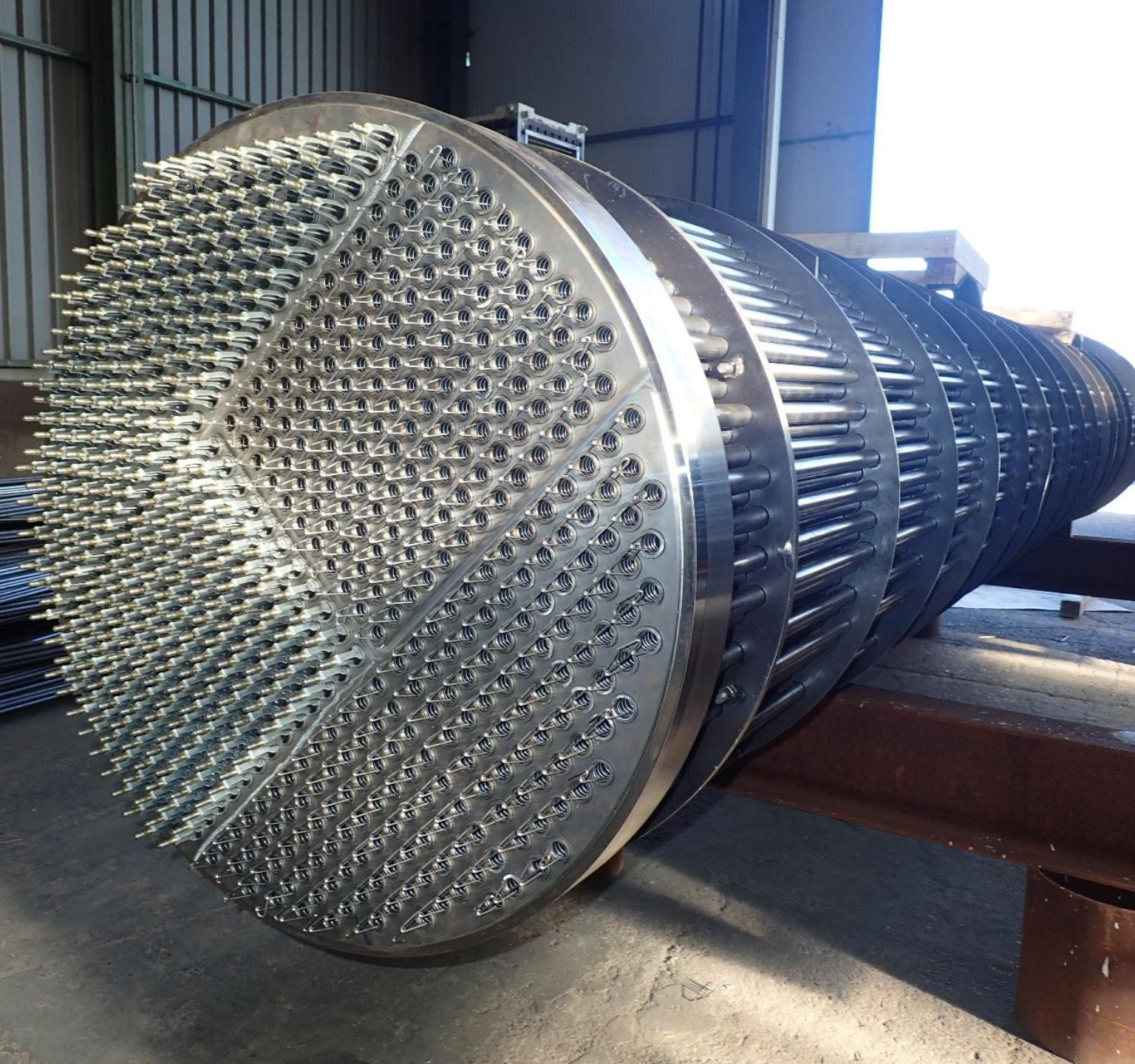




PETROVAL
REFINING & PETROCHEMICAL
PROCESS SOLUTIONS

Maximizing the Profitability of Existing Heat Exchangers Through Tube Inserts

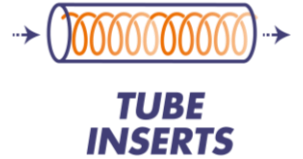
Presented by : Alexandre Demeulenaere
Global Product Manager

