THERMO CLEAN®
TOOL CLEANING
WE KNOW-HOW !

THERMAL CLEANING, NO ALTERNATIVE BUT A BETTER WAY TO CLEAN EQUIPMENT

HOW IT ALL STARTED 20 YEARS AGO:
THERMAL "POPCORN" REMOVAL FROM A HEAT EXCHANGER

Before: Only HP cleaning

Result:

- Still popcorn parts left
- Fast rebuilding of the fouling
- Short running cycles (2-3 months)
- High maintenance costs

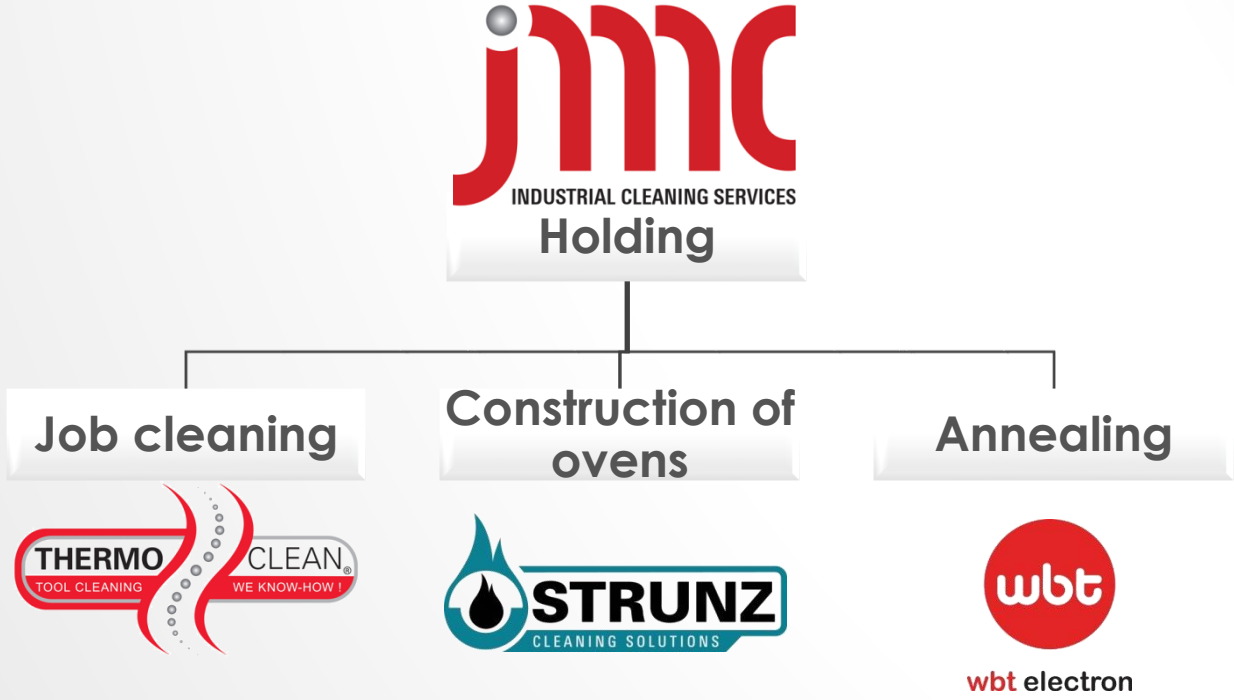
After: Thermal + HP cleaning

Result:

- No popcorn parts left
- Slow rebuilding of the fouling
- Long running cycles (2 years)
- Low maintenance costs

COMPANY INFORMATION

ORGANIZATION



COMPANY INFORMATION

THE THERMO-CLEAN GROUP TODAY

- Established in 1989
- Today: 10 cleaning sites in Europe
- +/- 200 employees
- Total turnover of € 22 million in 2018
- Thermal, chemical & mechanical cleaning of equipment and parts fouled with (partially) organic contaminations

STRUNZ
CLEANING SOLUTIONS

Since January 1st 2015 also a member of JMC Company

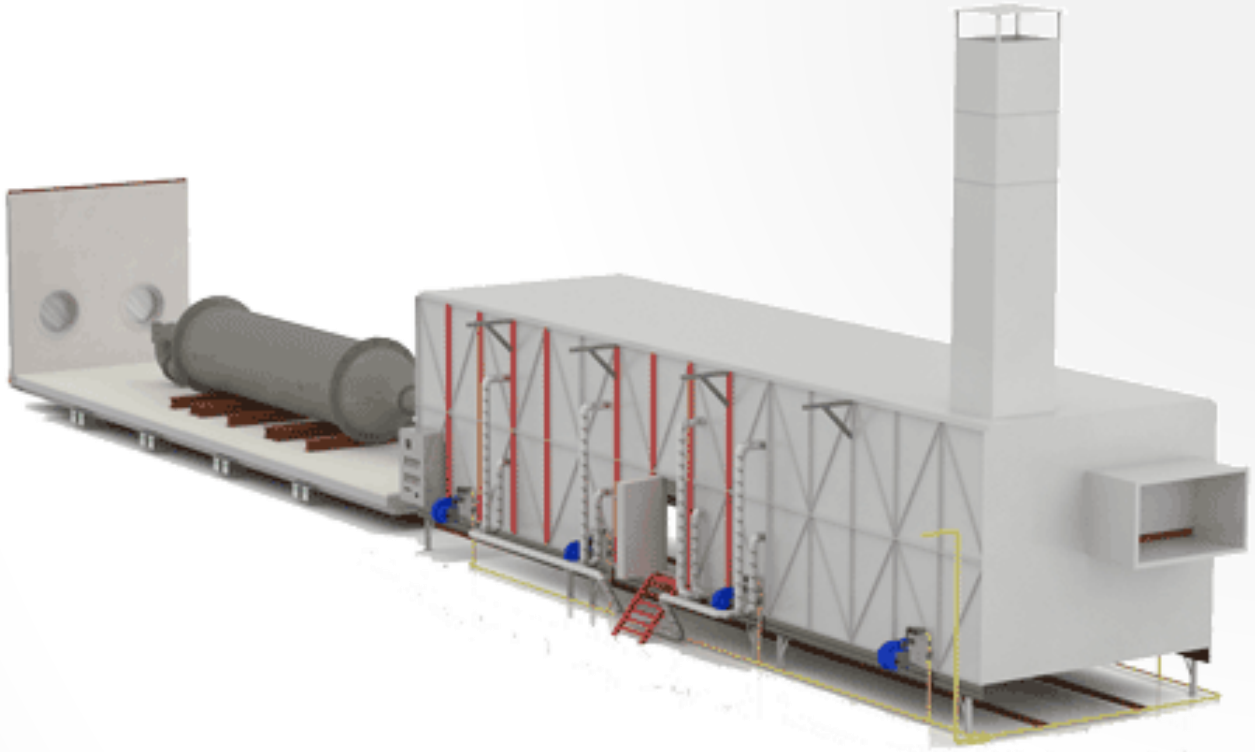
STRUNZ ANLAGENTECHNIK GMBH Im Erlet 24, D- 90518 Altdorf bei Nürnberg • **WWW.STRUNZOVENS.COM** • **INFO@STRUNZOVENS.COM**

wbt electron

WBT Electron offers a complete portfolio of different heat treatments at nearly any required temperature:

- preheating
- stress-relief annealing
- normalizing annealing
- solution annealing
- hydrogen-free annealing
- water, fog or air quenching
- drying, curing or sintering of fire-resistant materials

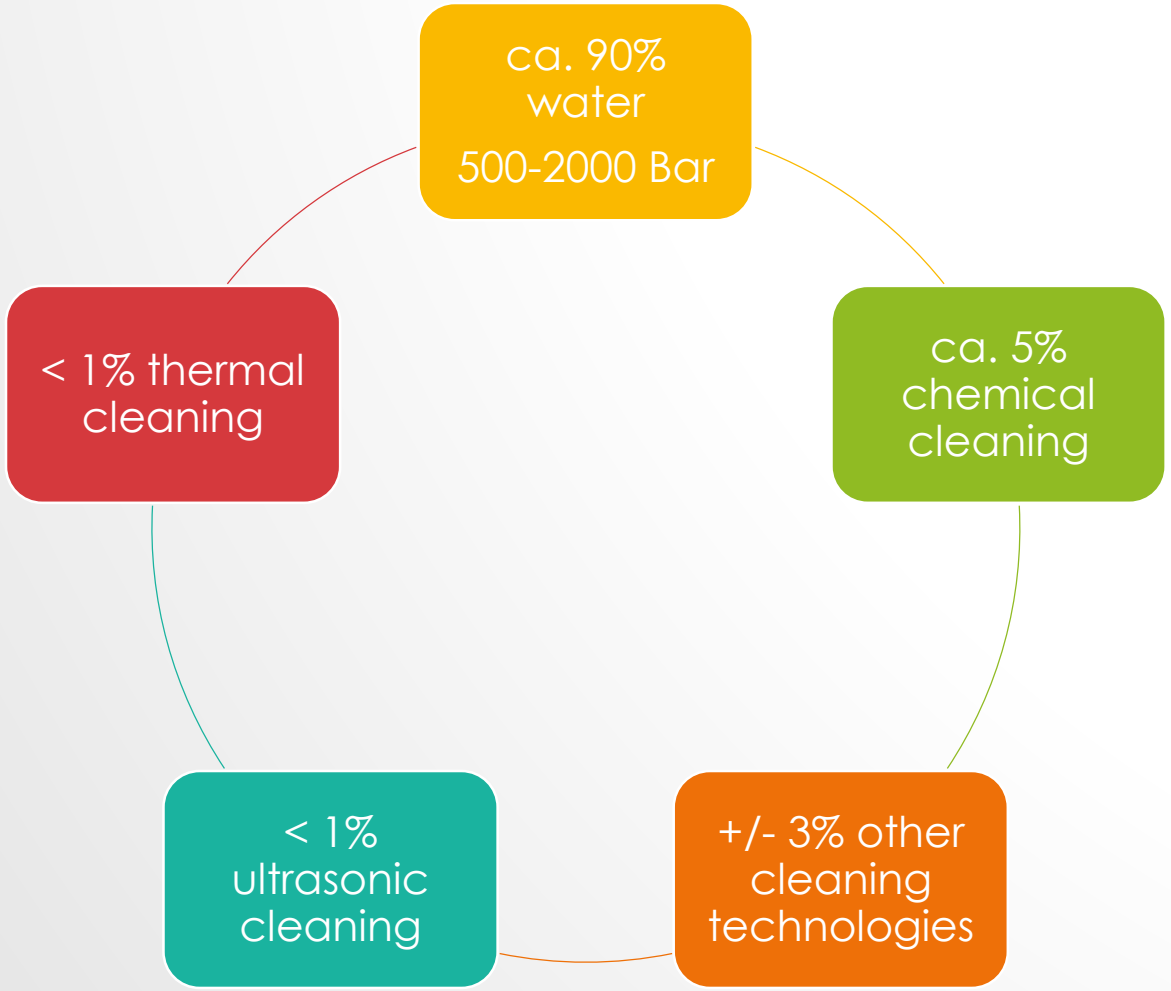
max. 18,650 x 4,500 x 4,250 mm;
1,300°C; 60 tons



