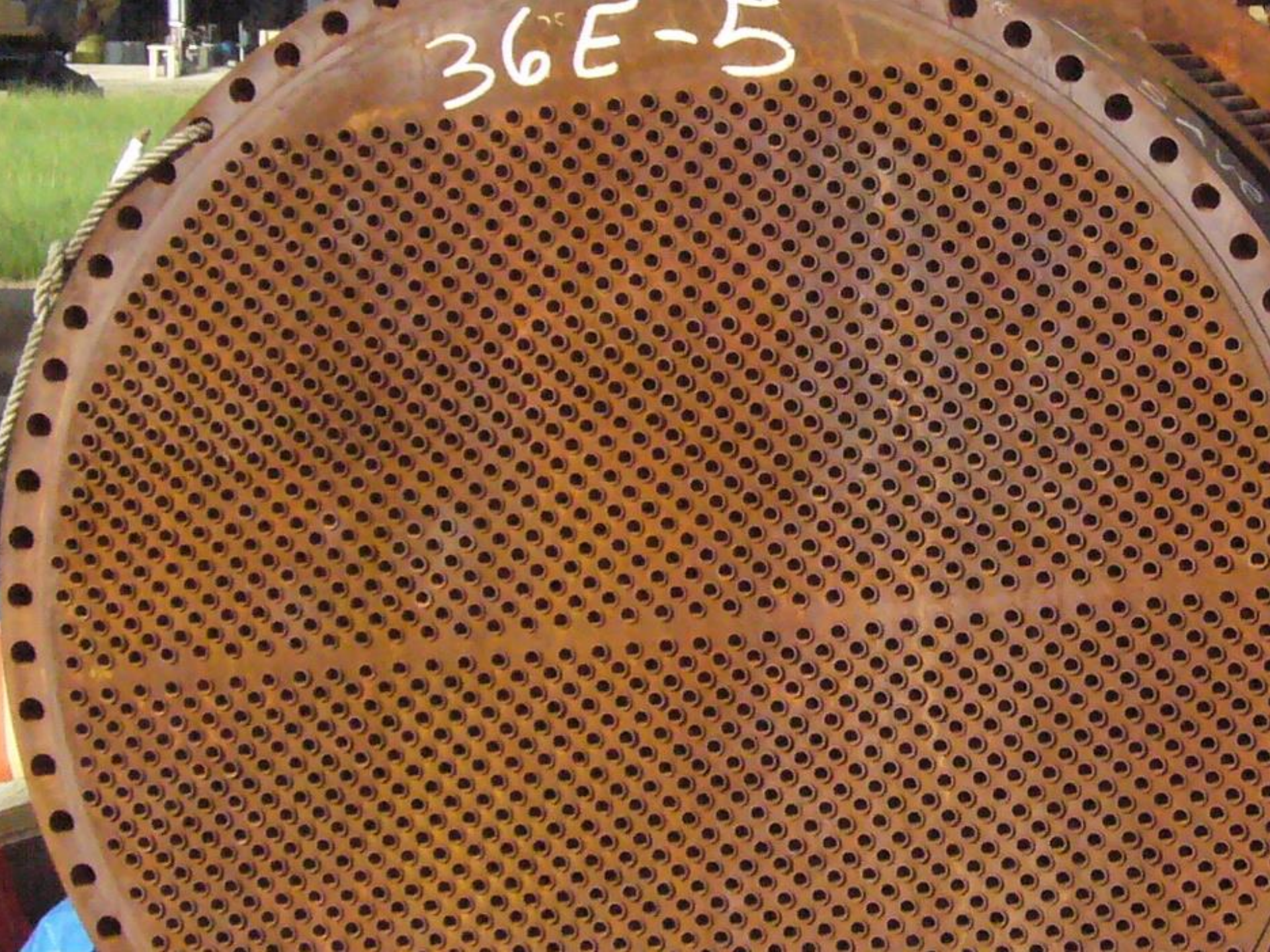
The bundle would need to be cleaned with high pressure water and inspected before removal from site





The bundle was cleaned with high pressure water and inspected before removal from site.





During the
the sheet off the
was so that
the isched
left with
between
tubes, we cut
the tubesheet
off.

The very nature of this submersion technology allows the sound wave cleaning to reach and remove contamination from those hidden areas that other methods simply cannot.





The Shell Scotford Upgrader

Fort Saskatchewan,
Alberta



Shell Scotford Upgrader



Project Scope:



- **44 Heat Exchangers**
- **682 Control/Relief & Check Valves**
- **4 Labyrinth mixers**

Beyond Scope:

- Several hand valves, pipe spools, hose assemblies and other non-specific items.