Wednesday the 10th of June 2026

TNChE Asia 2026
**5th Thailand International Chemical
Engineering & Chemical Technology**



HEAT TRANSFER LIMITATION DUE TO FOULING

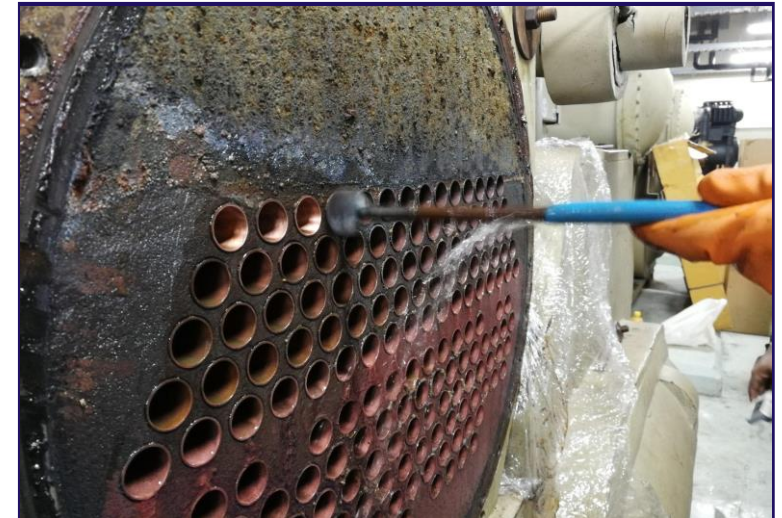
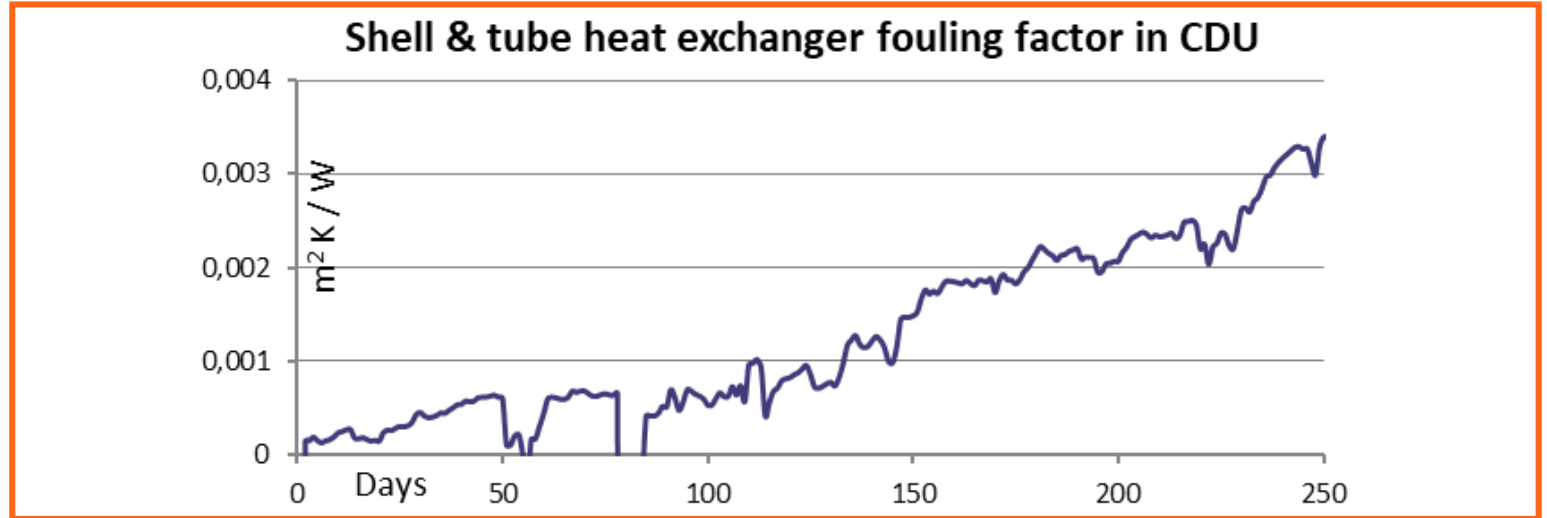


