Efficiency & Savings through On-Line Chemical Cleaning

SENTRO Technologies provides innovative cleaning services to the Refining, Petrochemical & Pipeline industries.

www.sentro-technologies.com

USA | UK | Germany | Russia | Turkey | India | Brazil | Indonesia

SENTRO Technologies
Introduction

Online Chemical Cleaning Solutions for
  - Furnaces, Heaters & Steam Boilers
  - Air Cooled Heat Exchangers (Fin Fans)

Case Study @ SAPREF

Credentials

Q&A
Introduction:
Online Cleaning for sustainable efficiency

Efficiency vs. Time

Offline Cleaning
Introduction:
Online Cleaning for sustainable efficiency
SENTROMAX
On-line Chemical Cleaning of Furnaces, Heaters & Steam Boilers

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Radiation & Convection sections become fouled during normal production

The fouling of the external tube surfaces with dust, dirt & refractory materials leads to:

- Reduced flue gas flow
- Increased flue gas temperature
- Reduced production
- Increased fuel consumption
- Increased emissions/pollution
- Increased corrosion

And results in:
- Plugging & the requirement to shut-down
Traditional cleaning methods have significant disadvantages

<table>
<thead>
<tr>
<th>Methods</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Off-Line Cleaning</strong></td>
<td>▸ Lost production during shutdown</td>
</tr>
<tr>
<td>Uses mechanical means such as</td>
<td>▸ Damage to refractory/insulation</td>
</tr>
<tr>
<td>high pressure water jet, sand</td>
<td>▸ Safety risks from entry to confined areas</td>
</tr>
<tr>
<td>blasting or manual labor using</td>
<td>▸ Partial cleaning due to limited access to bundles in convection sections</td>
</tr>
<tr>
<td>steel brushes.</td>
<td></td>
</tr>
<tr>
<td><strong>On-Line Cleaning by “Dry Ice”</strong></td>
<td>▸ Effective only on the upper surface of fin bundles (does not penetrate between the bundles)</td>
</tr>
<tr>
<td>Uses a spray of “dry ice” (CO₂)</td>
<td>▸ Significant risk of thermal shock to fins and tube supports (made of cast iron) causing stress cracks, metal deformation &amp; accelerated corrosion</td>
</tr>
<tr>
<td><strong>On-Line Cleaning by hazardous chemicals</strong></td>
<td>▸ Non-environmental friendly method.</td>
</tr>
<tr>
<td>Uses spraying of toxic chemicals containing ammonia or low pH acids.</td>
<td>▸ Creation of air pollution with hazardous gases during the cleaning.</td>
</tr>
<tr>
<td></td>
<td>▸ In humid conditions hazardous gases in the atmosphere can condense and accumulate on the ground and into water resources.</td>
</tr>
</tbody>
</table>
SENTROMAX On-line Furnace Cleaning

Removal of scale and deposits from the external tube walls during normal operating conditions

- Increase efficiency
- Increase production
- Save energy
- Reduce emission/pollution
- Reduced temperature profile
- Avoid shutting-down/start-up problems
- Save maintenance activities
- Future rights for carbon credits (Kyoto Protocol)
- Reduced and inhibited tube corrosion
SENTROMAX cleaning procedure

Dry chemical granules are sprayed by compressed air into the radiation and convection sections

- High Return on Investment
- Innovative Chemistry
- Safe Process
- Environmentally Friendly
SENTROMAX Radiant cleaning film-clip
SENTROMAX Convection cleaning film-clip
A process of chemistry & physics

- **Erosion impact through heat and flames**
- **Chemical neutralization reaction with acidic deposits**
- **Decomposition after reaction**
Chemistry & physics cont.

- Developed over years of R&D and field experience
- Non-toxic, non-hazardous, non-corrosive, non-poisonous, non-flammable, non-explosive, non-transport regulated
- Complete decomposition in high temperature
- Compatible with furnace metallurgy
On-Line Process

- Using existing openings, windows, or flanges
- No need for extra scaffolding
- No entry into confined spaces
Radiation section
before and after results
Radiation section application
Convection section:
Applied through **standard** OR **special**
OR **soot-blower** openings
Plugged convection section before, during, and after

Before

During

During: SENTROMAX draws out dirt

After
**SENTROMAX cleaning delivers Corrosion Resistance**

**Challenge:**
Fuel impurities including sulphur and vanadium cause tube surface corrosion and thereby reduces tube life span and increases maintenance costs.

**Solution:**
SENTROMAX chemical granules are coated with nano-sized Alpha-Fe2O3 Ecotrans R-1 (Magnetite).

Once the tubes are cleaned of fouling the Magnetite forms a mono-molecular passivation film on the tubes that:

1. Acts as a barrier against corrosion
2. Passivates the metal tubes
3. Inhibits further corrosion
4. Extends the tube life
Before cleaning

531°C

758°C

868°C
After cleaning

**Regap Refinery, Brasil, July 2012**

**Temperatures:**
- 461°C
- 615°C
- 721°C
Final results:

<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>B</th>
<th>C</th>
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<tr>
<td>BEFORE</td>
<td>758°C</td>
<td>868 °C</td>
<td>531°C</td>
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<tr>
<td>AFTER</td>
<td>615°C</td>
<td>711°C</td>
<td>461°C</td>
</tr>
<tr>
<td>delta T</td>
<td>(143°C)</td>
<td>(147°C)</td>
<td>(70°C)</td>
</tr>
<tr>
<td>%</td>
<td>18%</td>
<td>17%</td>
<td>13%</td>
</tr>
</tbody>
</table>
Milazzo Refinery, ITALY