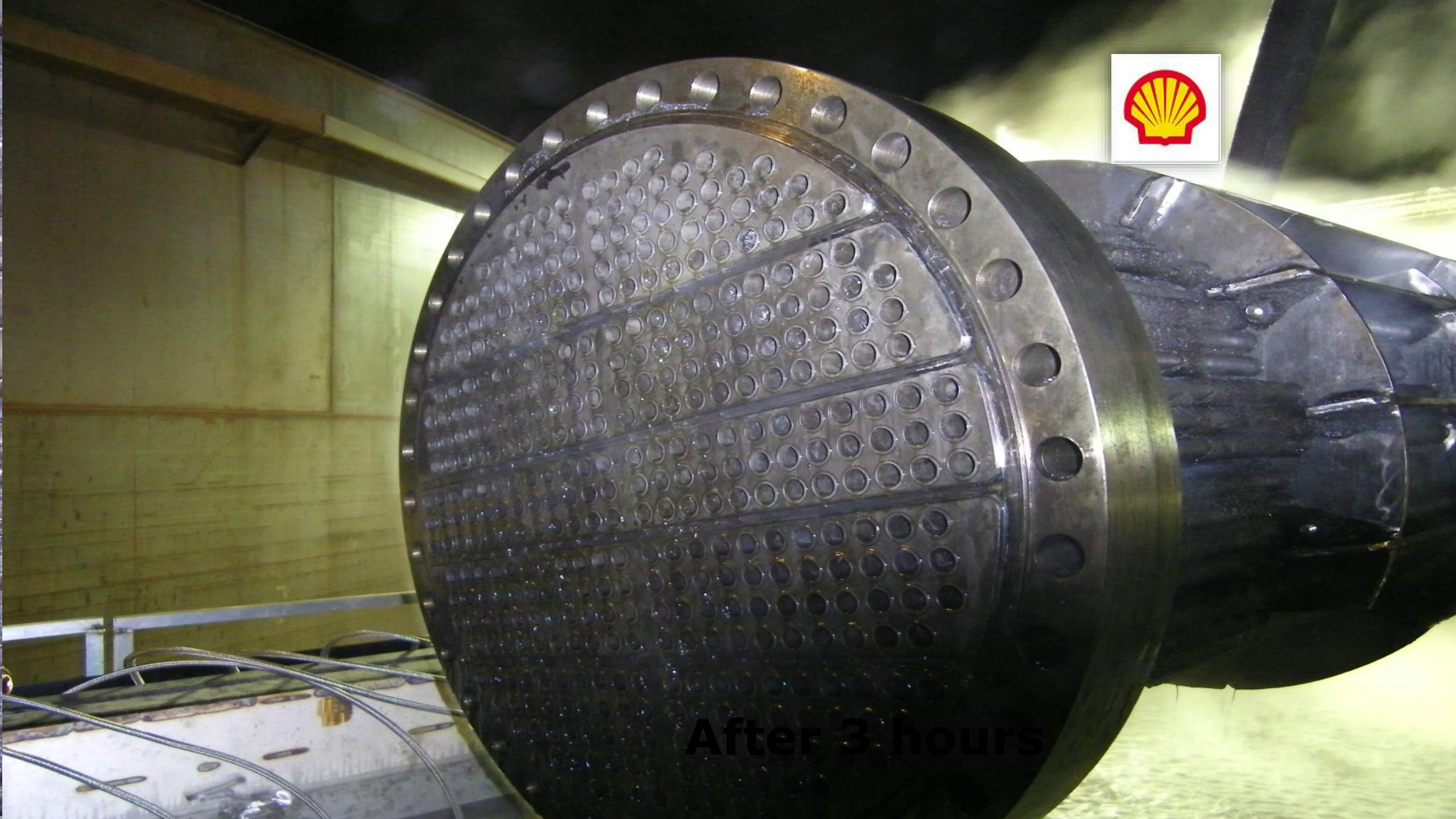




Turnaround Results–

Comments from the Turnaround Manager:

- *"We experienced excellence results with cleaning components for offsite repair/overhaul. 3rd party companies have never seen valves as clean as the ones coming from Scotford."*
- *"Stainless steel bundles were cleaned better than expected and typically achieved IRIS quality. Bundles with other material composition were generally cleaned to Eddy Current quality. To achieve IRIS spec for these non-stainless, some were rinsed with a 20Kpsi & rotary lance"*



After 3 hours



**Complete for inspection
After 8 hours**



New method of exchanger cleaning

The exchanger in the foreground is clean, the one in the background is ready for its bath.

Always an important part of any turnaround is exchanger cleaning. This time we're doing it differently, and more effectively. Rather than blasting with high-pressure water hose, they are now being soaked in a hot bath. It's a first for North Atlantic.

In the case of our exchangers, a crane slowly and carefully lowers the dirty piece of equipment into a 35-foot-long vessel where it will sit for about four hours—depending on how dirty it is. The combination of sound waves and degreasing cleansers that fully engulf the exchanger while in the ultrasonic bath is so gentle that the nylon straps that cradle the exchanger during the crane lift actually stay in the bath with the exchanger. Even the straps come out of the bath clean and unharmed.

Once the exchanger is clean, it is lifted out of the ultrasonic vessel and hosed-down to remove all the loosened dirt. Now it's ready to slide back into the refining process.

The same gentle cleaning process is also being used to clean our heater burners, burner nozzles, and some safety valves. Over the duration of this turnaround, Clean Harbors will clean about 100 of our exchangers.

The process is called Tech Sonic cleaning, and Clean Harbors has been using it to clean various refinery components for years.

Tech Sonic cleaning uses a combination of sound waves and non-corrosive cleaners combined in an ultrasonic vessel (bath) to remove hydrocarbon build-up safely from metal. It is much faster and safer than using the traditional high-pressure water hose, and it provides a much better clean because it can reach into places that a jet of water can't. It practically returns anything submerged into it to a like-new state.



When the exchanger is raised from its four-hour bath, it emits steam. Next it is hosed down to remove all the loosened debris.

What's an exchanger?

The purpose of a heat/effluent exchanger is to provide heat transfer from one liquid to another—in our case heat is transferred from a hot petroleum stream to a cold one without mixing. One stream is inside a series of small tubes while the other stream runs along side those tubes inside a shell casing in which the tubes are held. Heat is transferred from the hot stream to the cold stream as it flows through the shell and around the tubes.

North Atlantic Refining Maintenance Outage Come by Chance, Newfoundland

Project Scope Completed:

- 115 Heat Exchangers
- 120 burners with nozzles,
- 4 towers of demister pads,
- 10 pressure relief valves,
- various spools, pipes and hand valves.

Equipment on site:

- 2- 32' Tech Sonic Vessels
- 1- 8' Tech Sonic Vessel
- 2 high pressure units,
- 1 bundle blaster,
- 1 x 40K rotary lance.

Specialty Projects:



Modified
Asphalt
Service



Benicia, CA

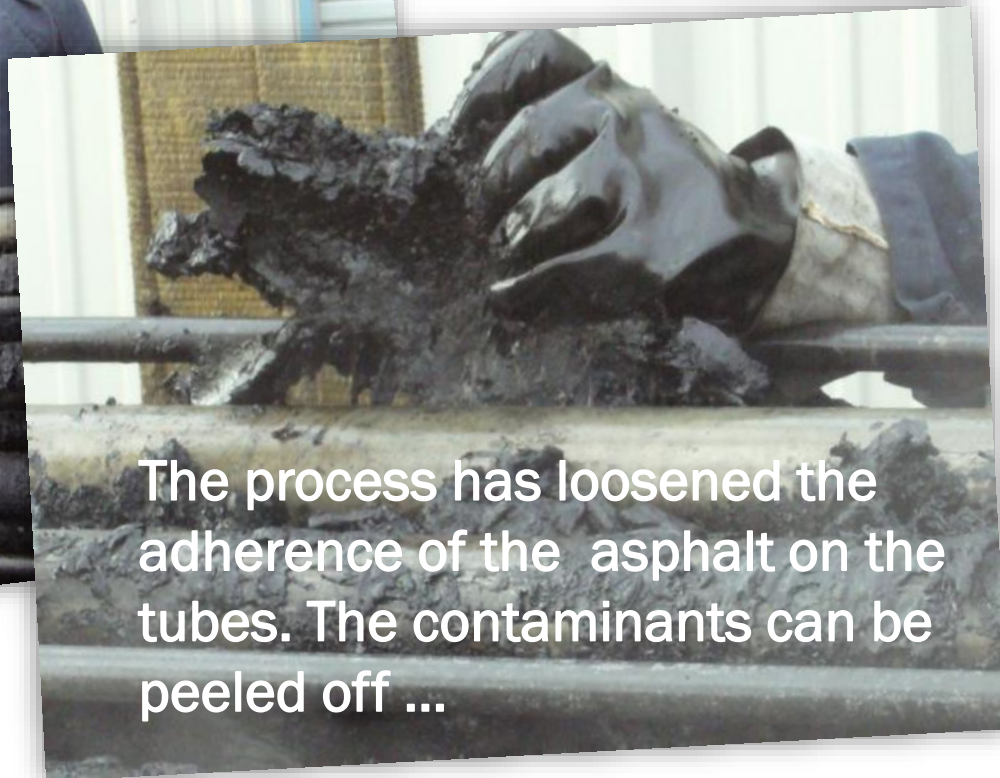
Specialty Projects:



Benicia, CA



After 5 hours



The process has loosened the adherence of the asphalt on the tubes. The contaminants can be peeled off ...