TUBE FOULING LEADS TO:

- Heat transfer decrease
- Pressure drop increase
- Limitation of exchanger duty

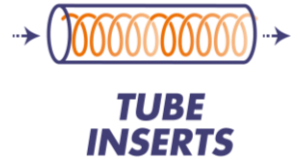
CAUSES:

- Productions losses
- Maintenance costs for cleaning
- Energy costs





THE CONCEPT OF INSERT



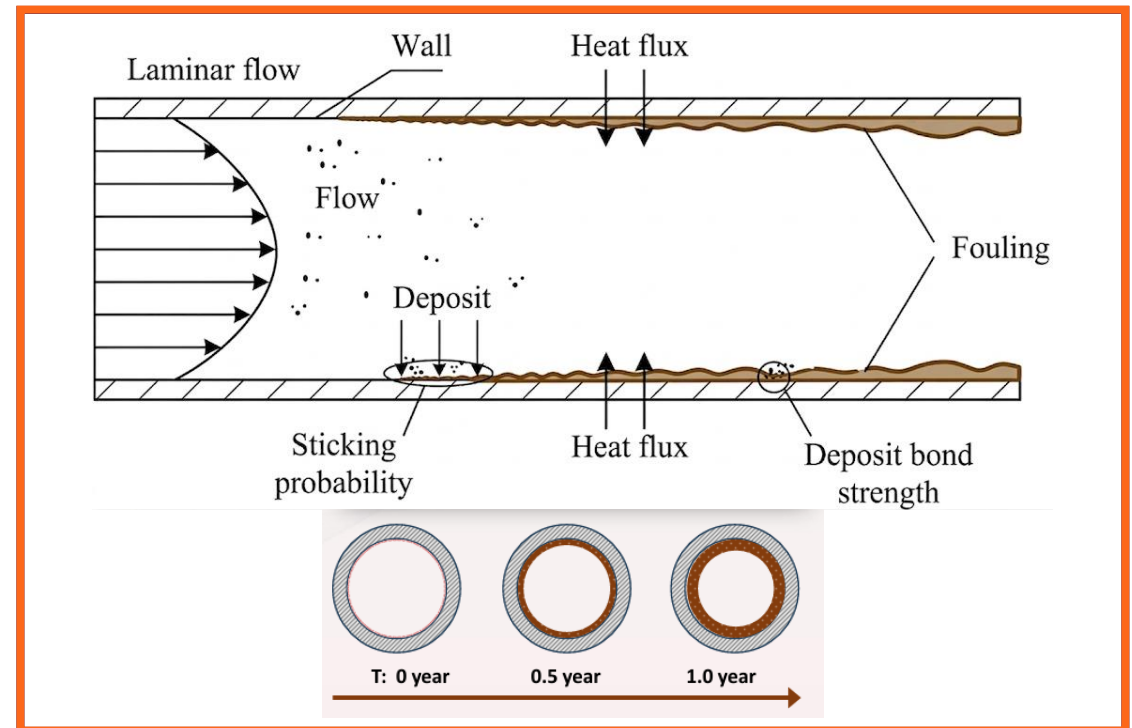
Heat transfer primarily occurs at the tube wall interface.

FOULING OCCURS AT TUBE WALL WHERE:

- The temperature is the highest
- The velocity is the lowest.

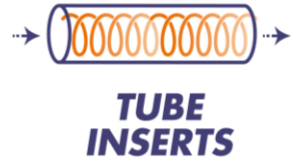
INSERTS PRINCIPLE IS TO WORK ON THE BOUNDARY LAYER BY:

- Mechanically remove deposit when it occurs
- Increase the turbulence to limit boundary layer thickness.