THERMAL HEAT EXCHANGER CLEANING

HEAT EXCHANGER CLEANING TODAY

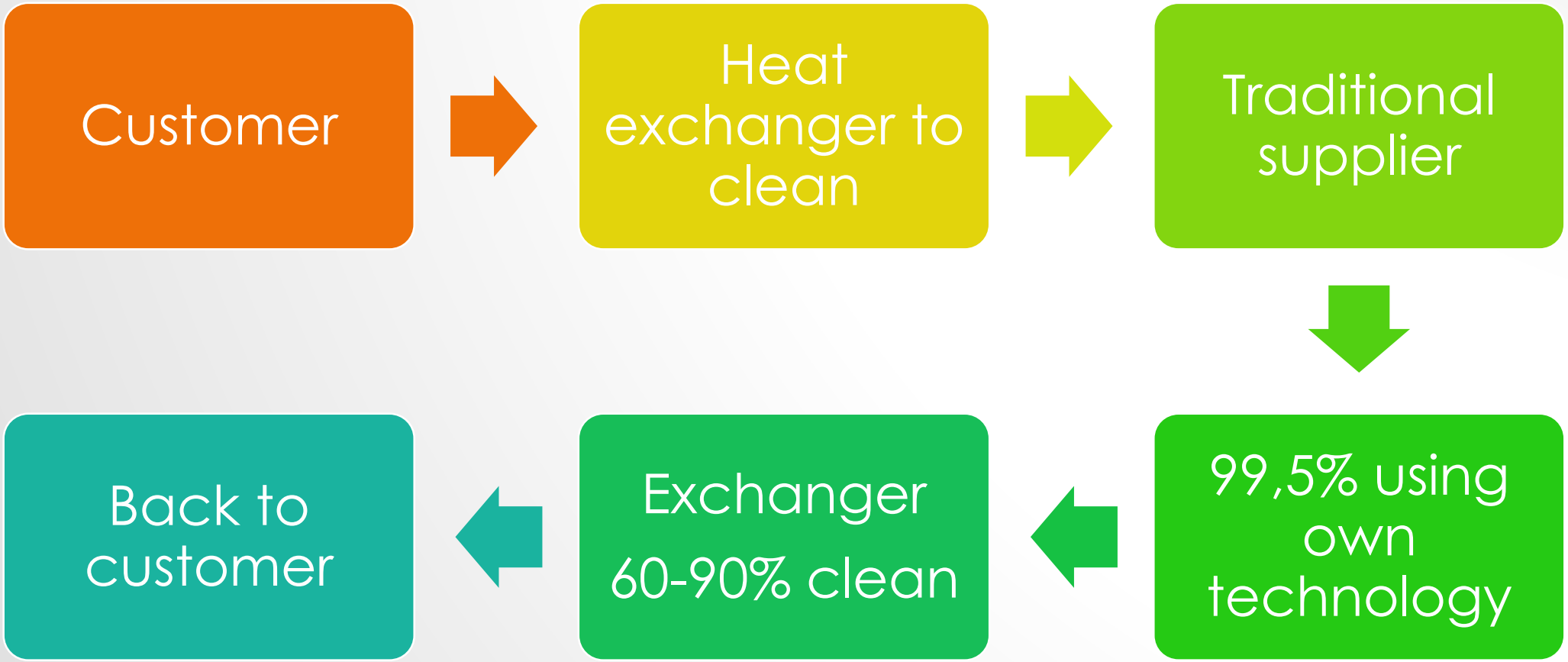
CHOSEN CLEANING SOLUTIONS



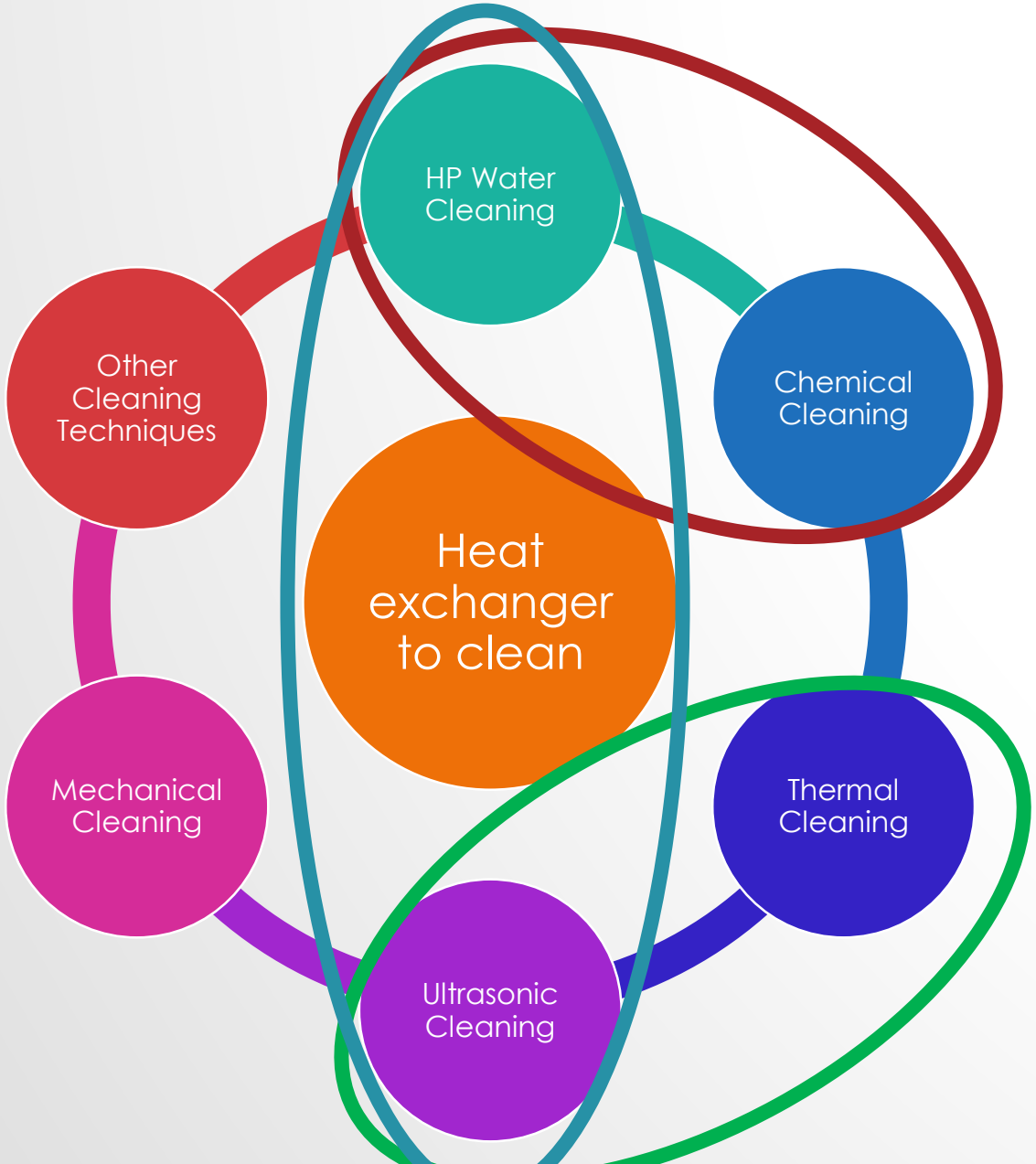
Alternative technique:

Re-tubing

HEAT EXCHANGER CLEANING TODAY



THE MOST EFFICIENT TECHNOLOGY

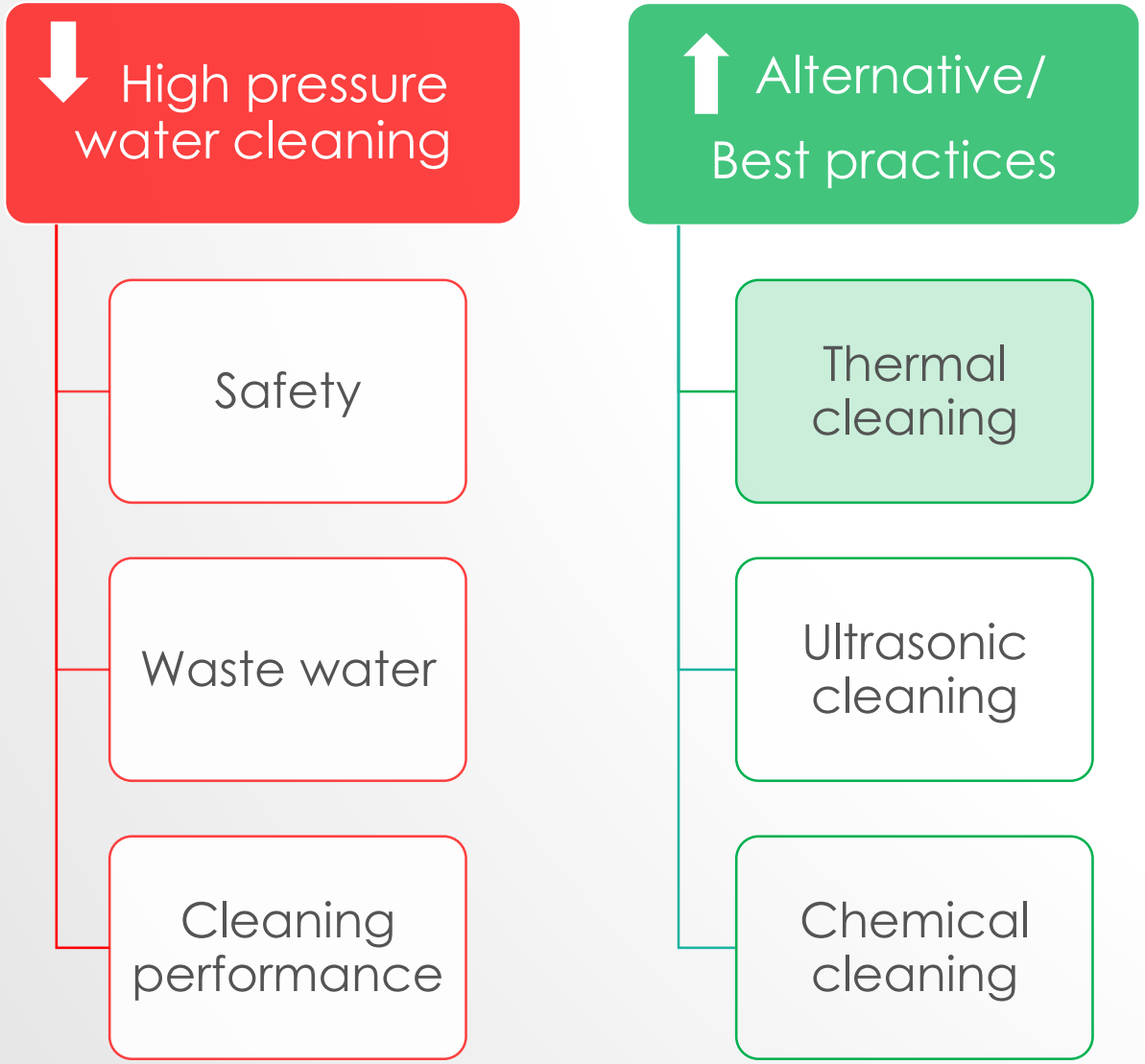


Choose the most efficient technology based on:

- Safety
- Dimensions
- Fouling
- Availability
- Cleanliness / Performance
- Waste
- On-site or not
- Costs / Savings
- Time
- Etc.

→ Goal: Prescribe the cleaning technology to use.

CLEANING POSSIBILITIES TOMORROW



LOW OXYGEN THERMAL CLEANING

- A thermal conversion of organic materials in an oxygen-poor environment.
- At a temperature of 400-450°C, the organic materials are converted into smaller molecules.
- The macromolecules are decomposed, resulting in pyrolysis gases (ethane, ethene, propane, propylene), pyrolysis oil - which contains aromatic components - & a carbon-rich residue.
- The pyrolysis gas and oil are transformed into carbon dioxide and vapor, by means of partial oxidation.
- The gases released during this process are reused to decompose the organic material.

Thermal cleaning reduces 1 kilogram of fouling to only 50-100 grams of dust, which is easy to remove.

LOW OXYGEN THERMAL CLEANING

The process takes place at operating temperatures of approx. **430 °C**.

organic materials (polymers/plastics)

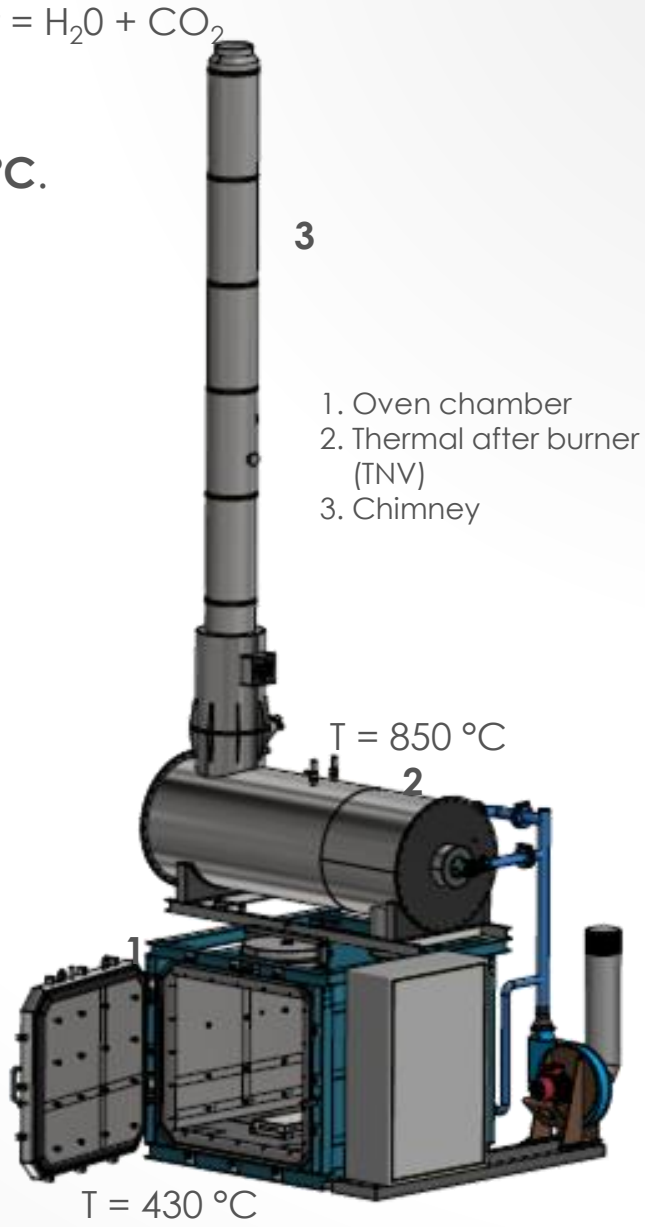
decomposition

pyrolysis gas

carbon

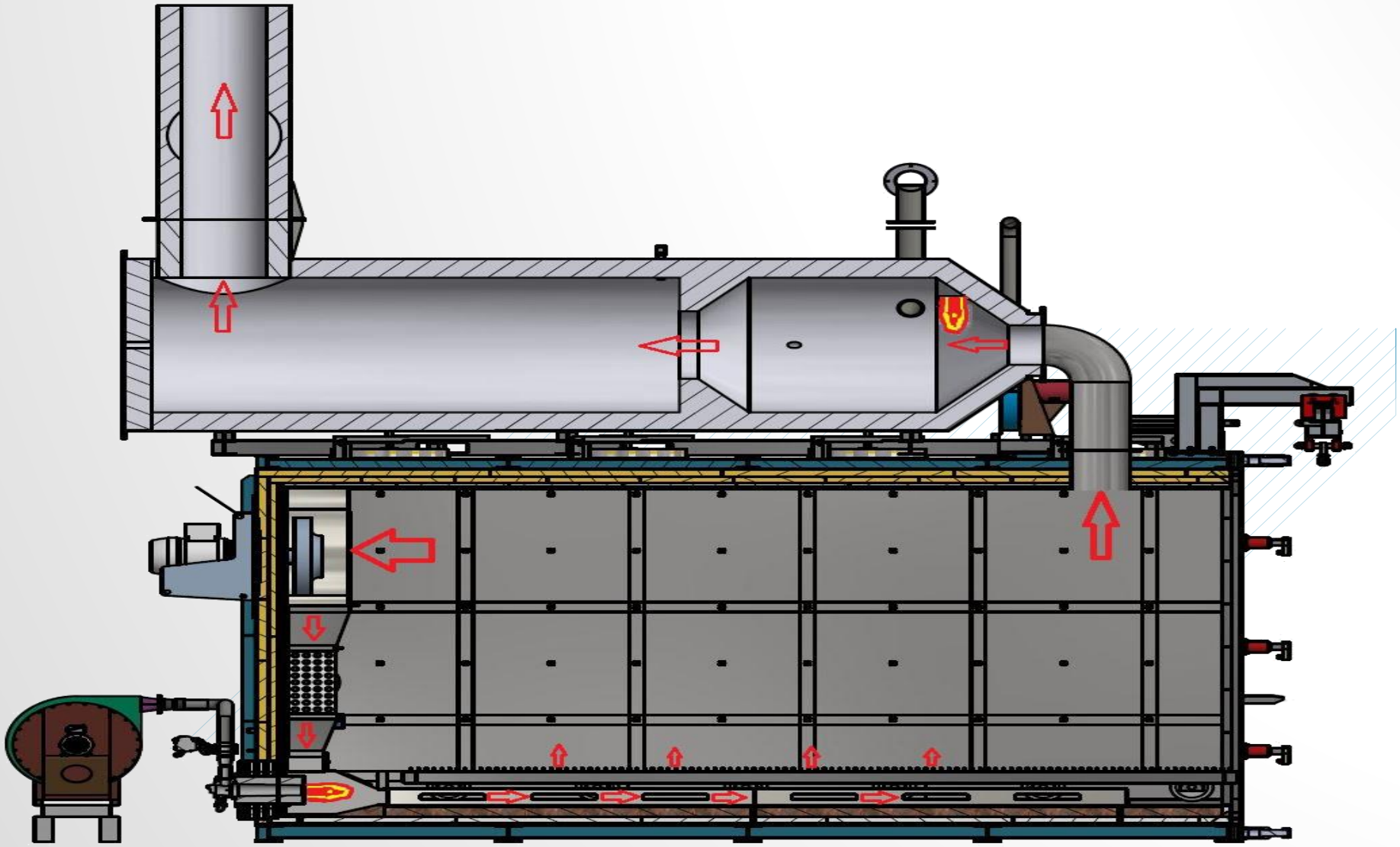
pyrolysis gas = H_2 + CO + CH_4 + CnHm + dust