Specialty Projects:



Benicia, CA



Before



After



Shell
Sarnia Manufacturing
Centre

Sarnia, Ontario



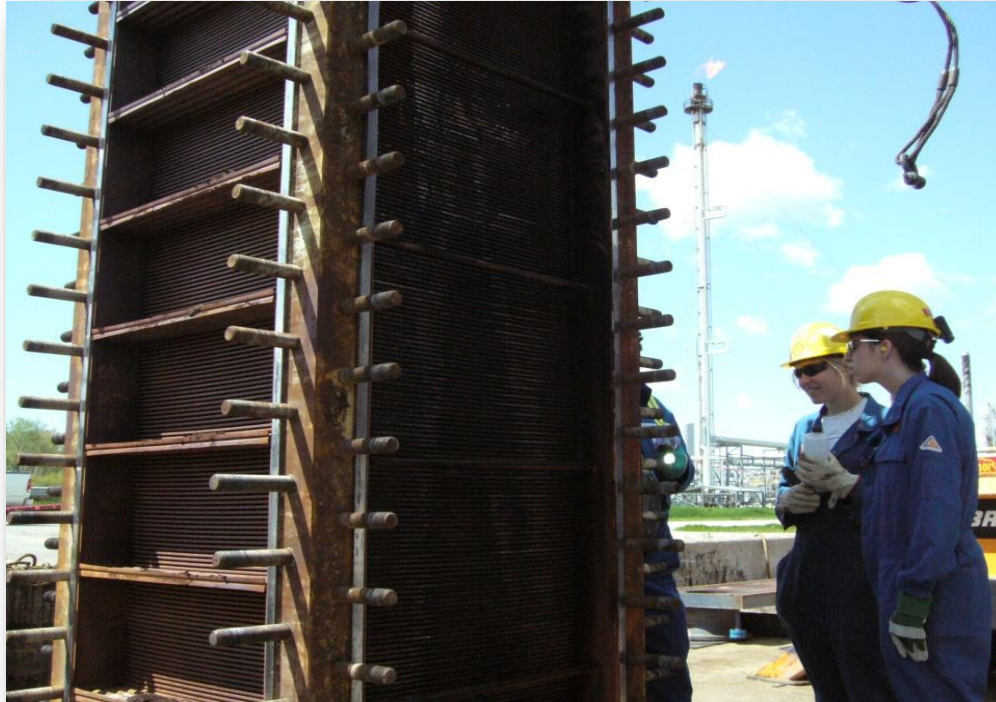
**Alfa Laval,
Compabloc®**

Fixed plate and frame design of
heat exchangers

Pre-clean condition: CC-106 units



Pre-clean condition: CC-106 units



The Challenge:
Previous attempts using conventional cleaning methods had failed to bring production capacities into an optimal range.

Pre-clean condition: CC-106 units

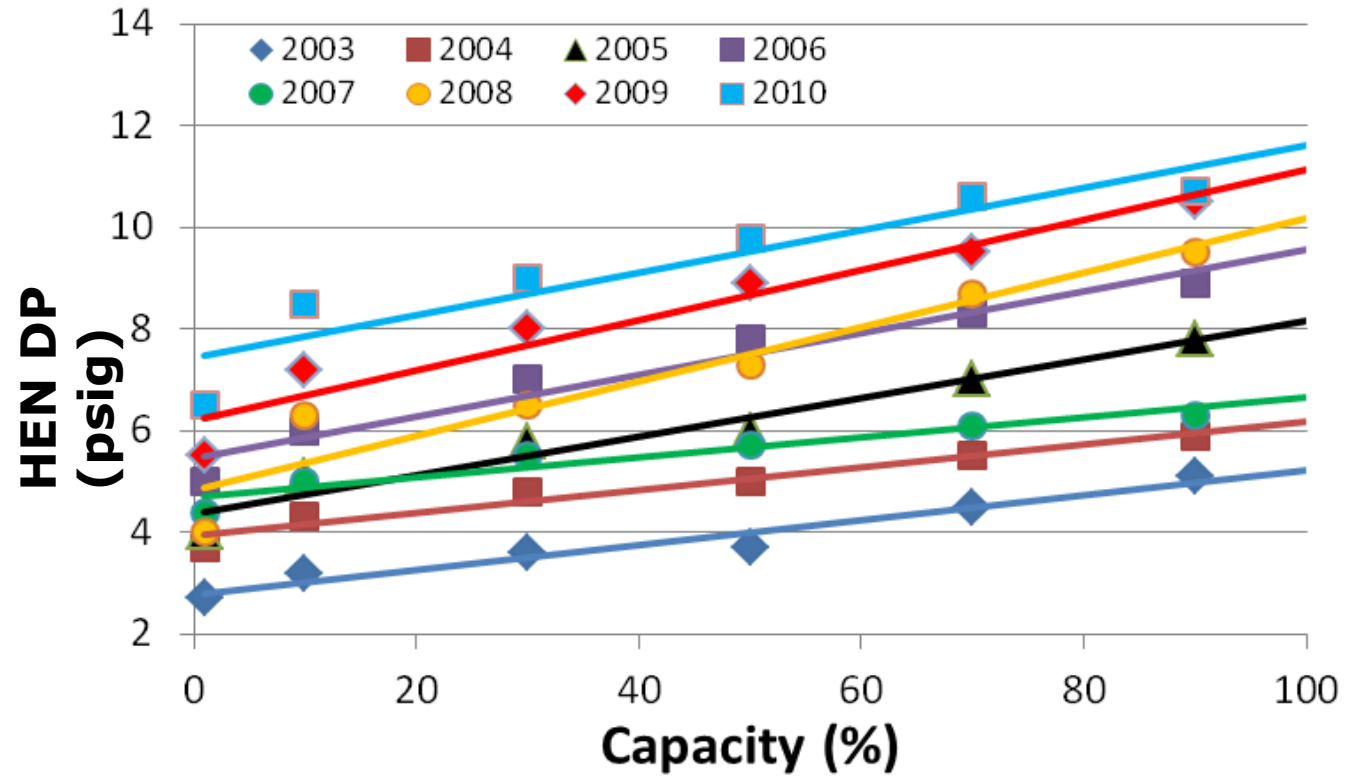


Figure 1. Differential Pressure (DP) vs. Flow Capacity (%) for the 8 unit Compabloc exchanger network by year