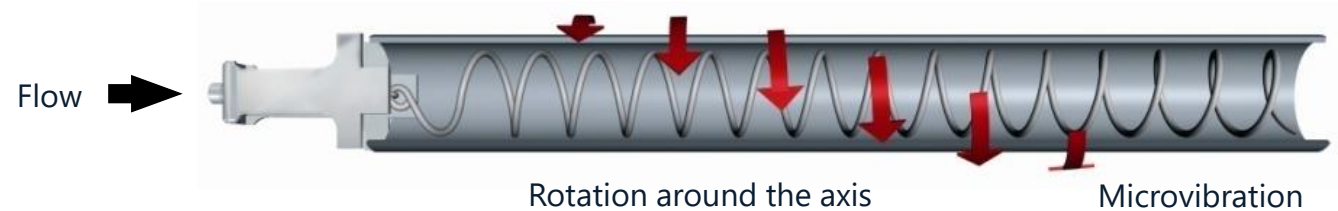


3 TYPES OF TECHNOLOGIES



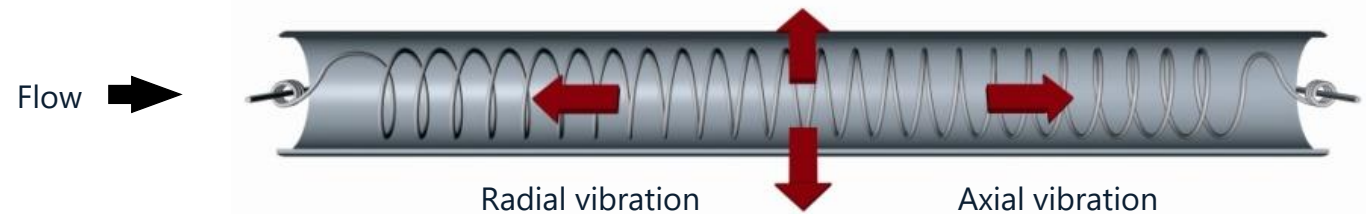
ROTATING

Mechanical cleaning effect based on rotation



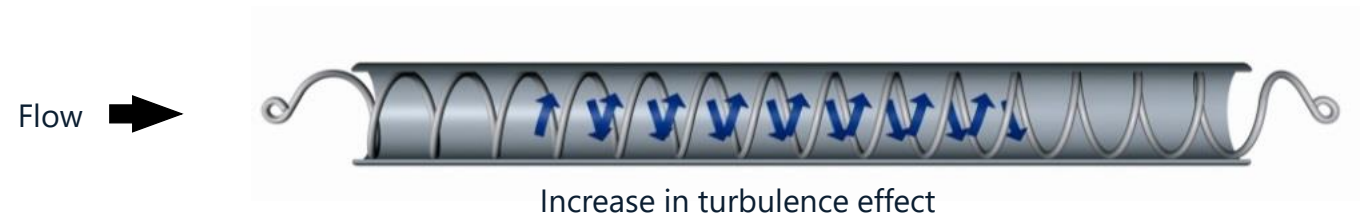
VIBRATING

Mechanical cleaning effect based on vibration



SWIRL-EFFECT

Reduce the stagnation adjacent to the tube wall

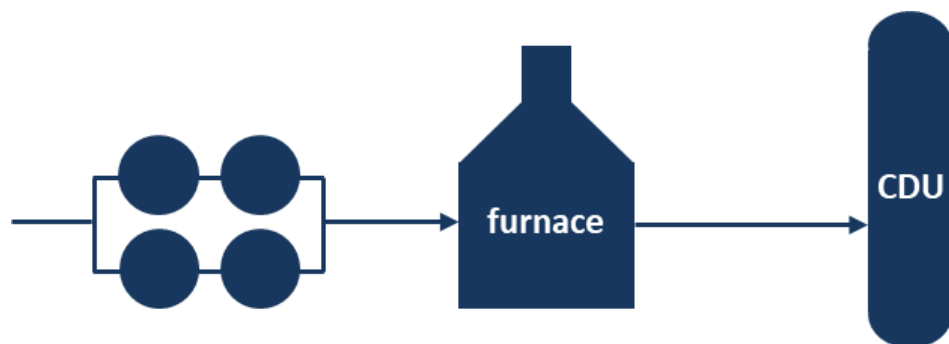




CASE STUDY A – ROTATING INSERT

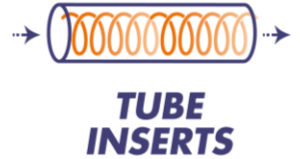