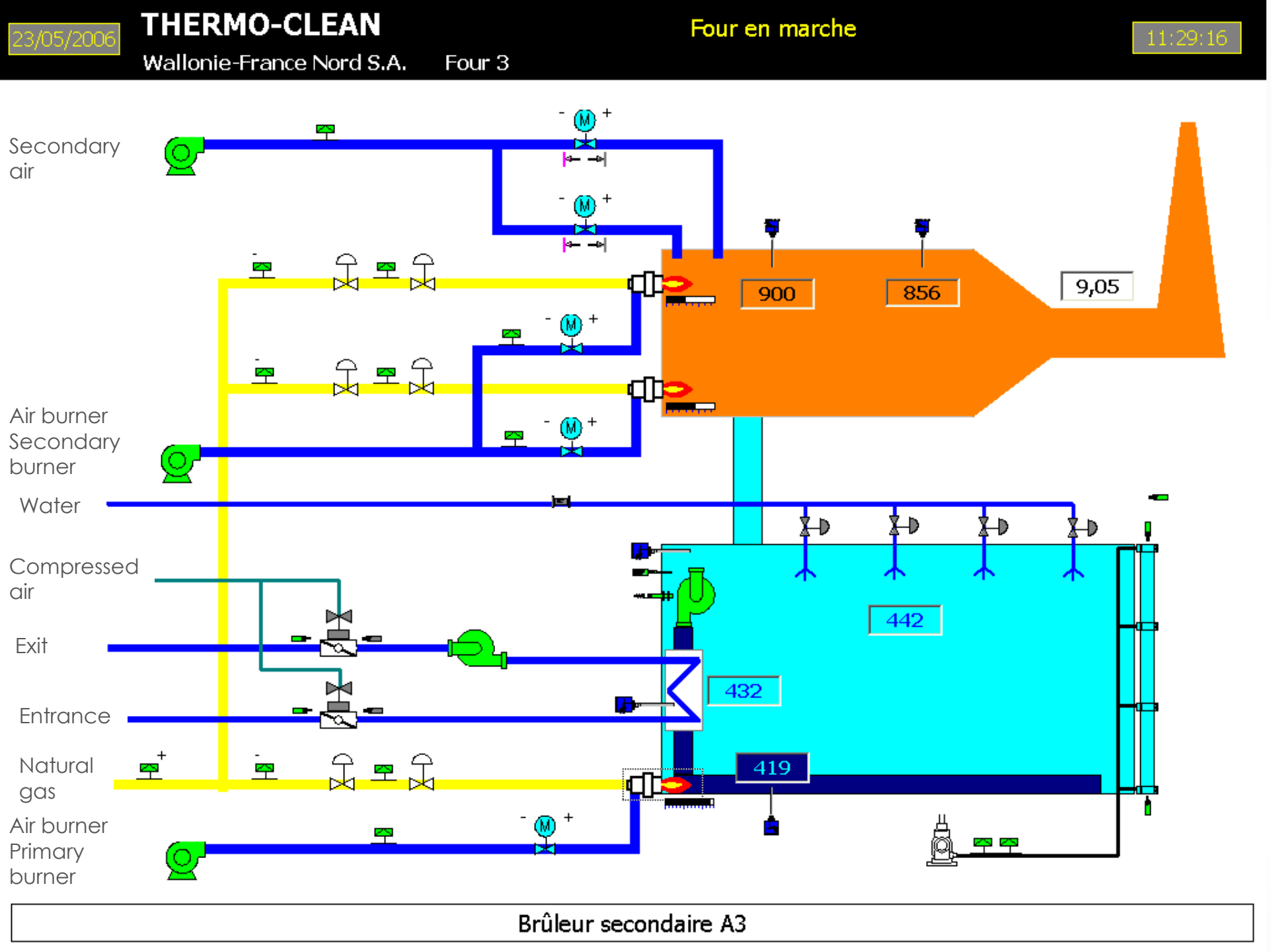
1 kilogram of fouling (organic material) → 50-100 grams dust