Before cleaning

900°C  948°C  973°C
After cleaning

726°C

753°C

784°C
Cell temp trends:

Cell A

Cell B

Cell C
## Final results:

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<td>753 °C</td>
<td>784°C</td>
</tr>
<tr>
<td>delta T (°C)</td>
<td>(174°C)</td>
<td>(196°C)</td>
<td>(189°C)</td>
</tr>
<tr>
<td>%</td>
<td>19%</td>
<td>20%</td>
<td>19%</td>
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AXION Refinery, Argentina
Safety Benefits

Personnel hazards avoided
✓ No personnel inside the furnace
✓ Proper Personal Protective Equipment
✓ Professional personnel and attitude

Maintenance & operational benefits
✓ No shut down or start up time needed
✓ No scaffold assembly
✓ No damage to refractory or insulation
✓ No damage to instrumentation
Environmental Benefits

Environmentally friendly process

- **NO** creation of waste
- Chemicals burned / dissolved inside the furnace
- No creation of acidic waste water *(like in off-line cleaning)*
SENTROMAX Cost Benefit

- Production increased
- Fuel consumption reduced
- Temperature profile (cell, bridge wall, stack) decreased

TOTAL EFFICIENCY of the furnace can be increased by 4-12%

Typical Return On Investment 2-12 weeks
Applicable for all furnaces, heaters and steam boilers that have negative pressure and cleaning access (at least 1.5" flanges)

- Delayed coker units
- Flexi coker units
- FCC units
- Platformers
- Reformers
- Hydrocrackers
- Hydrotreaters
- Topping units
- Visbreakers
- Vacuum unit
- Atmospheric distillation
- Process furnaces
Agenda

- Introduction
- Online Chemical Cleaning Solutions for
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  - Air Cooled Heat Exchangers (Fin Fans)
- Case Study @ SAPREF
- Credentials
- Q&A
SENTROFIN
On-line Dry Chemical Cleaning of Air Cooled Heat Exchangers (Fin Fans)
Fouled Air Cooled Heat Exchangers lead to the following problems:

- **Low** heat transfer efficiency
- **High** pressure drop
- **High** outlet temperature
- **High** energy consumption (fan power)
- **Low** throughput
- **Low** total efficiency
Traditional cleaning methods have disadvantages

SENTRO guarantees no damage to the fins

No cleaning means low efficiency

High pressure water & walking on fins causes fin damage

Acid causes damage to fins

Foam/Soap evaporates before penetrating all the way through the bundles
SENTROFIN cleaning solution is:

- EFFICIENT
- SAFE
- ENVIRONMENTALLY FRIENDLY
- COST EFFECTIVE
SENTROFIN dry-chemical cleaning method

Spray dry chemical, from bottom-to-top, with compressed air.

Each fan is temporarily switched off for 45 minutes for cleaning.
SENTROFIN Air Coolers cleaning film-clip

Air Cooler Cleaning - Video
SENTROFIN is a fine powder that does not damage the fins. It penetrates all the way through the bundle, and disperses like steam.
SENTROFIN removes 100% of the fouling (both organic & inorganic) from the bundles
SENTROFIN Advantages

- Cleaning during normal operation
- Removes all types of fouling from bundles
- No damage to fins
- No need for scaffolding
- No need to enter into the housing
- No need to remove the safety net
Visible Cleaning Results !!

Before Cleaning

After Cleaning

Half-clean, Half-dirty fins
Parameters to monitor effectiveness:

- Inlet/Outlet temperatures
- Airflow
- Power of the fan
Visual Inspection

Dirty (light blocked)

Clean (light visible)
Example of increased Air Cooler efficiency

Before Treatment:  
- T in = 47.9°C
- T out = 40.8°C

After Treatment:  
- T in = 47.2°C
- T out = 37.5°C

Delta T = 3.3°C (8.1%) 

Throughput benefit: 1,180 $/day
Energy consumption benefit: 243 $/day
Environment:

SENTROFIN cleaning is environmentally friendly

• NO creation of waste water
Safety: SENTROFIN is SAFE

• Temporarily turn-off each fan for only 45min
• No Scaffolding needed

Chemicals are non-corrosive and compatible with all types of metallurgy, non-hazardous, non-explosive, and non-toxic
Introduction

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Shell Case Study @ SAPREF

Credentials

Q&A
To whom it may concern,

The furnace on line cleaning (F7101 A/B/C) of both the radiant and convection bank of Crude Distiller 2 and the fin fan bank (E7209) was successfully done from Monday 8th April 2013 until Saturday 13th April 2013.

SENTRO performed this activity with the highest degree of competency and safety. In addition the housekeeping was excellent.

The final benefit with regards to BWT (bridge wall temperature) is 80 degrees and 25 degrees benefit with regards to stack temperature. The benefit would have been higher if there were more accesses to the convection bank.

The fin fan bank of E7209’s were cleaned. Prior to the cleaning the fan pitch was at 100%, the feed rate was at 260 t/d and we were flaring. Soon after the cleaning the fan pitch was at 20%, the unit feed rate increased to 340t/d and there was no flaring,

Kindest regards
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Case Study: SENTROMAX and SENTROFIN for SAPREF, Shell BP JV Refinery, Durban, South Africa
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Track record of On-Line Chemical Cleaning success across the Americas, Europe, the Middle East & Asia

References & recommendations available
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SENTRO Technologies is an international services company specializing in on-line dry chemical cleaning solutions for the petroleum, petrochemical, and power industries.

To discuss your cleaning requirements please contact:

Email: info@sentro-technologies.com