Pre-clean condition: CC-106 units

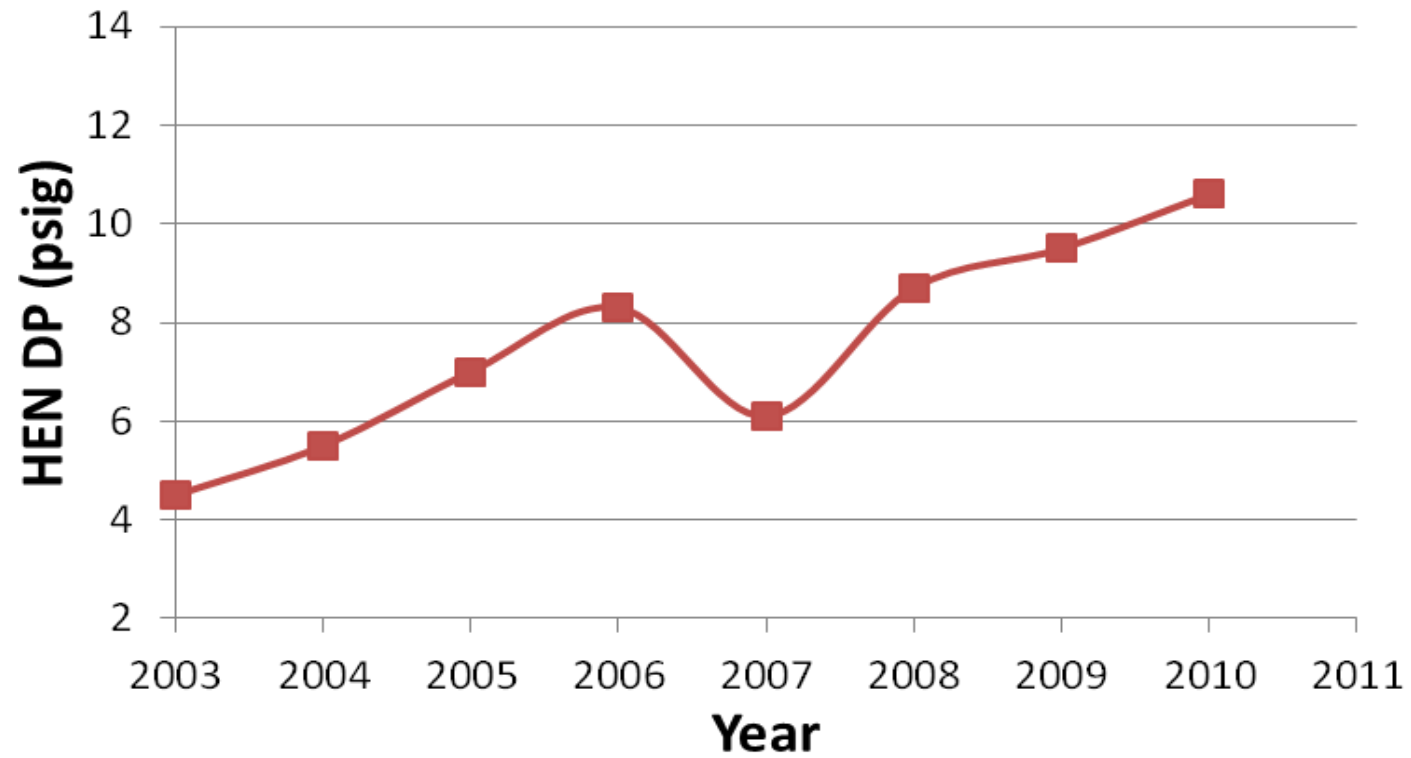
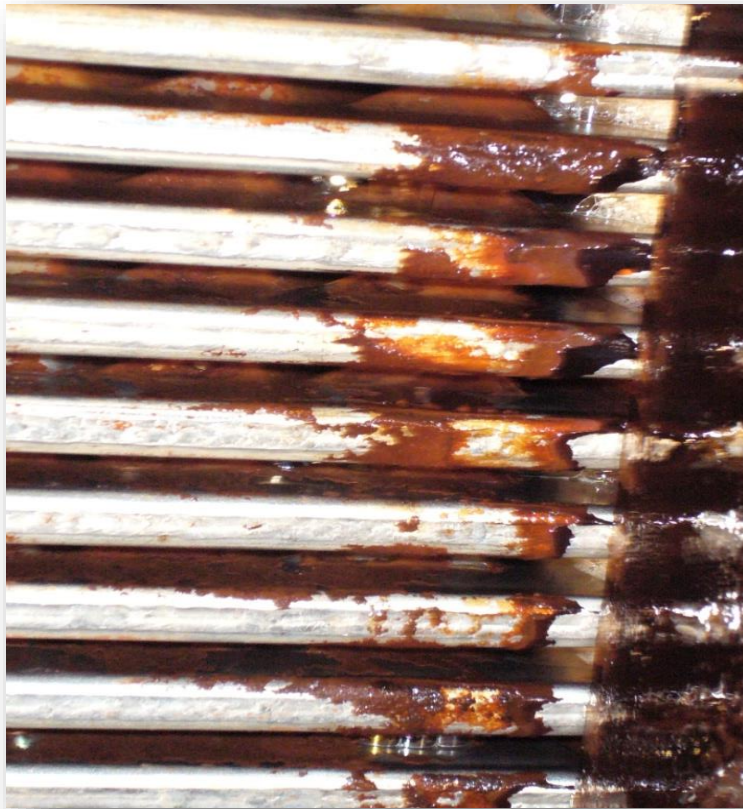


Figure 2. Compabloc exchanger network DP at 70% Capacity by Year

Progress Cleaning: CC-106 units



After 3 hours in the Ultrasonic bath.



After 5 hours

Progress Cleaning: CC-106 units



After 8 hours

Progress Cleaning: CC-106 units



After 10 hours



Clean condition: CC-106 units



After 12 hours

Clean condition: CC-106 units



Approved for service



Clean condition: CC-106 units

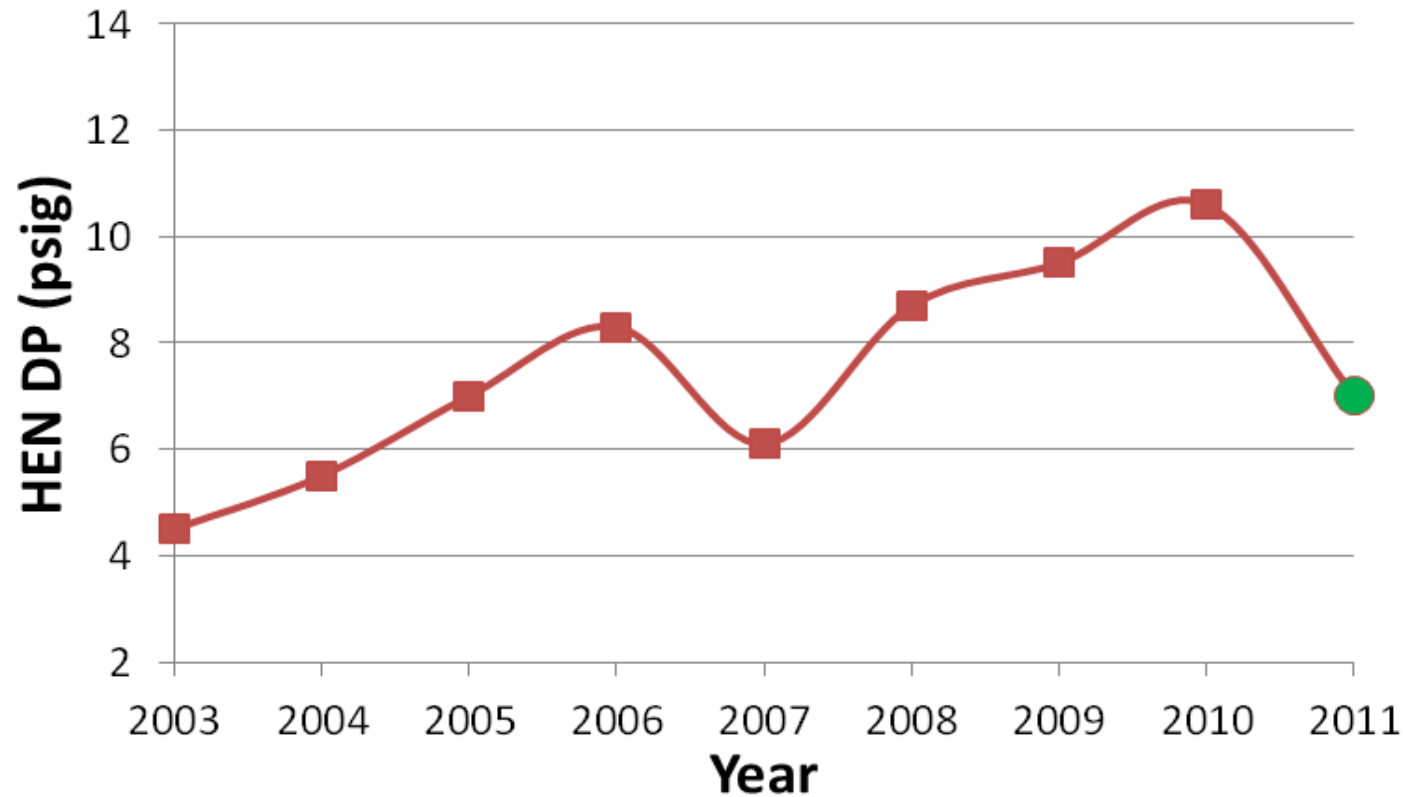


Figure 3. Compabloc (8 unit) exchanger network DP at 70% Capacity by Year. Note: Only 4 of the 8 units were cleaned in this TA.