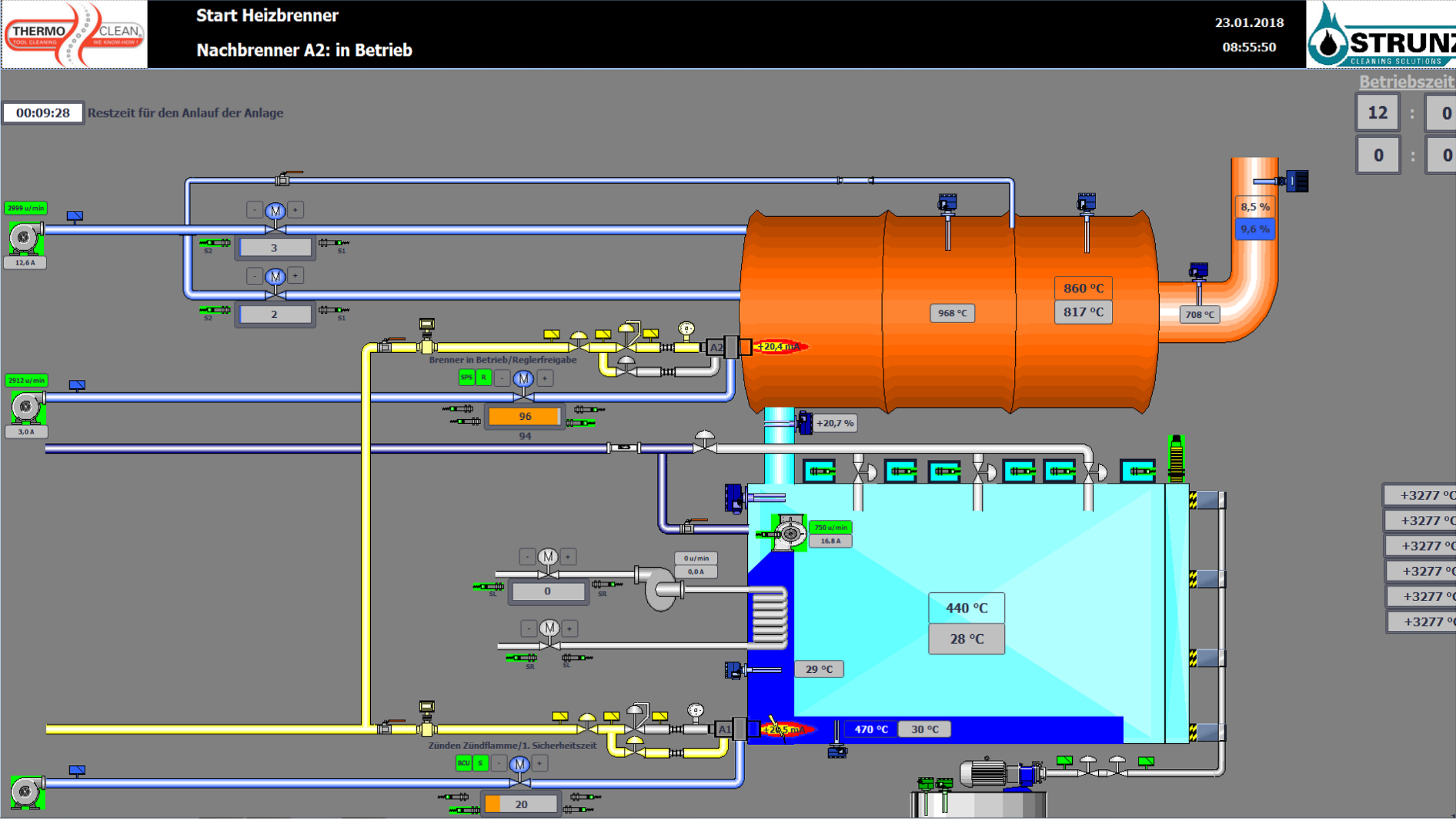


LOW OXYGEN THERMAL CLEANING

WORKING PRINCIPLE OF A PYROLYSIS OVEN

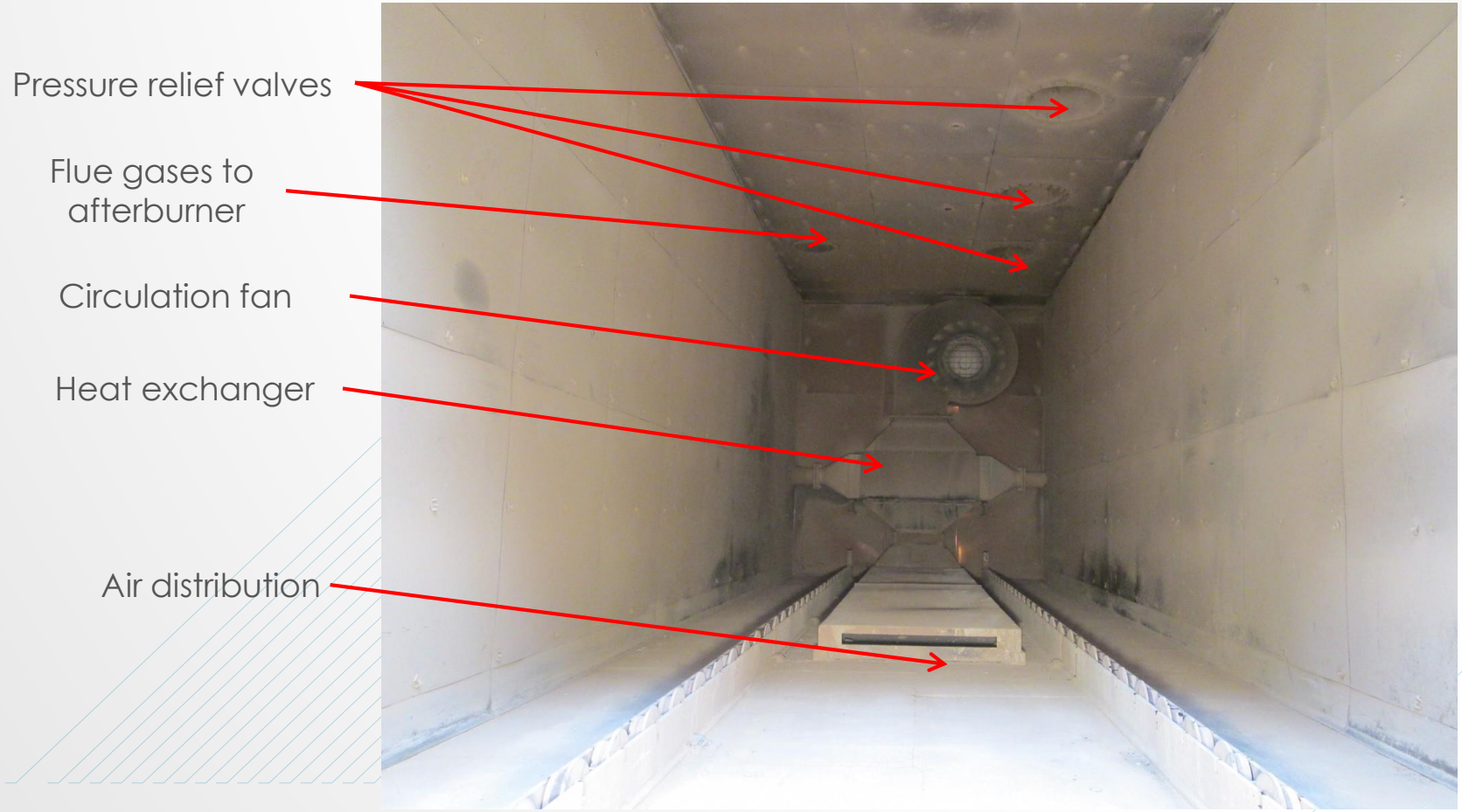


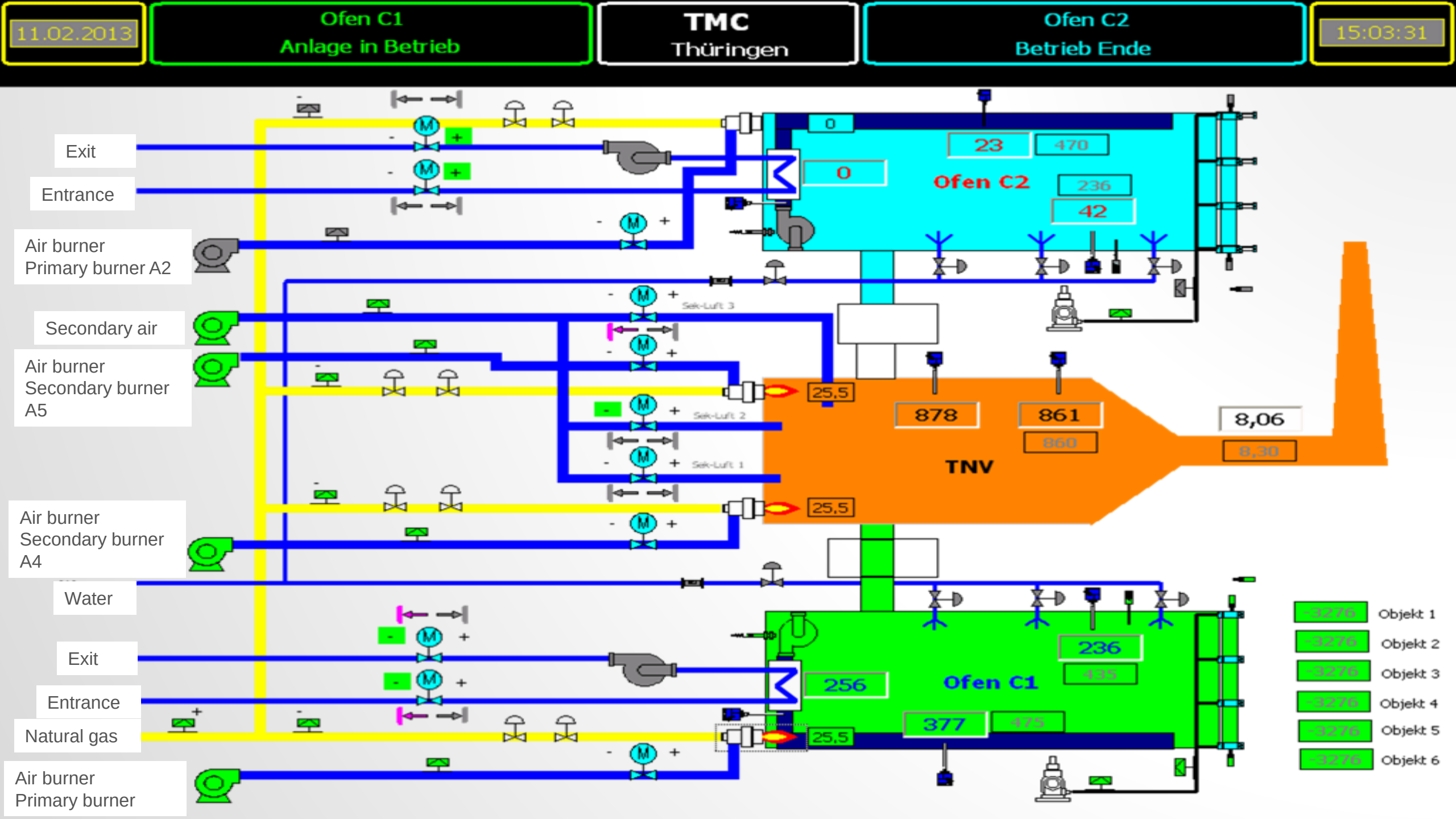

23/05/2006
THERMO-CLEAN
Wallonie-France Nord S.A.
Four 3
Four en marche
11:29:16
Secondary air
Air burner Secondary burner
Water
Compressed air
Exit
Entrance
Natural gas
Air burner Primary burner
900
856
9,05
442
432
419
Brûleur secondaire A3


Start Heizbrenner
Nachbrenner A2: in Betrieb
23.01.2018
08:55:50
Betriebszeit
12 : 0
0 : 0
00:09:28
Restzeit für den Anlauf der Anlage
2999 u/min
12,6 A
3
2
2912 u/min
3,0 A
Brenner in Betrieb/Reglerfreigabe
96
94
+20,4 mA
968 °C
860 °C
817 °C
708 °C
8,5 %
9,6 %
+20,7 %
750 u/min
16,8 A
0 u/min
0,0 A
0
440 °C
28 °C
29 °C
+20,5 mA
470 °C
30 °C
Zünden Zündflamme/1. Sicherheitszeit
20
+3277 °C

LOW OXYGEN THERMAL CLEANING

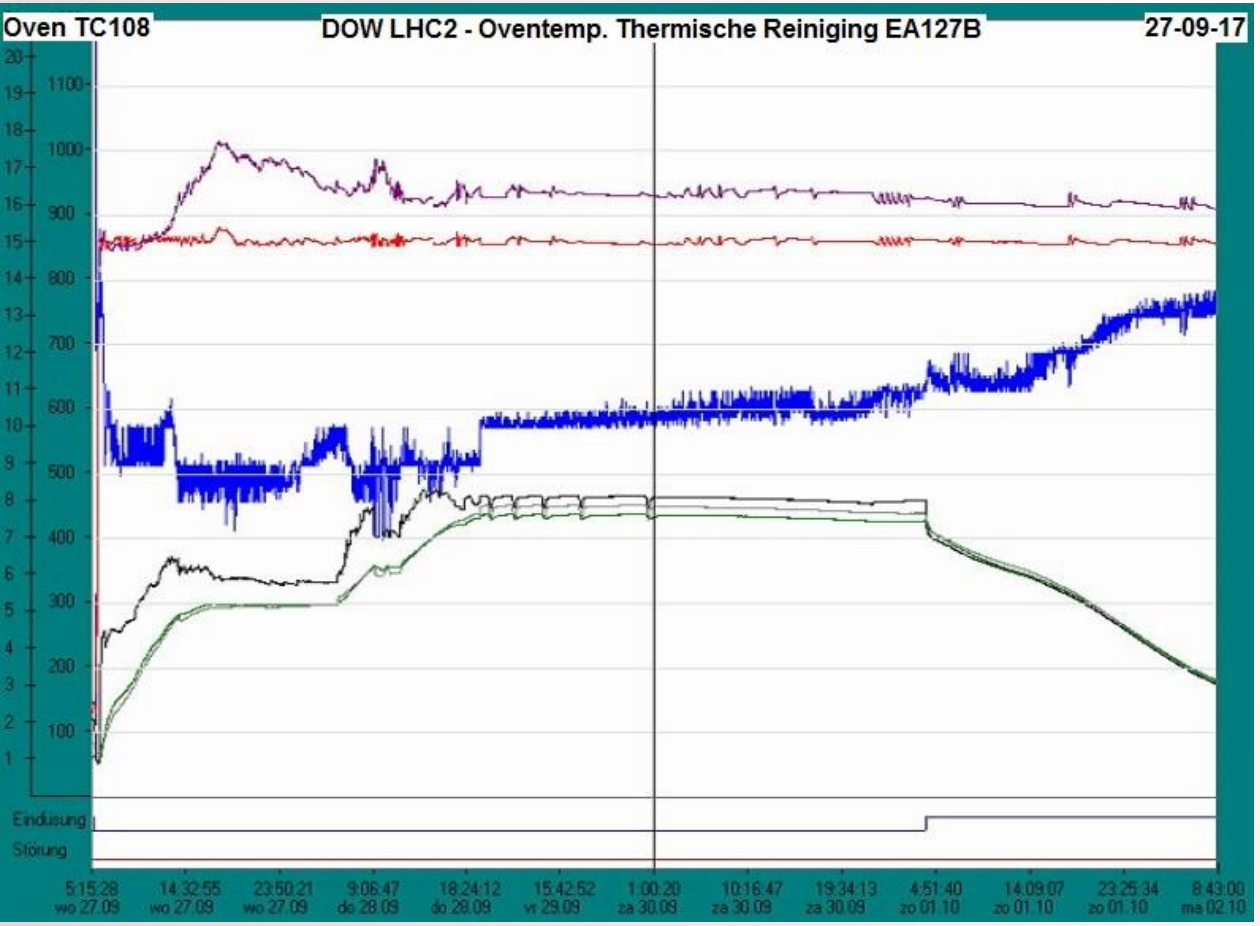
INSIDE OF A PYROLYSIS OVEN

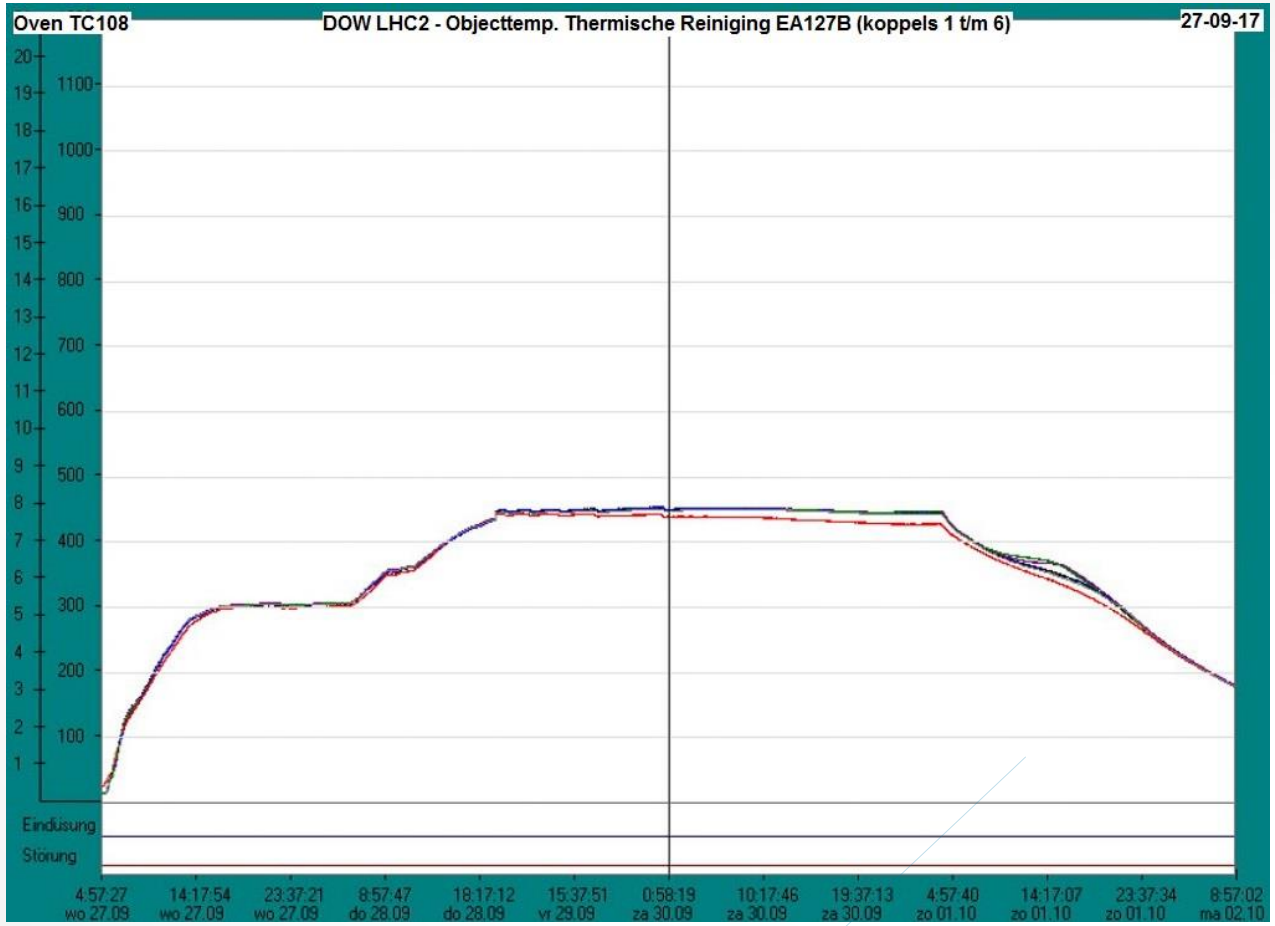



11.02.2013
Ofen C1
Anlage in Betrieb
TMC
Thüringen
Ofen C2
Betrieb Ende
15:03:31
Exit
Entrance
Air burner
Primary burner A2
Secondary air
Air burner
Secondary burner
A5
Air burner
Secondary burner
A4
Water
Exit
Entrance
Natural gas
Air burner
Primary burner
0
23
470
0
Ofen C2
236
42
25,5
878
861
860
8,06
8,30
TNV
25,5
256
Ofen C1
236
435
377
475
25,5
Objekt 1
Objekt 2
Objekt 3
Objekt 4
Objekt 5
Objekt 6

THERMAL CLEANING

EXAMPLE GRAPHS





Furnace Writer - Viewer - TC 1 - Furnace 7

Current data | Actual

Date 23/01/2018
Time 9:02:22

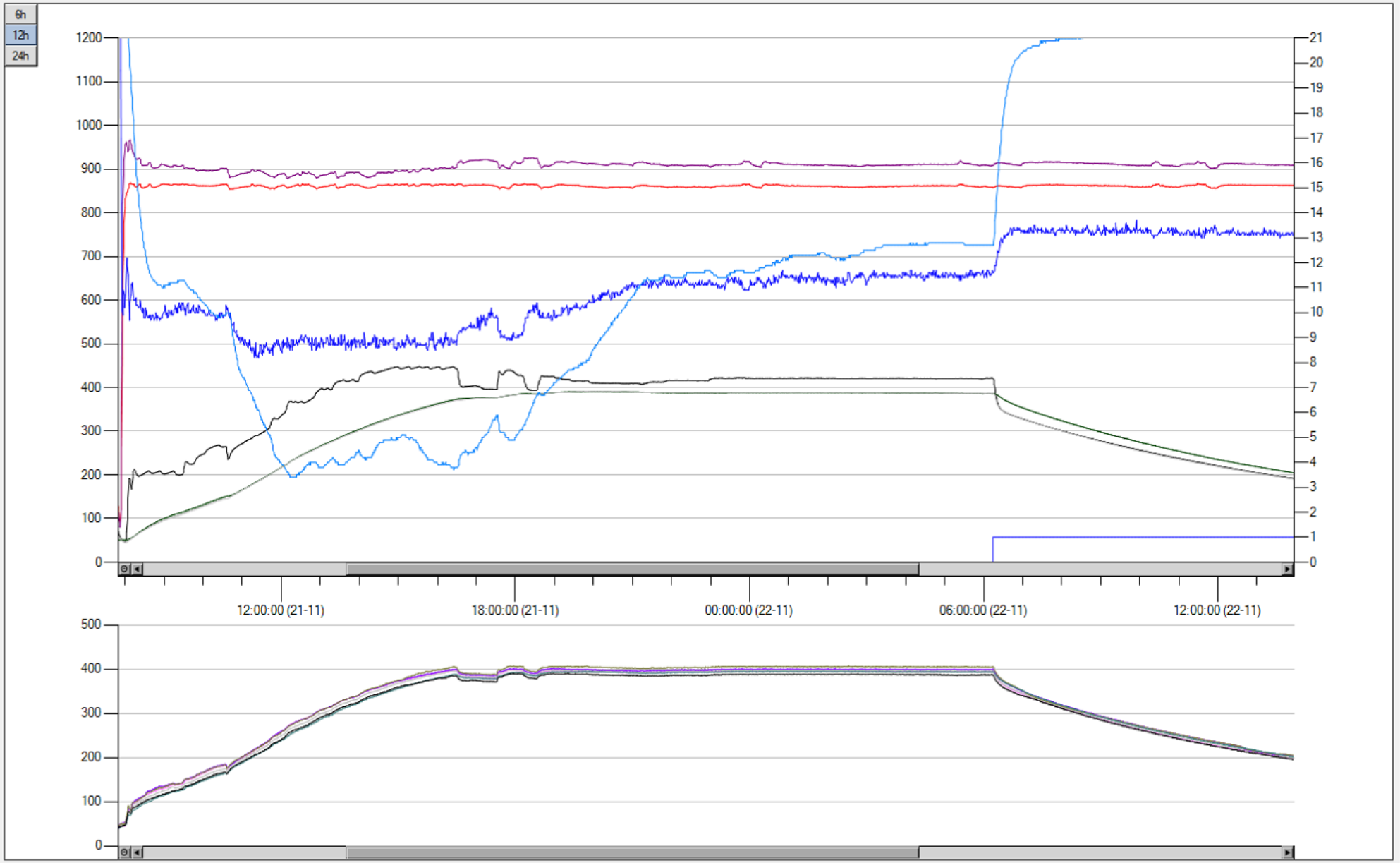
TNV-Austritt	852,8
TNV-Mitte	934,0
O2-Gehalt TNV	10,0
Primärbrenner	272,4
Ofen	35,6
Kanal	50,6
Eindüsung	0
Störung	0
Heizb. Klappe A01	100,0
Nachb. Klappe A11	93,2
TNV Klappe 1	1,8
TNV Klappe 2	2,7
Abluftklappe	0,0
O2-Gehalt Kamer	16,4
Nachb. Winkel luft..	0,0