POSITION IN THE TRAIN	BEFORE THE FURNACE
Number of bundles	2 branches of 2 bundles
Number of tubes	626
Product tube / shell side	Crude / Atmospheric residue
Flow rate (tube side)	330 t/h
Flow velocity (tube side)	1,2 to 1,8 m/s



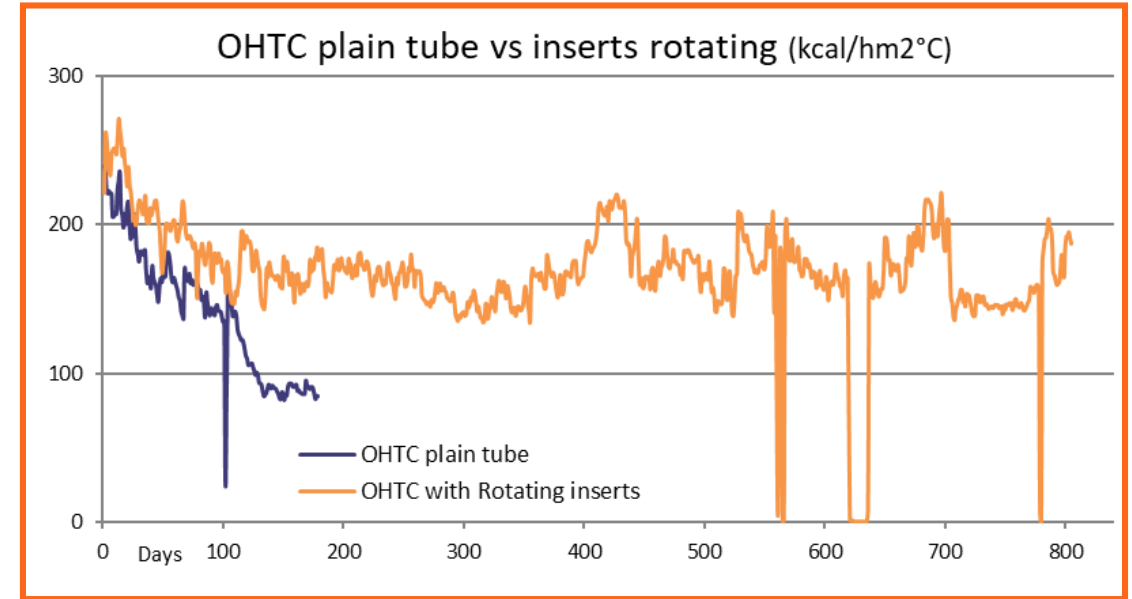


CASE STUDY A – ROTATING INSERT



KEY PERFORMANCE INDICATORS

- Fouling rate divided by 4
- OHTC @ Start of Run was higher by 25%
- OHTC after 200 days was higher by 110%
- Run extended from 183 to 820 Days