CC-106 units



Before

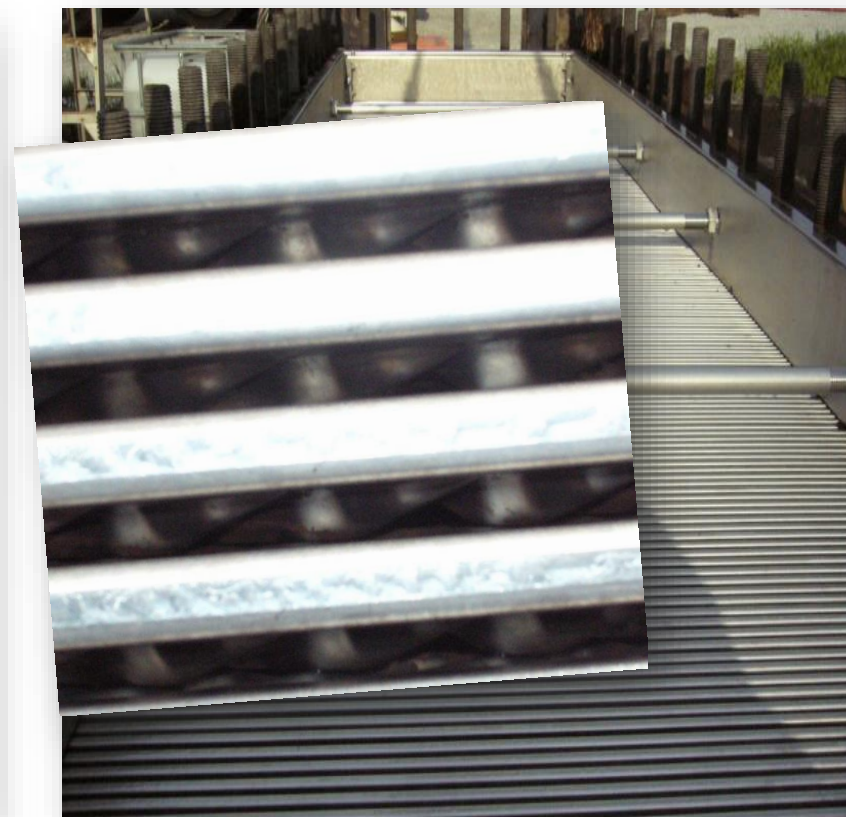


After

CC-106 units



Before



After

Key benefits of the process

- 1) Greater control/management of project scope.
- 2) Improved safety for all onsite personnel
- 3) Demonstrated improved performance of the cleaned components
- 4) Significantly reduces environmental impact
- 5) Reduced operational footprint
- 6) Improves cleanliness for items requiring 3rd party testing and repair.
- 7) Approved for specialty applications
- 8) Realized operational efficiencies

Key benefits of the process

A) Helps to manages project cleaning scope by:

- Reducing overall cleaning times-
 - The OD. and ID of items are cleaned simultaneously
 - Basket loading and/or rigging of multiple components
- Flexible cleaning platform allows many items outside of scope, to be facilitated thru the process
- Inspection times are reduced
- Reduces outbound time for items requiring 3rd party testing and repair (i.e. resurfacing, gasketing, corrosion evaluation)
- Ultrasonic Cleaning Equipment operates 24 hours/day!

Key benefits of the process

B) Improved safety for all onsite personnel by:

- Mitigation of risk when compared to high-pressure water use
- Less high-pressure equipment required on site
- Less labor required to operate ORANGE equipment
 - A single ORANGE technician can operate multiple ultrasonic baths
- Fouling contaminants are held in the bath for easy removal after cleaning

Key benefits of the process

C) Improved performance of the cleaned components :

- Statistical result and testimonial data from clients reveal that the “through-put” performance of monitored heat transfer equipment, has significantly improved.
- Experimental data, reveals that (many) of these cleaned assets will perform at optimal levels for greater time intervals.

Key benefits of the process

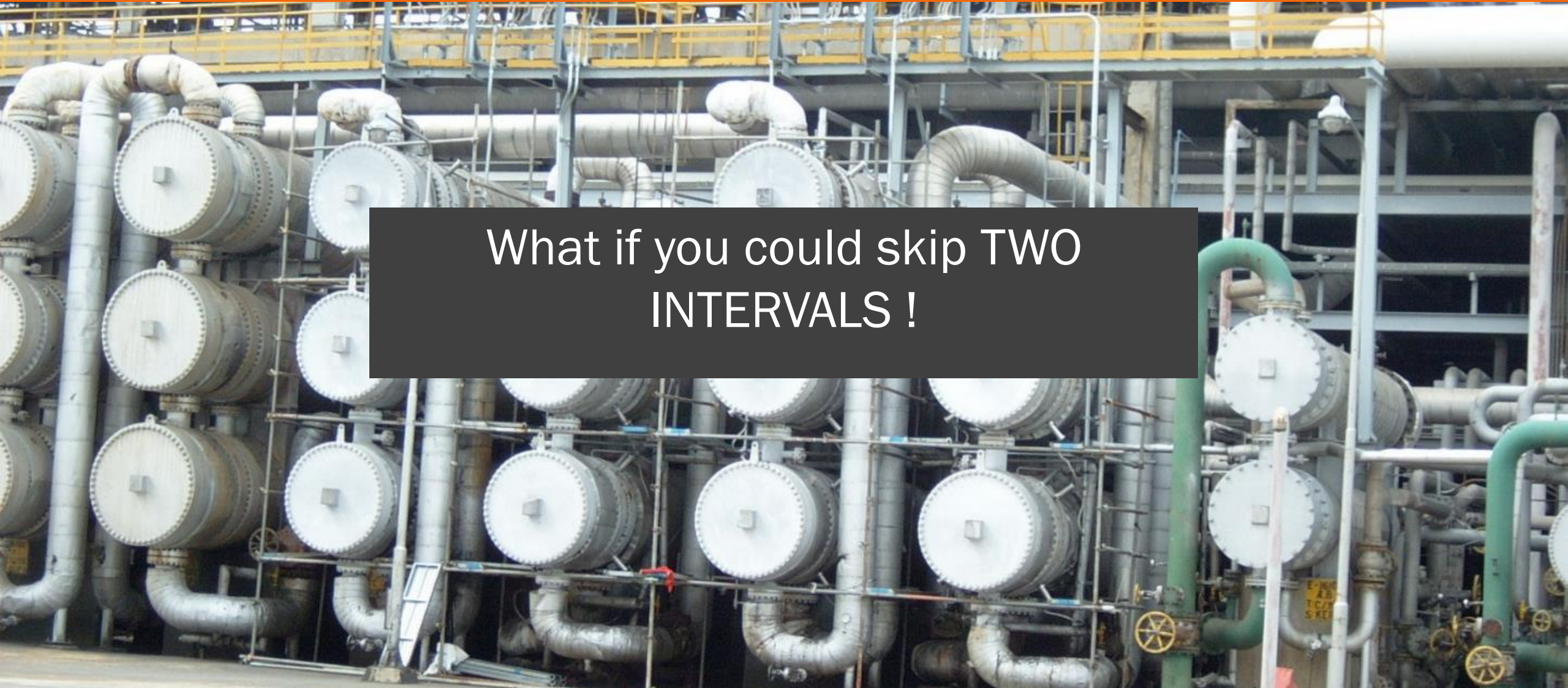
D) Significantly reduces **environmental impact** by:

- Significantly reducing water use as compared to high-pressure equipment.
- Far less waste water effluent to process thru site facility.
- Contaminants are held in the bath not all over the wash bays and in the sumps
- Our aqueous-based chemistries are compliant with site use/ regulations and can be disposed of thru your API separators
- Less diesel-powered equipment and fuel required to operate
(*Ultrasonic bath can operate on electricity provided at the wash bays*)

What if the heat exchanger is too big for the bath or simply cannot be removed from the operating unit?