	C°	Dt	C°
Objekt 1			327...
Objekt 2			327...
Objekt 3			327...
Objekt 4			327...
Objekt 5			327...
Objekt 6			327...
Ofen			0,0

Eindüsung Off
Störung Off
Settings
Print preview

Graphic | Object Alerts | Alarm History

6h 12h 24h



23/01/2018 9:01:45 Start charge

Alerts
On Timeout 60 seconds Reset
Comment

Visible in graphic
Default 1 | Default 2 | Default 3

- TNV-Austritt
- TNV-Mitte
- O2-Gehalt TNV
- Primärbrenner
- Ofen
- Kanal
- Eindüsung
- Störung
- Heizb. Klappe A01
- Nachb. Klappe A11
- TNV Klappe 1
- TNV Klappe 2
- Abluftklappe
- O2-Gehalt Kamer
- Nachb. Winkel luftklappe
- Objekt 1
- Objekt 2
- Objekt 3
- Objekt 4
- Objekt 5
- Objekt 6

Selections
Current data
Selection date/time
From 20/11/2017 21:01
Till 23/11/2017 09:01
Show selection

Furnace Writer - Viewer - TC 1 - Furnace 7

Current data | Actual

Date 22-01-2018
Time 22:39:00

TNV-Austritt	860,5
TNV-Mitte	909,7
O2-Gehalt TNV	10,4
Primärbrenner	457,2
Ofen	427,2
Kanal	429,7
Eindüsung	0
Störung	0
Heizb. Klappe A01	23,2
Nachb. Klappe A11	74,4
TNV Klappe 1	2,9
TNV Klappe 2	3,1
Abluftklappe	0,0
O2-Gehalt Kamer	11,3
Nachb. Winkel luft...	0,0

	C°	Dt	C°
Objekt 1			327...
Objekt 2			327...
Objekt 3			327...
Objekt 4			327...
Objekt 5			327...
Objekt 6			327...
Ofen			0,0

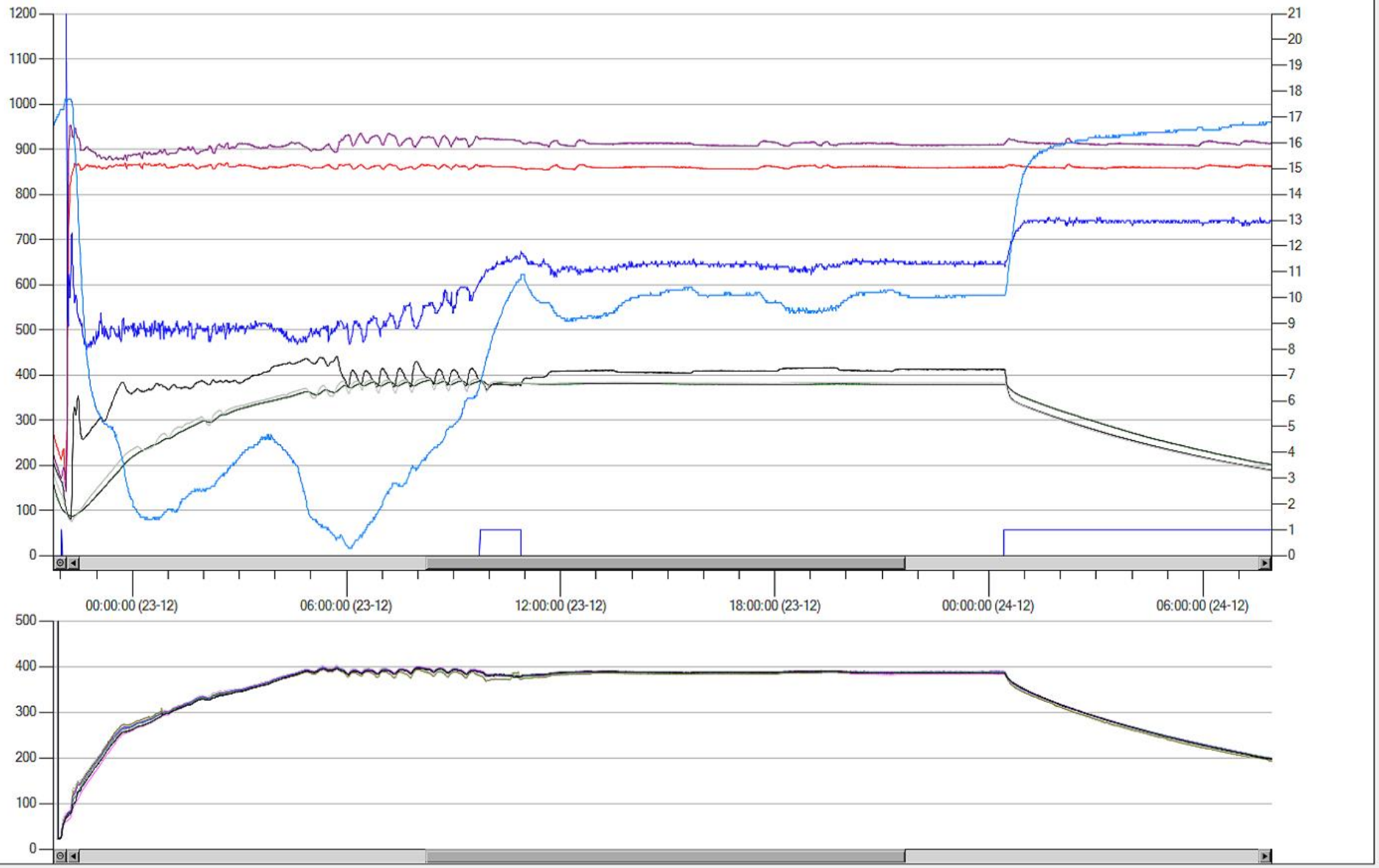
Eindüsung Off
Störung Off

Settings

Print preview

Graphic | Object Alerts | Alarm History

6h 12h 24h



23/01/2018 9:01:45 Start charge

Visible in graphic

Default 1 | Default 2 | Default 3

- TNV-Austritt
- TNV-Mitte
- O2-Gehalt TNV
- Primärbrenner
- Ofen
- Kanal
- Eindüsung
- Störung
- Heizb. Klappe A01
- Nachb. Klappe A11
- TNV Klappe 1
- TNV Klappe 2
- Abluftklappe
- O2-Gehalt Kamer
- Nachb. Winkel luftklappe
- Objekt 1
- Objekt 2
- Objekt 3
- Objekt 4
- Objekt 5
- Objekt 6

Alerts

On Timeout 60 seconds Reset

Comment

Selections

Current data
Selection date/time

From 21/12/2017 21:04
Till 25/12/2017 09:04

Show selection

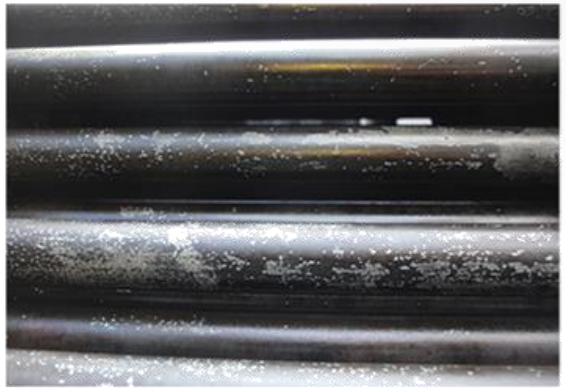
LOW OXYGEN THERMAL CLEANING

CLEANING STEPS

BEFORE THERMAL CLEANING

AFTER THERMAL CLEANING

+/- 1 HOUR HP CLEANING

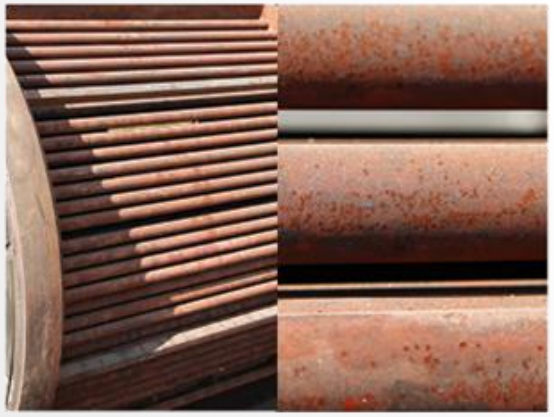


FINAL RESULT

LOW OXYGEN THERMAL CLEANING

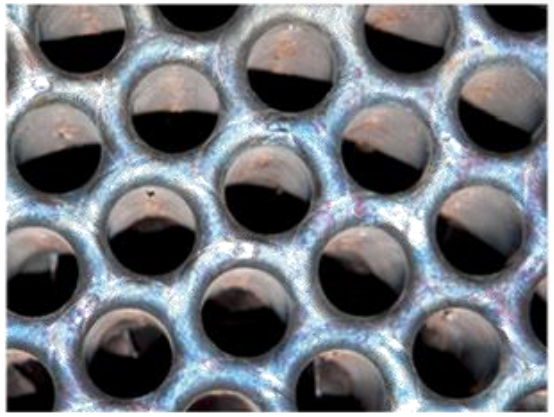
THERMAL CLEANING MAKES IT POSSIBLE TO CLEAN EVERYWHERE!

INSIDE TUBES



AROUND TUBES

BETWEEN TUBES & SHELL



INSIDE TUBES WITH STATIC MIXERS

LOW OXYGEN THERMAL CLEANING

PREPARING FOR THE THERMAL CLEANING

Very important:

- To place the heat exchanger properly in the oven
- To place the thermocouples on the right spot to have reliable measurements

LOW OXYGEN THERMAL CLEANING

WHICH KIND OF FOULING?

- All organic or partially organic fouling can be removed thermally.
- Lime deposit can become more brittle by thermal cleaning and then removed by HP after-treatment (not always!).
- Attention! Compounds such as sulphur, chlorine, fluorine...

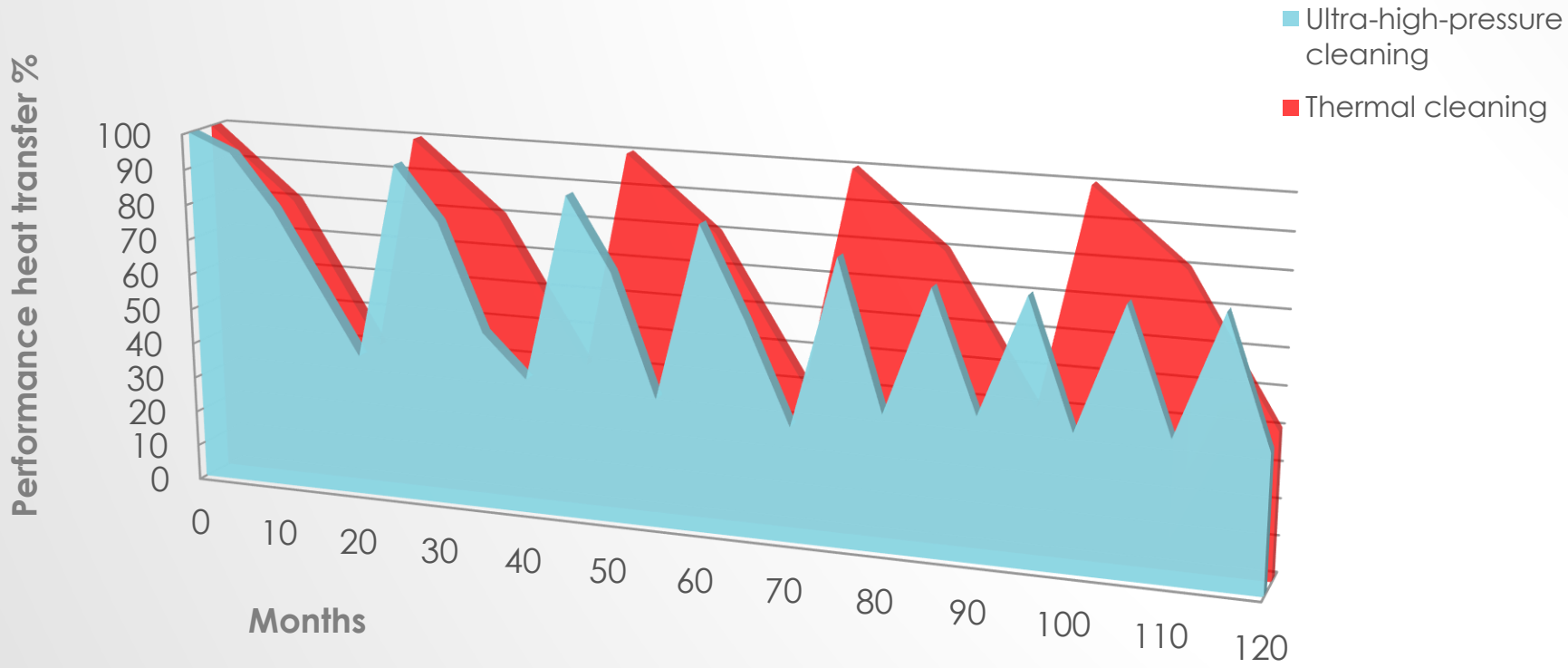
LOW OXYGEN THERMAL CLEANING

COMPARISON ULTRA-HIGH-PRESSURE ~ THERMAL

	Ultra-high-pressure	Thermal + HP after-cleaning
Typical cleaning results	65-75%	95-100%
Water consumption	50,000-500,000 L	Max. 10,000 L
Risk level	High risk of injury (manual)	Very low risk of injury
Time	4-16 hours, sometimes 1-2 weeks	12-100 hours
Capacity	1 pc.	Possible to clean several pieces simultaneously.
Effective for all types of fouling	Not effective for many contaminants (e.g. lime and hardened plastics are difficult).	Yes. Almost all (organic) contaminants can be removed.
Waste (Water & original fouling)	100% used water+ 100% fouling. Chemical waste.	1%. Is collected.