GAIN ON ENERGY RECOVERY (GJ/year) 75 000

GAIN ON ENERGY RECOVERY (TOE/year) 1 820

GAIN ON CO2 EMISSIONS (tons/year) 5 460

**ENERGY SAVING
1092 K\$**

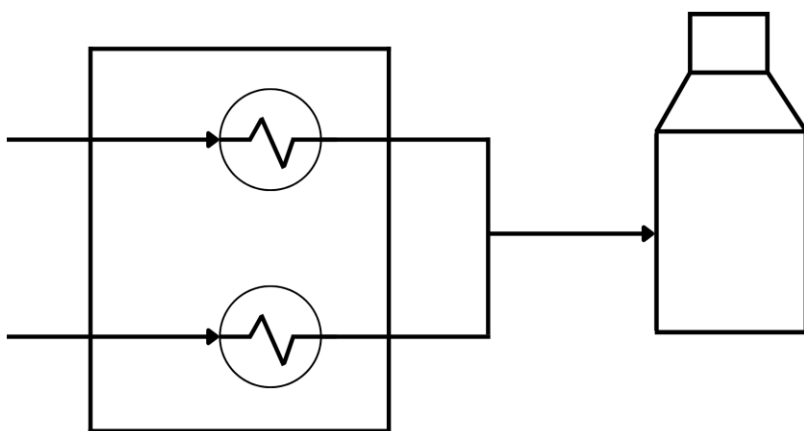




CASE STUDY B – VIBRATING INSERT

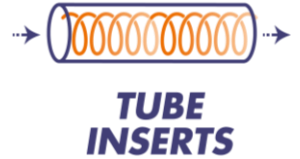


POSITION IN THE TRAIN	BEFORE THE FURNACE
Number of bundles	2 bundles in parallel
Number of tubes	600
Product tube / shell side	Crude / Bottom PA
Flow rate (tube side)	430 t/h
Flow velocity (tube side)	1,8 m/s





CASE STUDY B – VIBRATING INSERT



KEY PERFORMANCE INDICATORS

- Initial run of 1 year
- Drop in Duty by 40%
- Average Duty of 8,3 MW (30Gj/hr)

+25% Duty Average

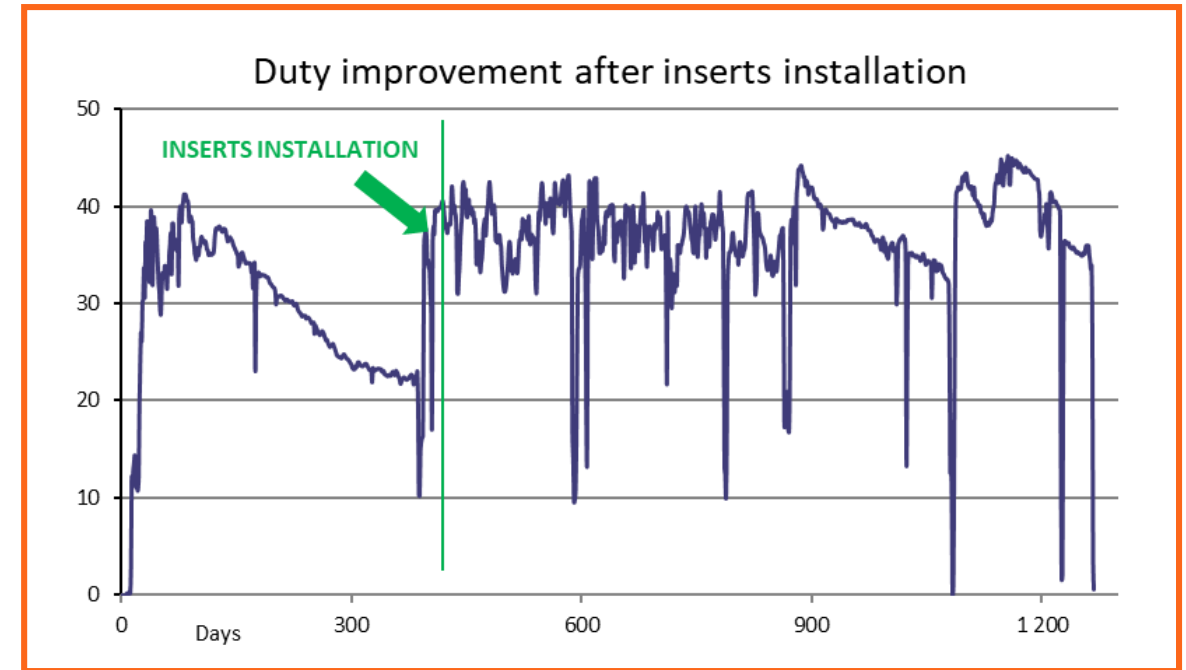
WITH INSERTS

- Run tripled with Spirelf
- Duty stabilized during entire 872 day-run
- Average Duty of 10,3 MW (37Gj/hr)