Can we clean this in place?





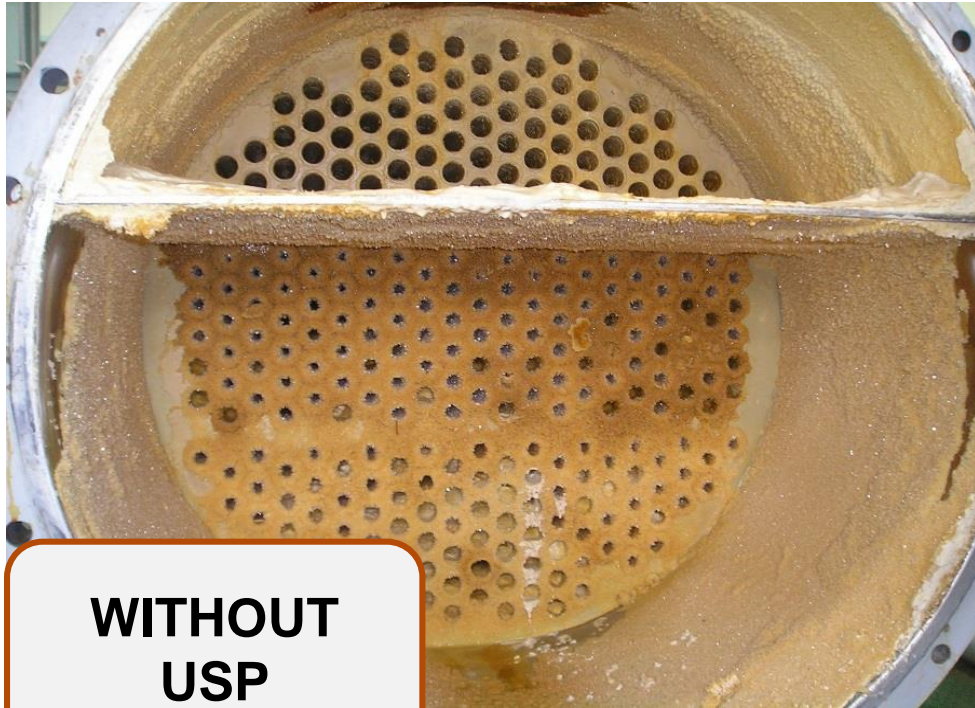
What if you could skip TWO
INTERVALS !

Ultrasonic Scale Prevention

- USP works in-line, 24/7
- High frequency, low displacement vibrations
- Provides greater heat transfer efficiency with energy savings.



AFTER 1 Year in operation (Power Generation Plant)



**WITHOUT
USP**



WITH USP

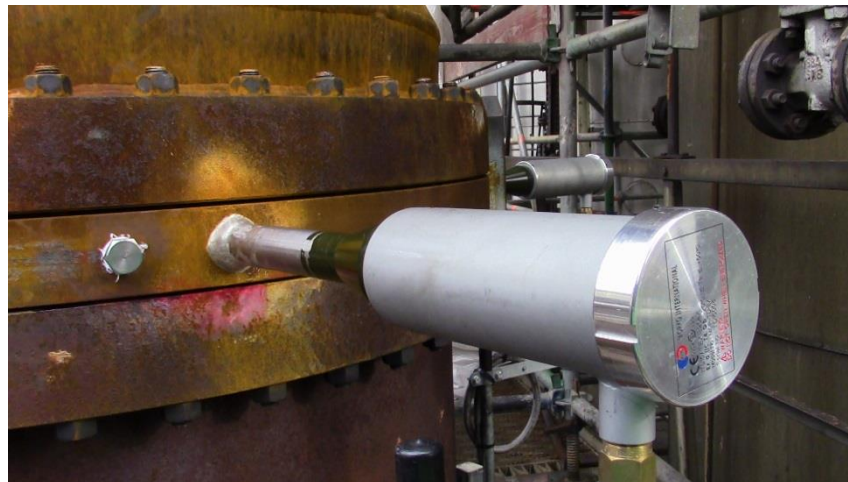


KUMHO
PETROCHEMICAL



CD-6 Shell Pernis, (Rotterdam) April 2015

- Heat exchangers 214 A/B have severe fouling issues.
- A dedicated USP system consisting of mount on transducers and ultrasonic generators provide pulsed-power to remove existing fouling and inhibit new fouling from forming on the heat transfer surfaces.
- The systems is: CE,UL and/or ATEX certified