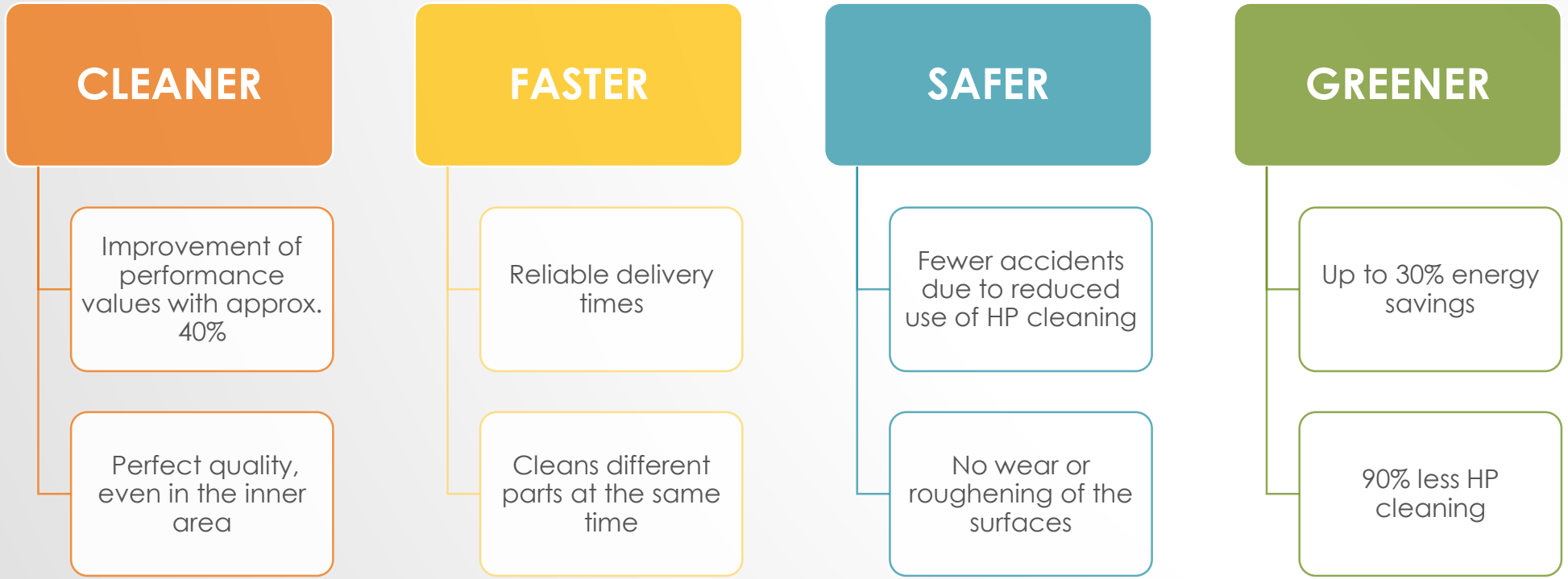
LOW OXYGEN THERMAL CLEANING

COMPARISON OF FREQUENCY ULTRA-HIGH-PRESSURE ~ THERMAL



LOW OXYGEN THERMAL CLEANING

ADVANTAGES OF THERMAL CLEANING



Improved cleaning = Less frequent cleaning
→ Lower operating costs!

LOW OXYGEN THERMAL CLEANING

DISADVANTAGES OF THERMAL CLEANING

Dimensions and weights depending on the cleaning installation

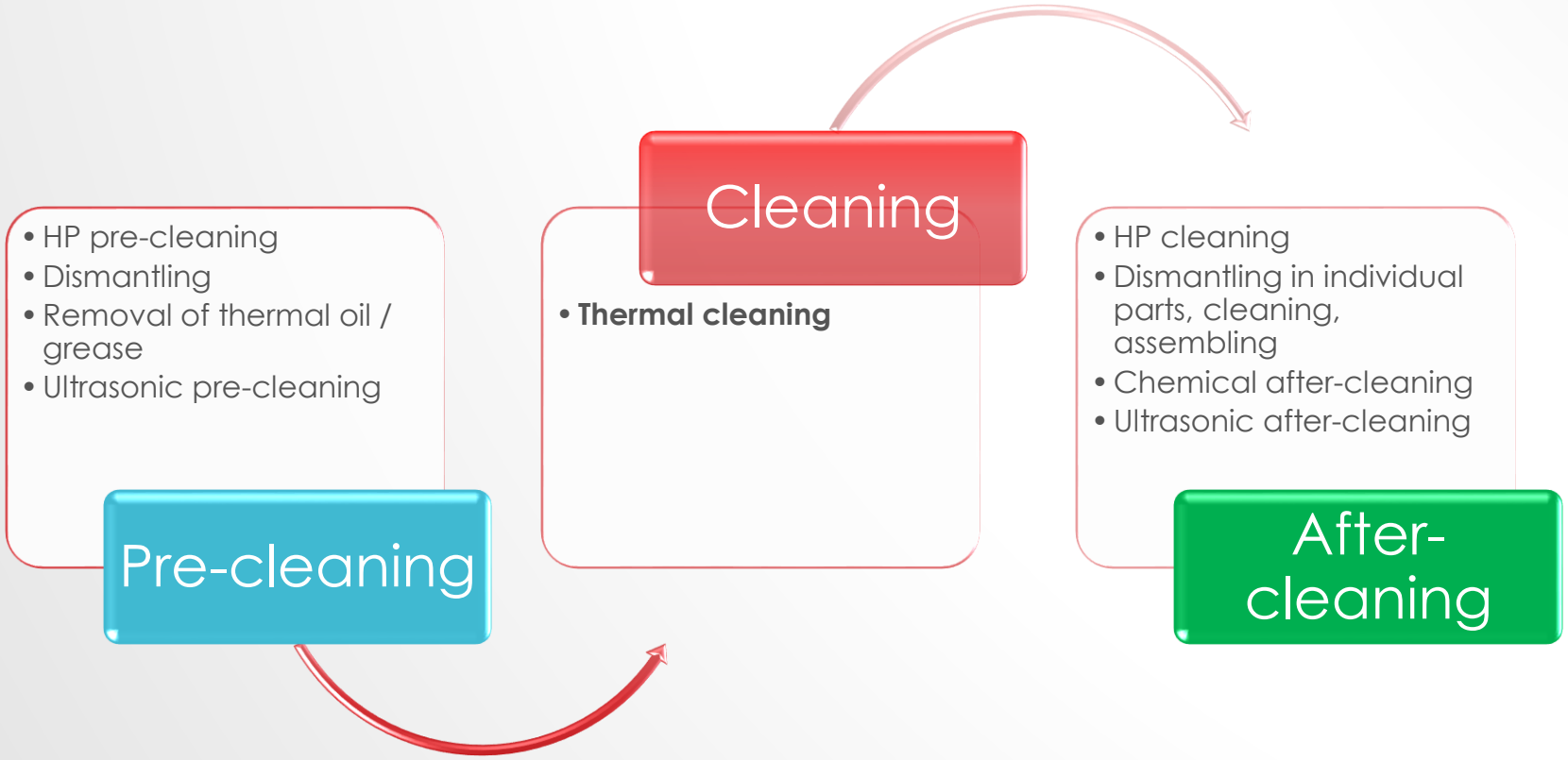
Total thermal capacity

Material has to withstand the temperature

No on-site cleaning possible

LOW OXYGEN THERMAL CLEANING

OPTIMAL RESULTS BY COMBINING PROCEDURES



LOW OXYGEN THERMAL CLEANING

COMPARISON BETWEEN THE TWO CLEANING TECHNOLOGIES

	High pressure water cleaning	Thermal cleaning + HP after-cleaning
Hourly rate	€€€	€€€€
Water	€€€	€
Waste water	€€€€€	€
Location	€€	-
Safety engineer from customer	€	-
Lifting costs	€€	€
Transportation costs	€	€€€

LOW OXYGEN THERMAL CLEANING

- A good preparation of the thermal cleaning is needed.

  Your supplier needs:

  the weight, type & degree of fouling, dimensions, drawings, materials used to build the exchanger, restrictions of the manufacturer (if available), …

- Due to steady cleaning cycles, a determined cleaning schedule is possible.

- Duplex and Monel heat exchangers can be cleaned by means of special cleaning programs.

- Some foulings can be cracked or removed at lower temperatures.

→ This cleaning technology is suitable for all equipment fouled with organic or partly organic fouling.

EXAMPLES OF THERMAL CLEANING

U-BUNDLE

Dust particles after the thermal removal of a cokes layer coming from a cracking unit.

After conventional cleaning the weight was **15,645 kg**.

After thermal cleaning the weight was **14,505 kg**.

So removed by thermal cleaning: **1,140 kg**.

LOW OXYGEN THERMAL CLEANING

These bundles where already cleaned by HP technology and declared clean!

Before thermal cleaning:
6,228 kg.

After thermal cleaning & rinsing:
6,065 kg.

Conclusion:
Thermal cleaning removed another **163 kg** after being declared clean!

LOW OXYGEN THERMAL CLEANING

These bundles where also cleaned by HP technology and declared clean!

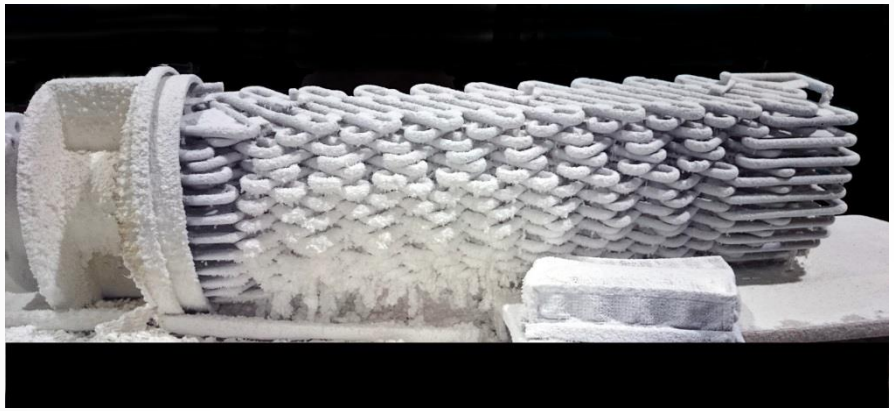
The removal of the remaining residue has led to significantly longer running times and energy savings!

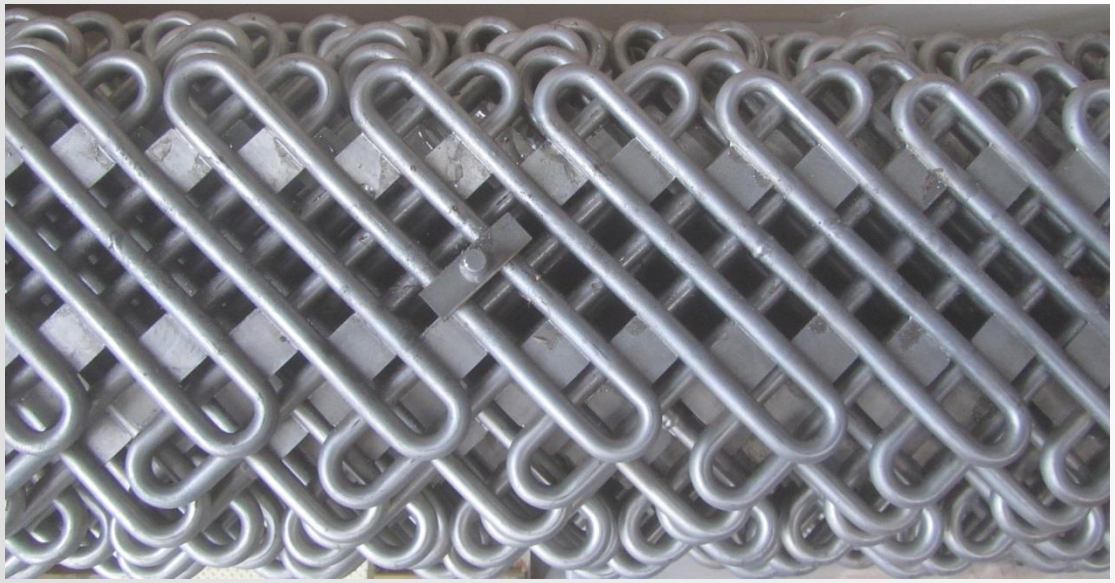
Special bags to transport the fouled heat exchanger in a safe way to avoid possible effluent leaking out.