GAIN ON ENERGY RECOVERY (GJ/year) 60 100

GAIN ON ENERGY RECOVERY (TOE/year) 1 450

GAIN ON CO2 EMISSIONS (tons/year) 4 350



**ENERGY SAVING
870 K\$**

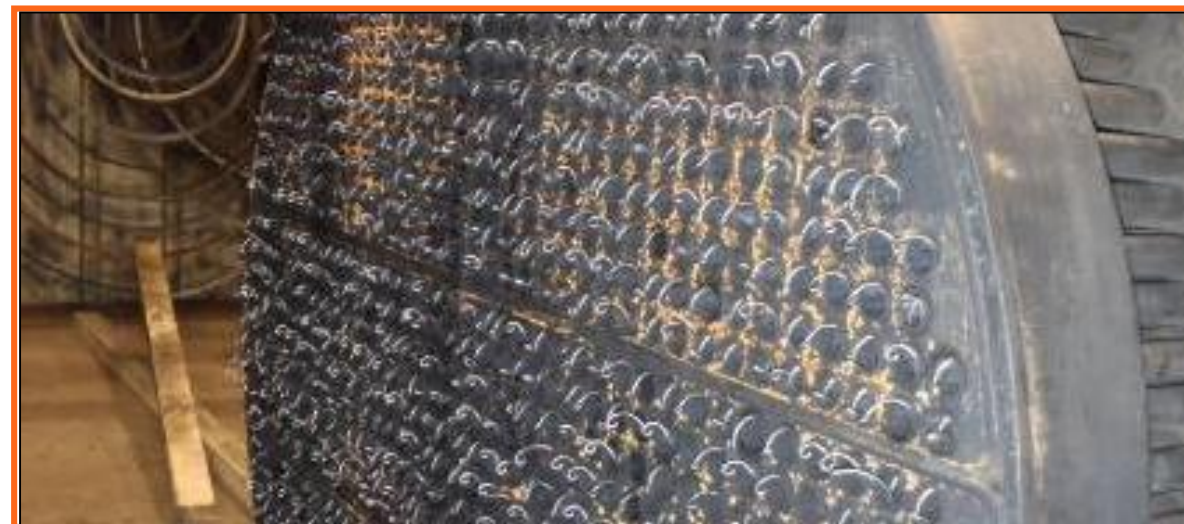
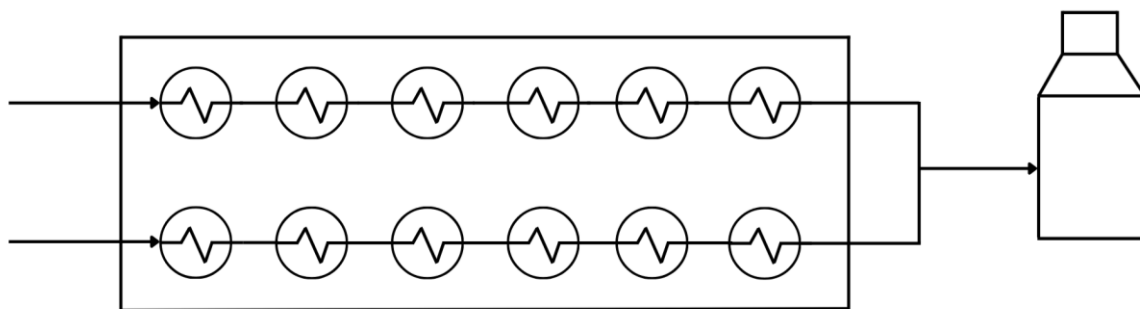




CASE STUDY C – SWIRL-EFFECT INSERT

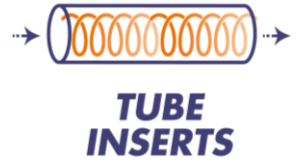


POSITION IN THE TRAIN	BEFORE THE FURNACE
Number of bundles	2 branches of 6 bundles
Number of tubes	732
Product tube / shell side	Atmos Residue / Crude
Flow rate (tube side)	134 t/h
Flow velocity (tube side)	0,8 m/s





CASE STUDY C – SWIRL-EFFECT INSERT



KEY PERFORMANCE INDICATORS

Swirl-effect inserts on 4 out of 6 exchangers improved tube-side heat transfer and increased duty.