CD-6 Shell Pernis

Ultrasonic Generators



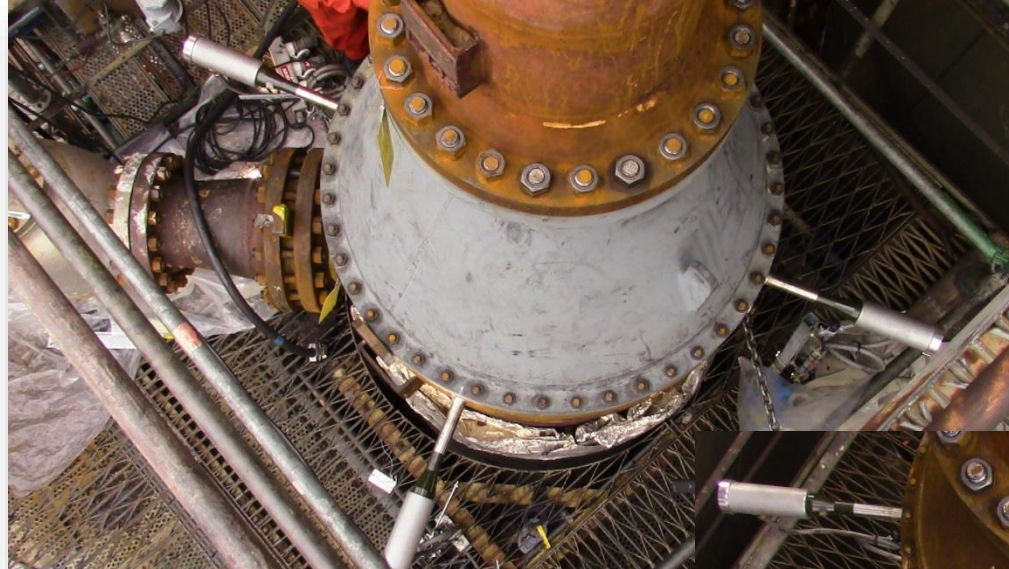
CD-6 Shell Pernis

Ultrasonic
Transducers

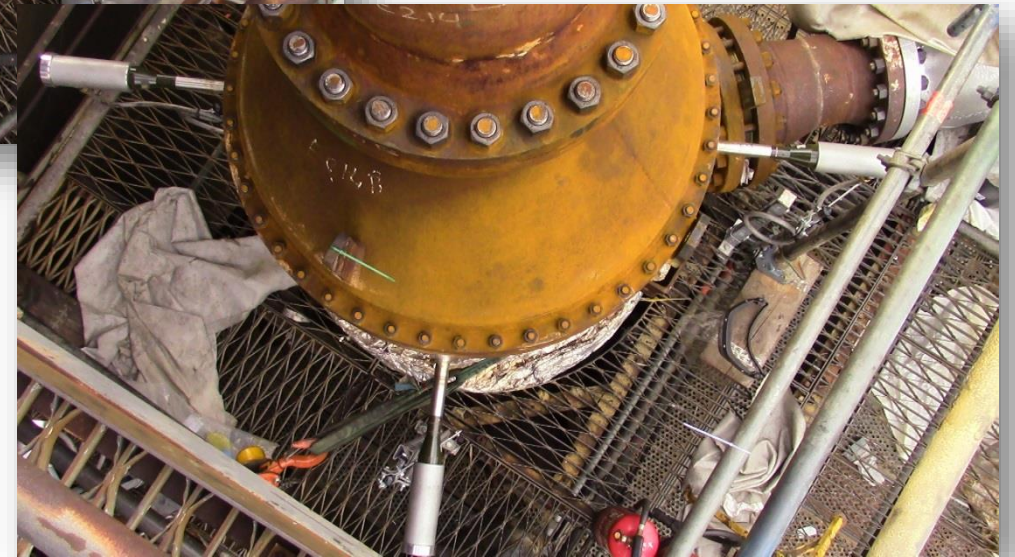


CD-6 Shell Pernis

- 214 A/B
- 4 USP Transducers per heat exchanger.