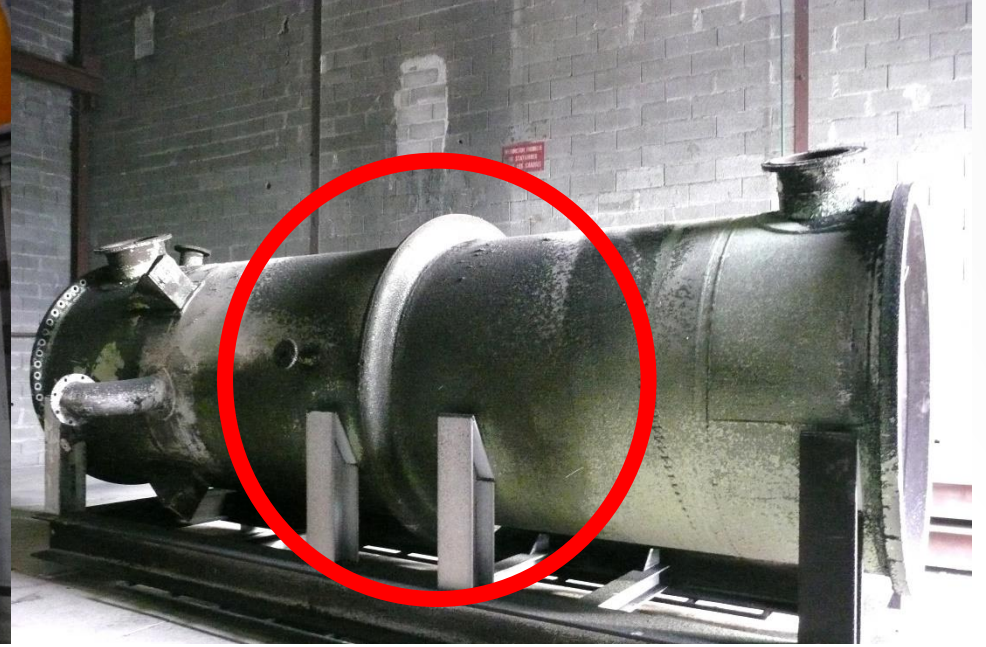
DIFFERENT TYPES

STRAIGHT BUNDLES

DIFFERENT TYPES







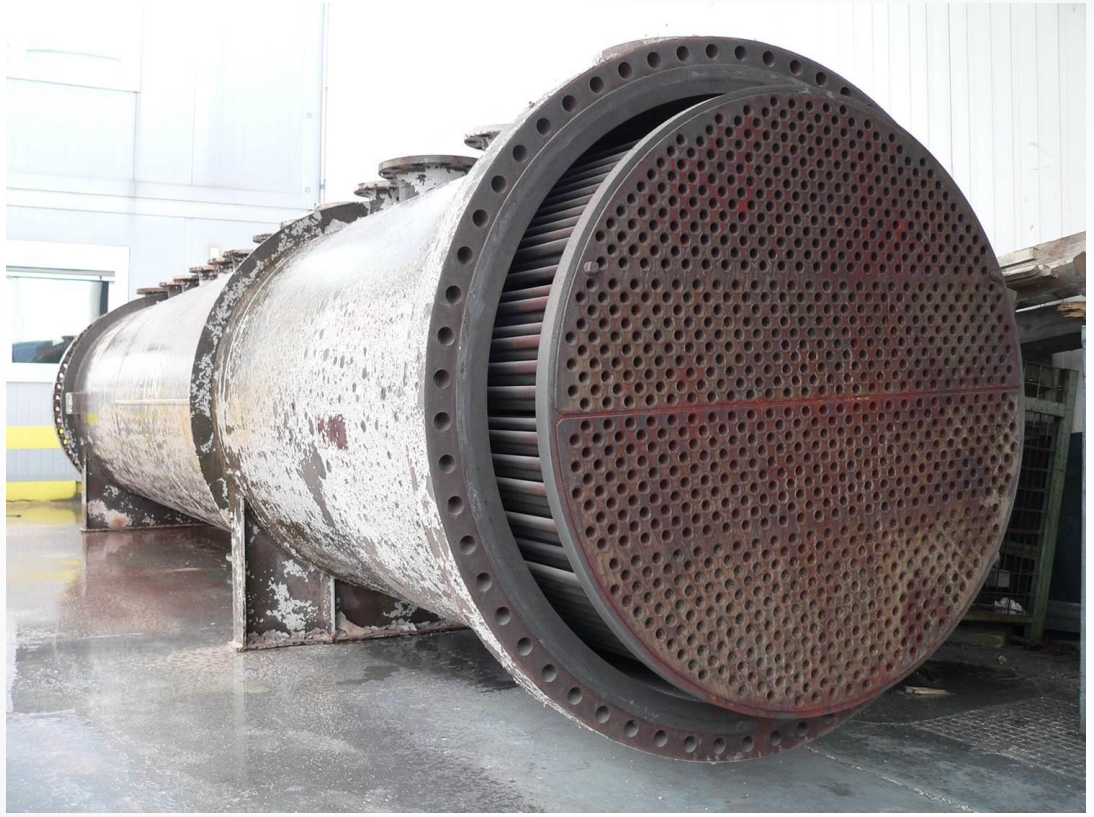
total weight 23 T; 3,300 kg fouling between tubes & shell

Important:

To support the exchanger before & during thermal cleaning to avoid deformation due to strength loss at 400°C.