SOR: +8% duty

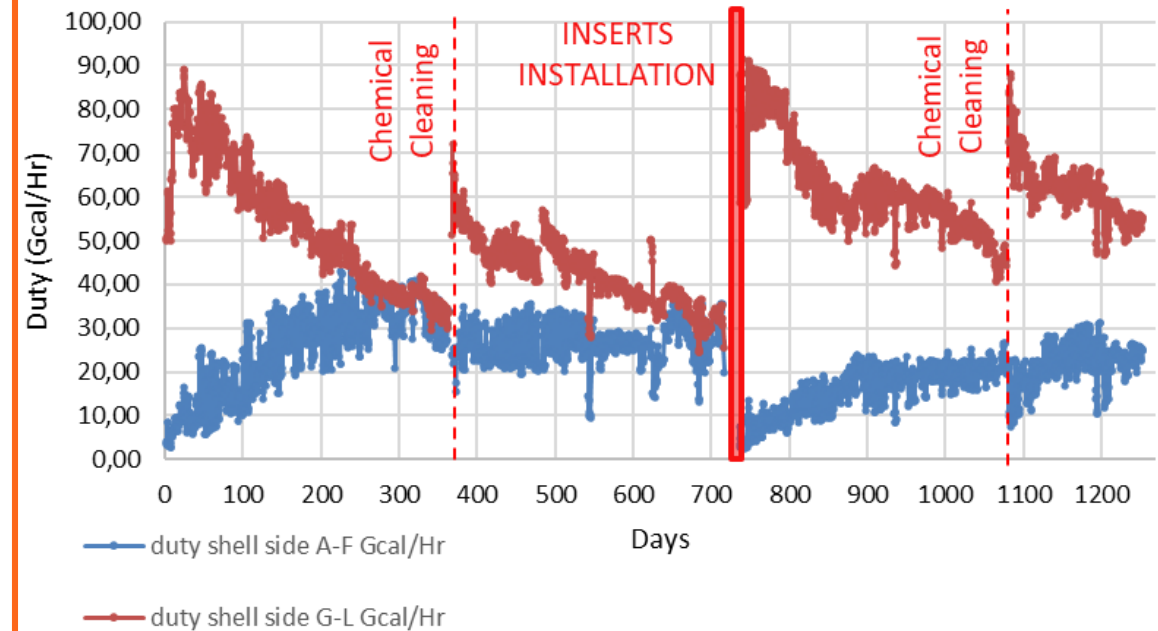
MID-RUN: +14% train duty

POST-CLEANING: +9% train duty

EOR / AVERAGE: +20% duty (local)

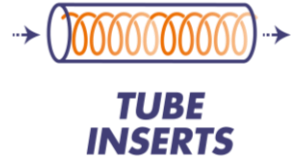
Overall +3% duty total train

Duty comparison Plain tube/ Swirl-Effect Insert





FROM FOULING CONTROL TO IMPROVED PERFORMANCE



TUBE FOULING LEADS TO

- Heat transfer decrease
- Pressure drop increase
- Limitation of exchanger duty

TUBE INSERTS (mechanical & hydraulic effects)

- Mechanical cleaning effect
- Increased turbulence
- Boundary layer disruption

PERFORMANCE IMPROVEMENTS

- ✓ Fouling mitigation: Mechanical & swirl inserts reduce tube-side fouling by up to 4×
- ✓ Enhanced heat transfer: OHTC improvement up to +100% in real operation
- ✓ Duty increase up to 20%

OPERATIONAL & ENERGY IMPACT

- ✓ Extended run length & stable performance
- ✓ Reduced cleaning frequency
- ✓ Energy savings up to **\$1M/year**
- ✓ CO₂ reduction : **1000–5000 tons/year**



Thank you for your attention

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you at Booth D3!**