214A



214B

CD-6 Shell Pernis

- Frequency calibration for optimizing US cavitation and vibration
- Testing

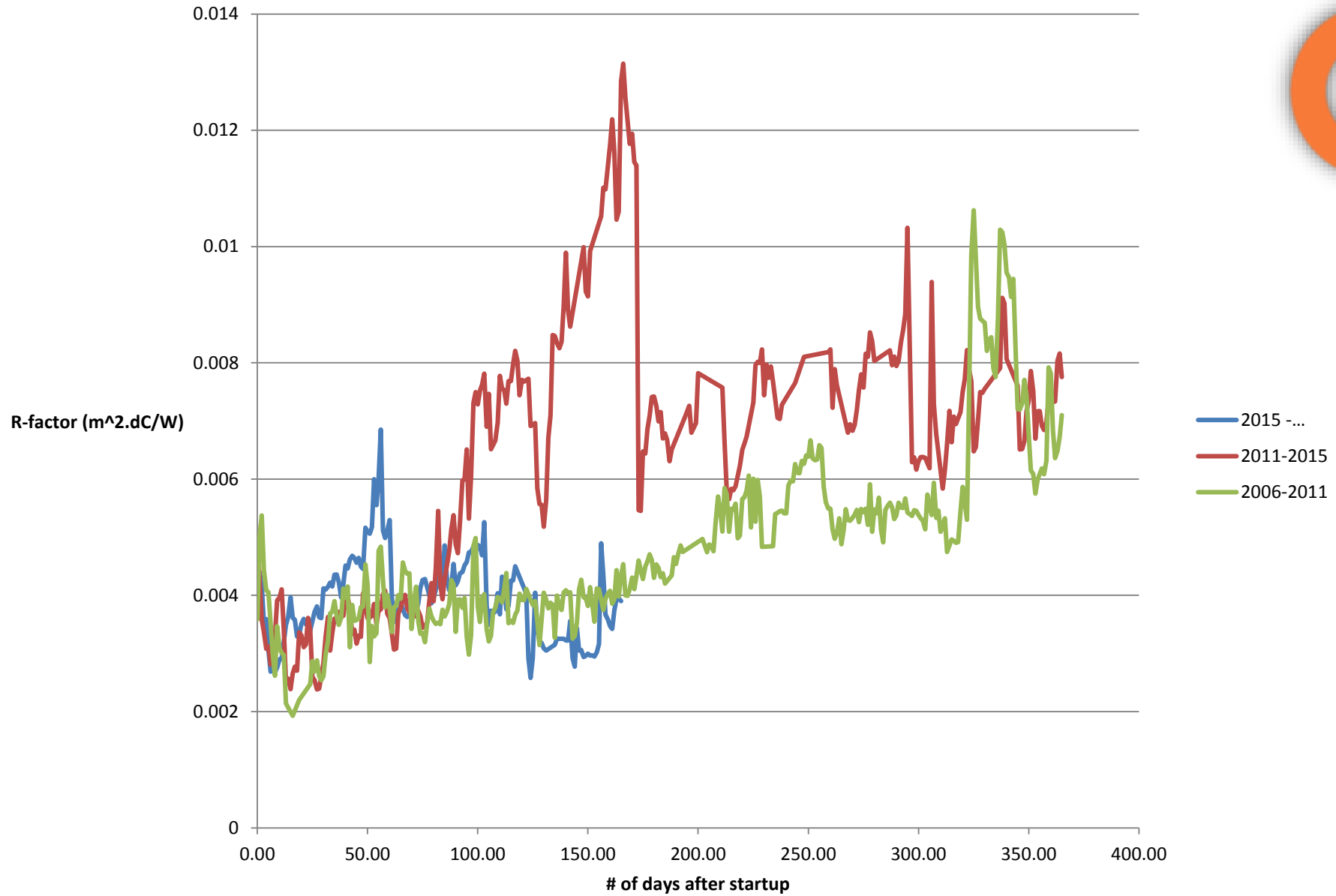


CD-6 Shell Pernis

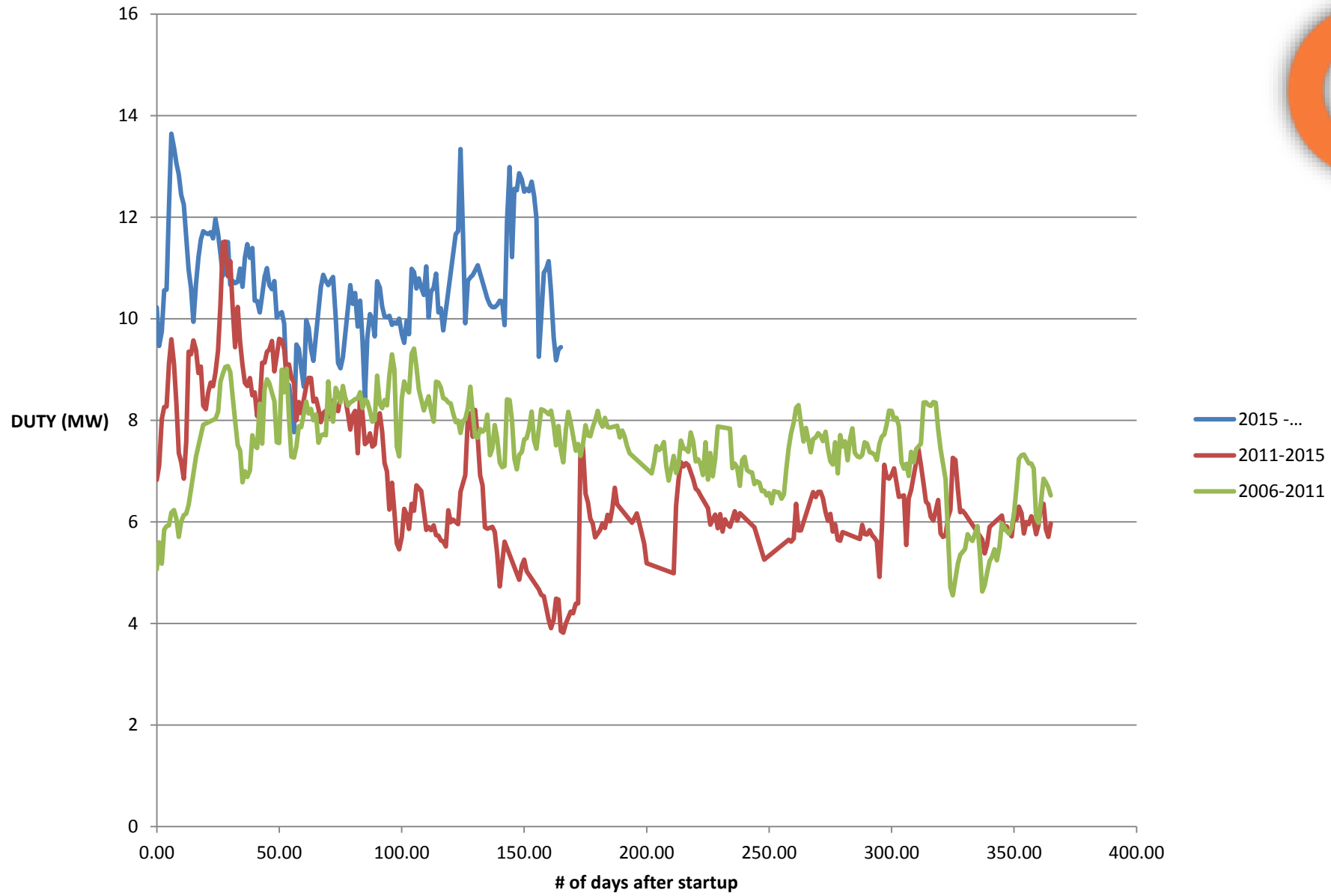
- Ready to go!



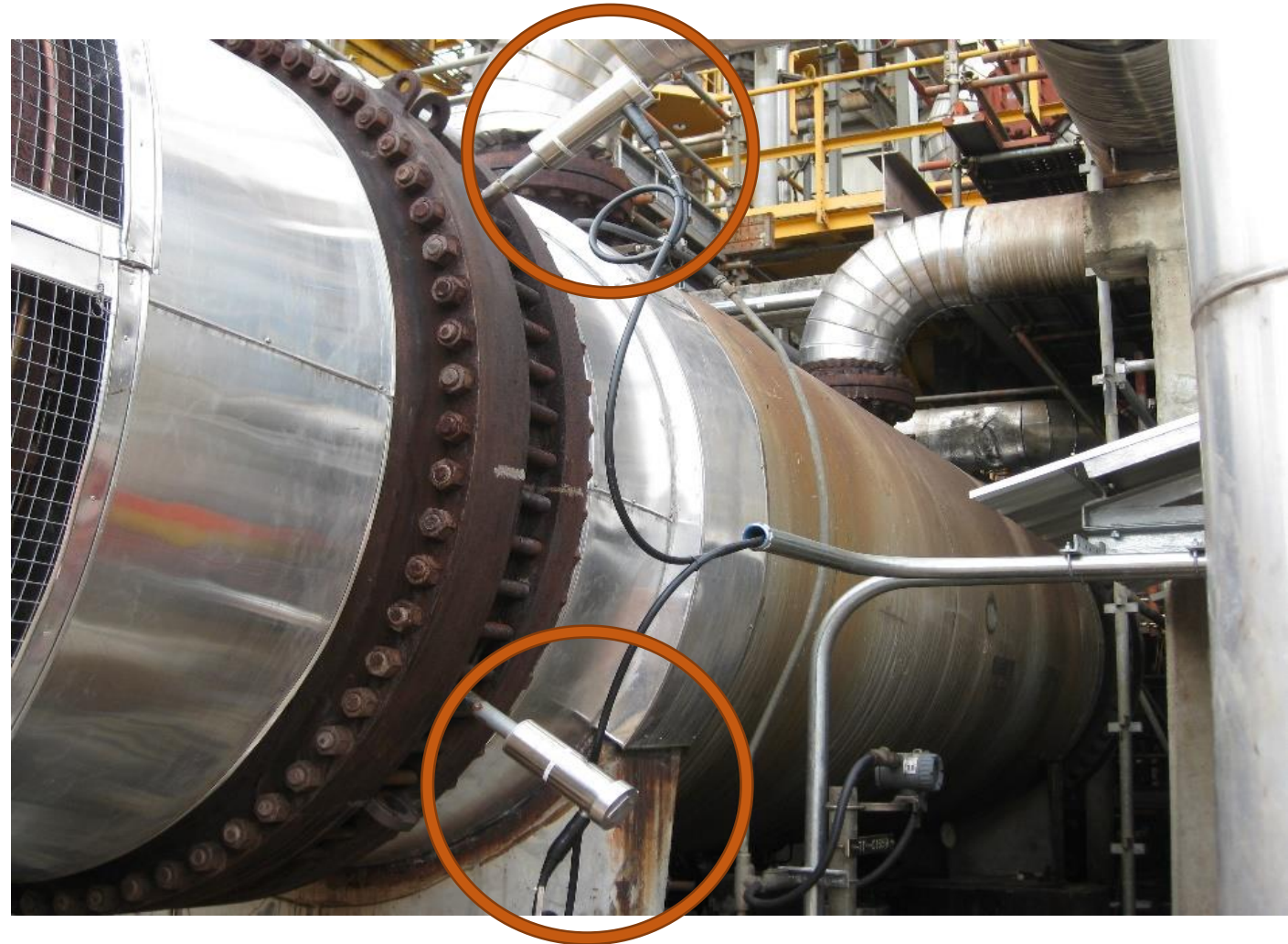
CD6 USP E214AB Performance comparison: overall fouling factor

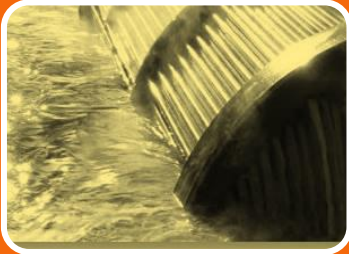


CD6 USP E214AB Performance comparison: DUTY



UPTIME— is the key benefit of this technology. The USP system allows your processing units to continue in full operation as cleaning takes place.





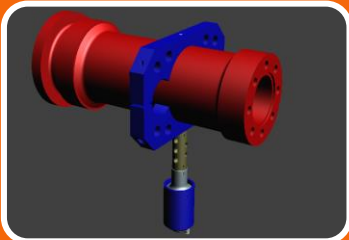
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Fouling Mitigation & Process Improvement

- M³ Technology (clamp on) apparatus with pre-selected ultrasonic power output, to match with specified outcomes

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ORANGE
ULTRASONICS