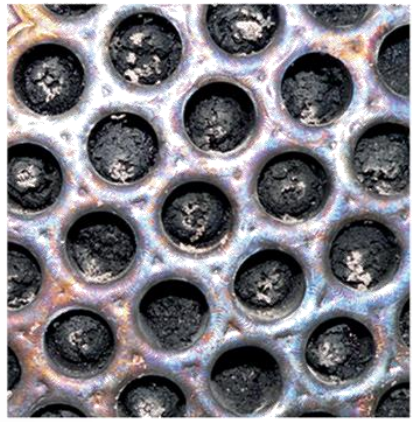
DIFFERENT TYPES

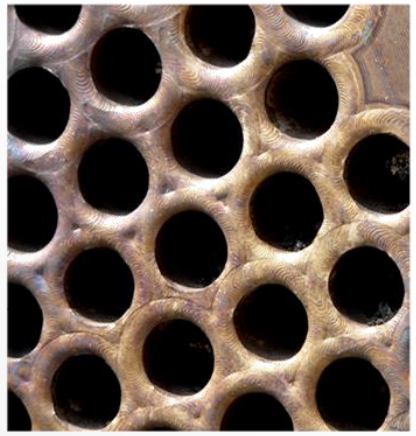
WITH FIXED HOUSINGS



DIFFERENT TYPES

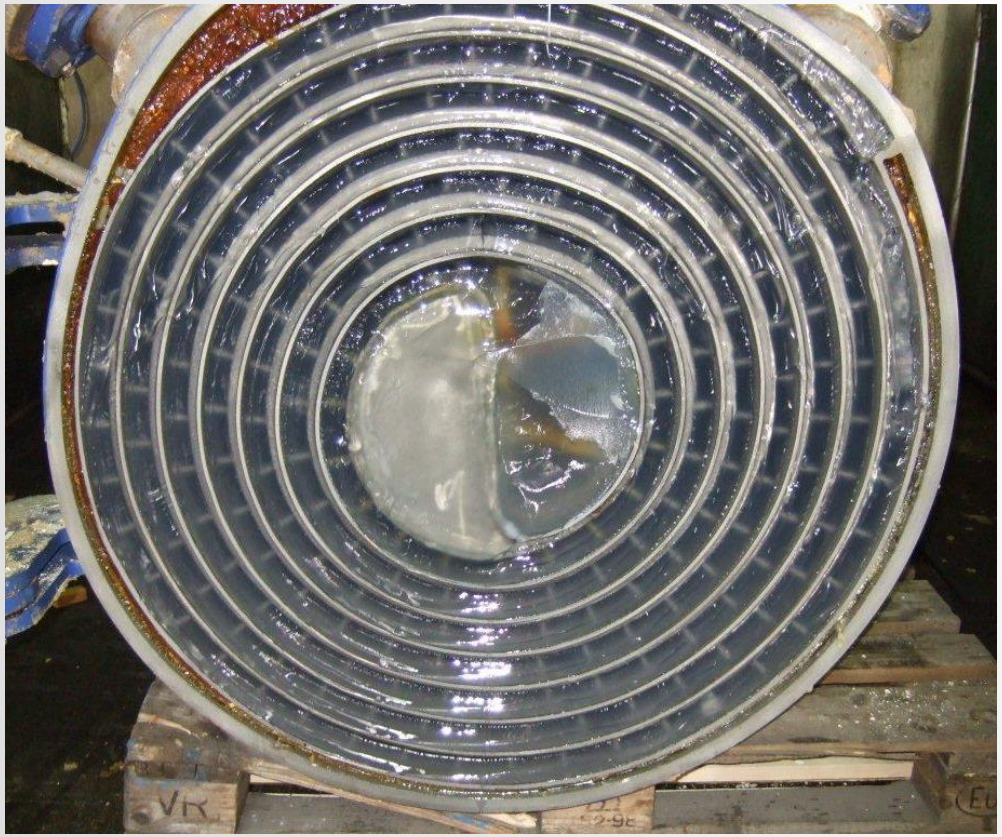
WITH FIXED STATIC MIXERS

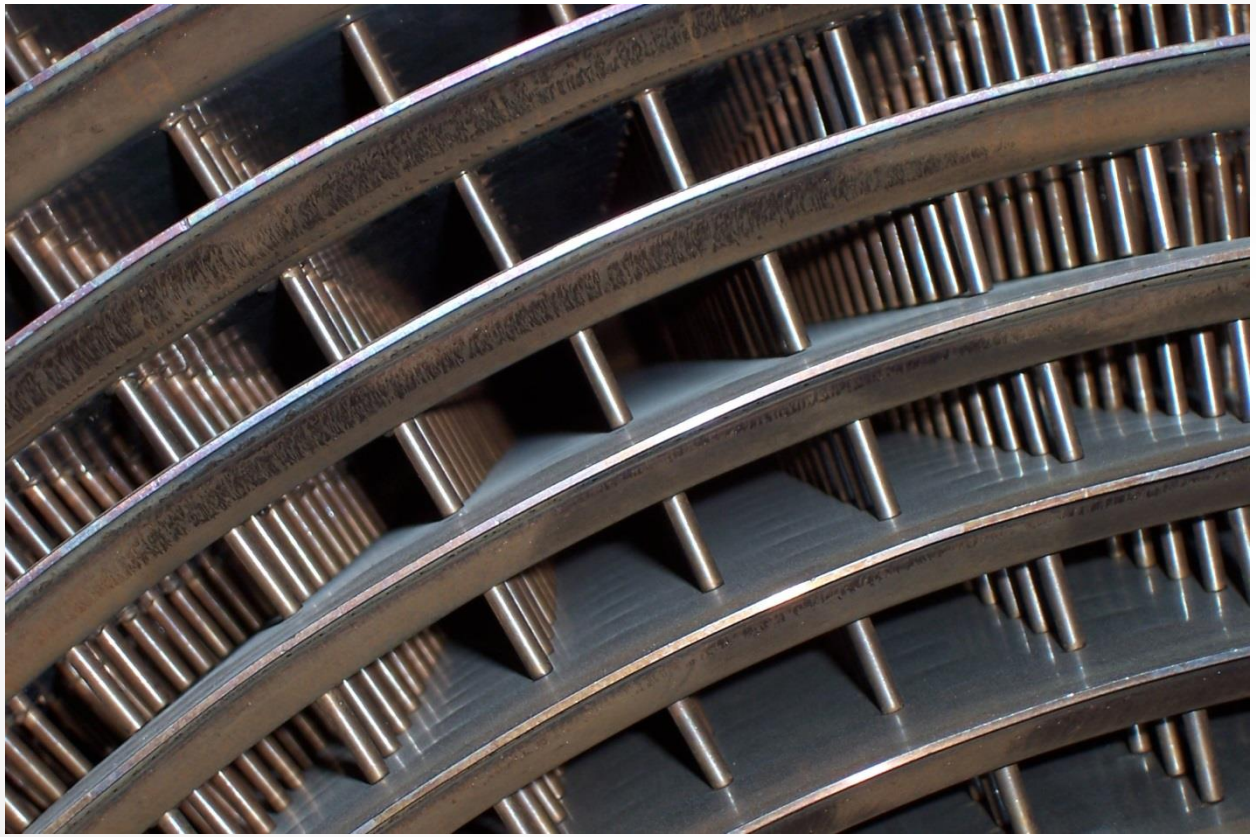




DIFFERENT TYPES

SPIRAL HEAT EXCHANGER



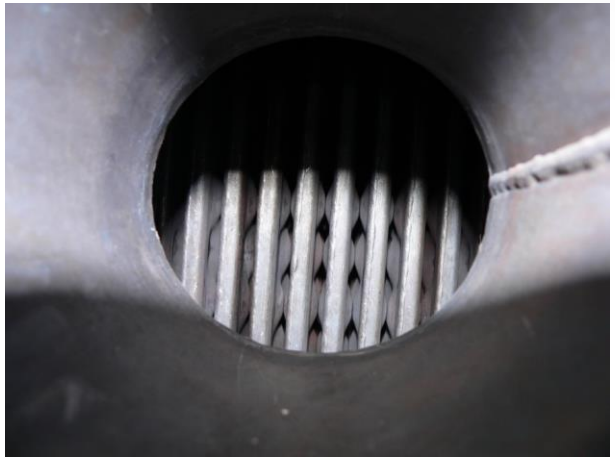


DIFFERENT TYPES

SPIRAL HEAT EXCHANGER

DIFFERENT TYPES

COMPABLOCS

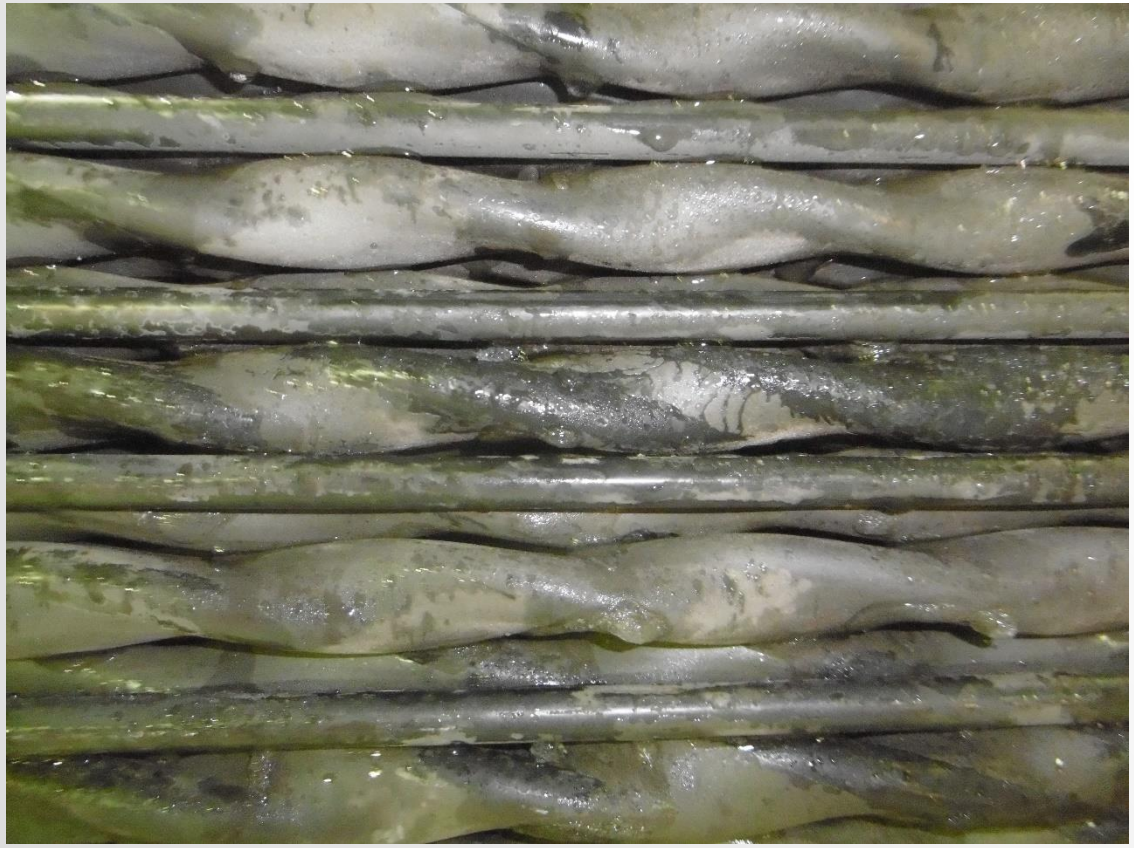


DIFFERENT TYPES

REACTOR WITH HEAT EXCHANGER

DIFFERENT TYPES

WITH TWISTED TUBES



EXAMPLES BEFORE & AFTER

EXAMPLES BEFORE & AFTER

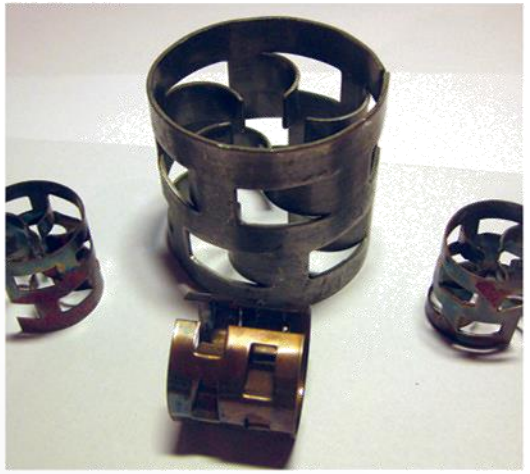
SULPHUR CONCRETE REMOVAL

OTHER EXAMPLES BEFORE & AFTER

CATALYST CLEANING

OTHER EXAMPLES BEFORE & AFTER

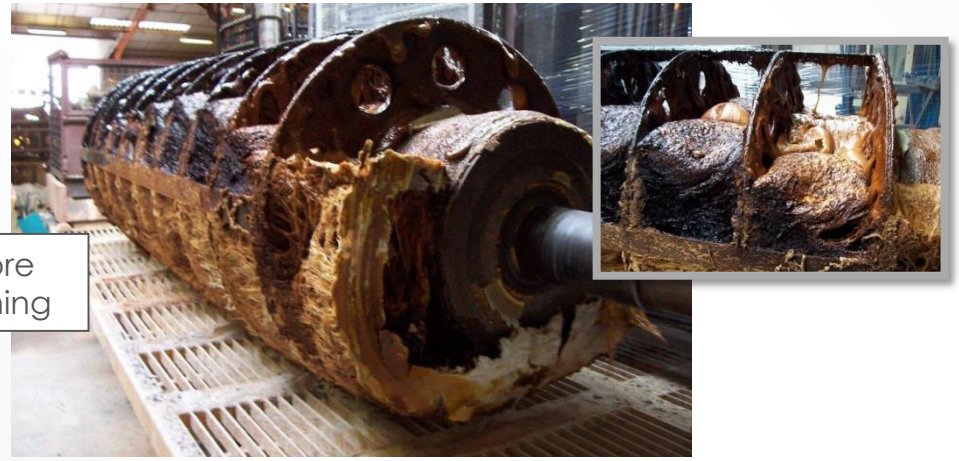
CLEANING RASHIG RINGS



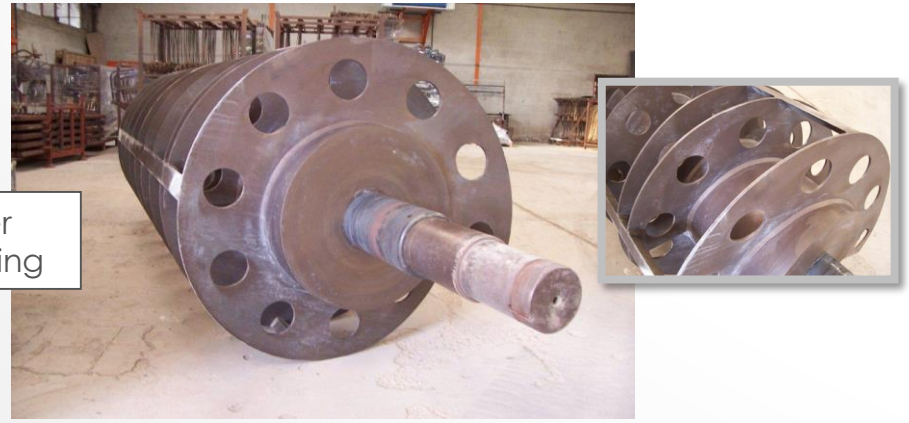
OTHER EXAMPLES BEFORE & AFTER

REACTOR PARTS

before cleaning



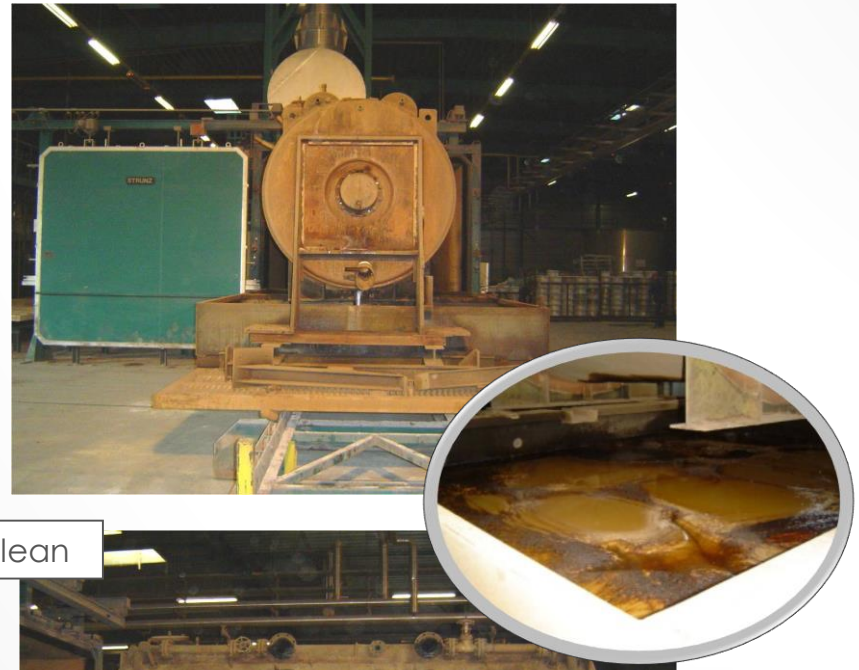
after cleaning



OTHER EXAMPLES BEFORE & AFTER

REACTOR PARTS

At the customer's premises



At Thermo-Clean

Cleaning in 2 phases:

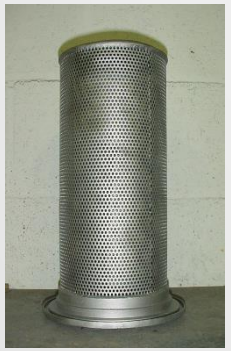
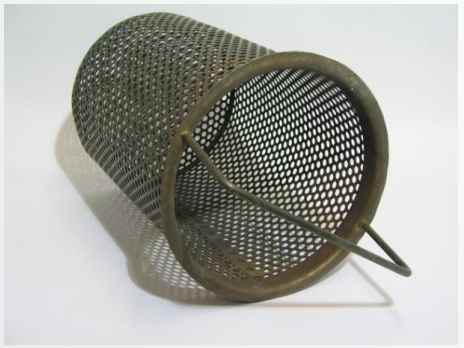
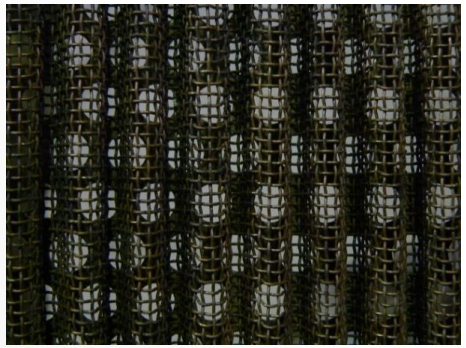
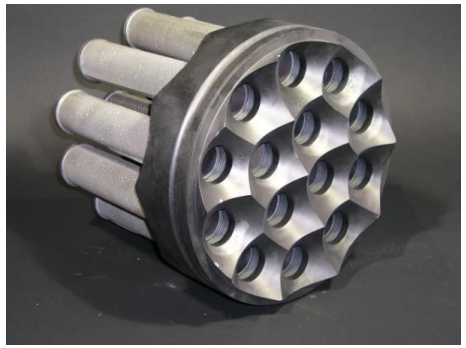
- **Melt off: -90% of the fouling**
- **Thermal cleaning as after-cleaning**

OTHER EXAMPLES BEFORE & AFTER

VARIOUS METAL FILTERS





OTHER EXAMPLES BEFORE & AFTER

DEMISTERS

before cleaning

after cleaning

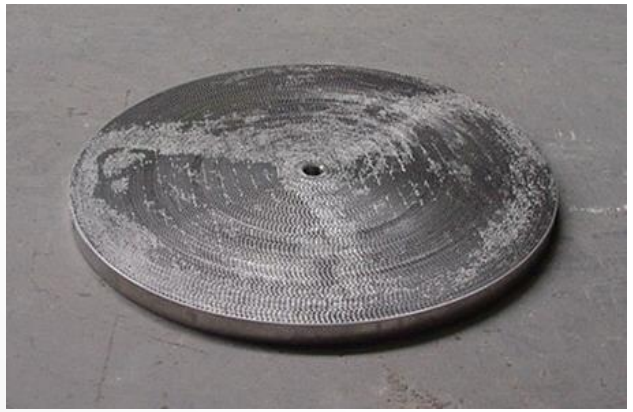
OTHER EXAMPLES BEFORE & AFTER

FLAME ARRESTORS









OTHER EXAMPLES BEFORE & AFTER

MATERIAL OUT OF THE PLASTICS INDUSTRY

OTHER EXAMPLES BEFORE & AFTER

DIE PLATE CLEANING

before cleaning

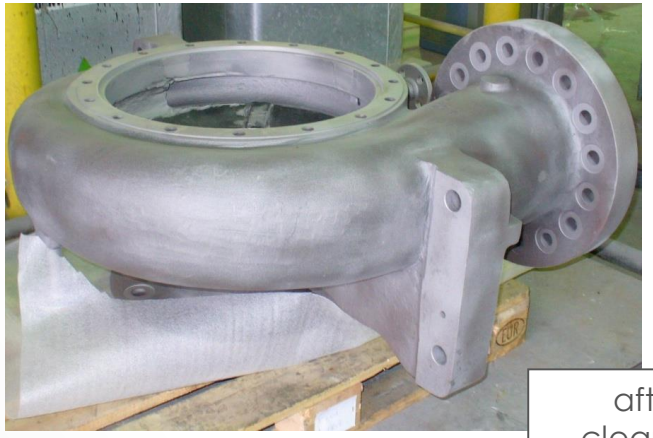
after cleaning

thermal cleaning and
wet glass bead blasting

OTHER EXAMPLES BEFORE & AFTER

PUMPS & HOUSINGS

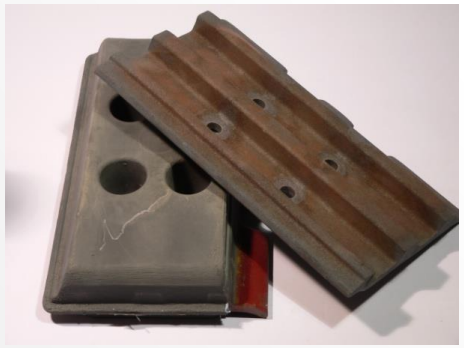
before cleaning



after cleaning

OTHER EXAMPLES BEFORE & AFTER

RUBBER REMOVAL



WHAT CAN BE CLEANED?

SOME EXAMPLES

- Heat exchangers with fouling in & or between tubes;
- Heat exchangers with fixed shell & fouling between tubes & shell;
- Compablocs, heat exchanger plates, spiral heat exchangers;
- Vane decks, demisters, mellow packs;
- Pipe work (also with static mixers);
- Extruder screws & parts;
- Polymer & refinery pumps;
- Flame arrestors, sieve packs, valves;
- Filters, spin packs, die plates, hot runners…

REFERENCES FROM THE PLASTICS & REFINERY INDUSTRY

- BASF
- Borealis
- Covestro (Bayer)
- Trinseo (Dow)
- DuPont
- ExxonMobil
- Rhodia
- Arkema
- BP
- Esso
- Lanxess
- Mineraloelraffinerie Oberrhein
- Q8
- Raffinerie Heide
- Sabic
- Total Polymers
- Lanxess
- Shell
- Total Additifs Carburants
- Total Petrochemicals