Emissions Processing at QATALUM Smelter
By Fives Solios

Setting New Environmental Standards

Author: Bassam HUREIKI (Key account Manager Solios Environnement SA)
Summary

1- Fives Solios – brief overview
2- QATALUM Smelter – brief overview
3- Reduction Area Emissions (Potrooms & GTCs)
4- Carbon Area Emissions (FTC & GAP)
5- Conclusion
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Gas Treatment Center (GTC) for Electrolysis Pots

Fume Treatment Center (FTC) for Anode Baking Furnace (ABF)

Pitch Fume Treatment System (PFTS) for Paste Plant
Summary

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QATALUM in brief:
(50% HYDRO, 50% QATAR PETROLEUM)
- 585,000 T Al/year
- 2 Potlines
- 704 HAL275 Cells (300 kA)
- 2 Anode Baking Furnaces
- 1 Green Anode Plant (60T/h)

- Roof emissions ➔ 4 GTCs
- ➔ 1 FTC
- ➔ 1 EOLIOS
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3- Reduction Area Emissions
Potrooms Fluoride Emissions

Fluoride Emissions in Modern Smelter in kg TF/t_{Al}
Without Anode Butts Treatment & Dual Ducting System

- Anode butt & hot crust emissions: 0.10 kg TF/t_{Al}
- Pots emissions: 0.25 kg TF/t_{Al}
- Dry Scrubber stack emission: 0.05 kg TF/t_{Al}

30
3- Reduction Area Emissions
Potrooms Fluoride Emissions

Fluoride Emissions in QATALUM Smelter in kg TF/t_{Al} <0.008
With Anode Butts Treatment, Dual Ducting System and Wet Scrubbers

Anode butt & hot crust emissions
Pots emissions
Dry Scrubber
Wet Scrubber

0.21
0.04
0.12
0.05
30
0.04

Fives, 200 years of industrial progress
Turn-key supply of 4 GTCs including for each:

- Connecting ducts from 176 pots to GTC including Dual Ducting System (YPRIOS)
- 13 TGT-RI filters treating 1.4 million Nm$^3$/h of gas
- 4 concrete SO$_2$ Wet Scrubbers using sea water
- Alumina handling systems
3- Reduction Area Emissions
GTCs, Fluoride Emissions
3- Reduction Area Emissions
GTCs, Fluoride Emissions
Guaranteed Values:

- Pots gas flow:
  - Normal suction: minimum 7,000 Nm$^3$/h @ 170°C
  - Over suction: minimum 18,000 Nm$^3$/h

- Pollutants Emissions Required by QATALUM, among the most stringent in the world:

<table>
<thead>
<tr>
<th>Pollutants Emissions</th>
<th>Raw gas concentration at pot outlets (mg/Nm$^3$)</th>
<th>After Dry Scrubber (mg/Nm$^3$)</th>
<th>After Wet Scrubber (mg/Nm$^3$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gaseous Fluoride</td>
<td>275</td>
<td>0.5</td>
<td>0.1</td>
</tr>
<tr>
<td>Particulate Fluoride</td>
<td>205</td>
<td>0.3</td>
<td>0.2</td>
</tr>
<tr>
<td>Total Dust</td>
<td>950</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>SO$_2$</td>
<td>275</td>
<td>NA</td>
<td>35</td>
</tr>
</tbody>
</table>
3- Reduction Area Emissions
GTCs, Fluoride Emissions

→ Measured values during Performance Test of GTC1 (June 2011):

<table>
<thead>
<tr>
<th>Pollutants Emissions</th>
<th>After Dry Scrubbers mg/Nm³</th>
<th>After Wet Scrubbers mg/Nm³</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gaseous Fluoride</td>
<td>0.14 ✓ (0.5)</td>
<td>0.02 ✓ (0.1)</td>
</tr>
<tr>
<td>Particulate Fluoride</td>
<td>0.01 ✓ (0.3)</td>
<td>0.05 ✓ (0.2)</td>
</tr>
<tr>
<td>Total Dust</td>
<td>0.28 ✓ (3.0)</td>
<td>0.75 ✓ (2.0)</td>
</tr>
<tr>
<td>SO₂</td>
<td>NA</td>
<td>6.7 ✓ (35)</td>
</tr>
</tbody>
</table>

→ Measured values during Performance Test of GTC2 (October 2011):

<table>
<thead>
<tr>
<th>Pollutants Emissions</th>
<th>After Dry Scrubbers mg/Nm³</th>
<th>After Wet Scrubbers mg/Nm³</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gaseous Fluoride</td>
<td>0.24 ✓ (0.5)</td>
<td>0.04 ✓ (0.1)</td>
</tr>
<tr>
<td>Particulate Fluoride</td>
<td>0.07 ✓ (0.3)</td>
<td>0.02 ✓ (0.2)</td>
</tr>
<tr>
<td>Total Dust</td>
<td>0.8 ✓ (3.0)</td>
<td>0.39 ✓ (2.0)</td>
</tr>
<tr>
<td>SO₂</td>
<td>NA</td>
<td>10.9 ✓ (35)</td>
</tr>
</tbody>
</table>
3- Reduction Area Emissions
GTCs, Fluoride Emissions

→ Measured values during Performance Test of GTC3 (March 2012):

<table>
<thead>
<tr>
<th>Pollutants Emissions</th>
<th>After Dry Scrubbers mg/Nm³</th>
<th>After Wet Scrubbers mg/Nm³</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gaseous Fluoride</td>
<td>0.21 (0.5)</td>
<td>0.03 (0.1)</td>
</tr>
<tr>
<td>Particulate Fluoride</td>
<td>0.04 (0.3)</td>
<td>0.02 (0.2)</td>
</tr>
<tr>
<td>Total Dust</td>
<td>0.38 (3.0)</td>
<td>0.20 (2.0)</td>
</tr>
<tr>
<td>SO₂</td>
<td>NA</td>
<td>2.7 (35)</td>
</tr>
</tbody>
</table>

→ Measured values during Performance Test of GTC4 (March 2012):

<table>
<thead>
<tr>
<th>Pollutants Emissions</th>
<th>After Dry Scrubbers mg/Nm³</th>
<th>After Wet Scrubbers mg/Nm³</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gaseous Fluoride</td>
<td>0.3 (0.5)</td>
<td>0.02 (0.1)</td>
</tr>
<tr>
<td>Particulate Fluoride</td>
<td>0.07 (0.3)</td>
<td>0.02 (0.2)</td>
</tr>
<tr>
<td>Total Dust</td>
<td>0.78 (3.0)</td>
<td>0.28 (2.0)</td>
</tr>
<tr>
<td>SO₂</td>
<td>NA</td>
<td>9.3 (35)</td>
</tr>
</tbody>
</table>
Conclusion:

- Pollutants Emissions requested by QATALUM are among the lowest in the world and the measured ones (by a third party) are for all GTCs 3 to 6 times under the Required values:

<table>
<thead>
<tr>
<th>Pollutants Emissions</th>
<th>Mean Value for 4 GTCs after Dry Scrubber (mg/Nm³)</th>
<th>Required figures after filters (mg/Nm³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gaseous Fluoride</td>
<td>0.22</td>
<td>✔ 0.5</td>
</tr>
<tr>
<td>Particulate Fluoride</td>
<td>0.05</td>
<td>✔ 0.3</td>
</tr>
<tr>
<td>Total Dust</td>
<td>0.56</td>
<td>✔ 3.0</td>
</tr>
<tr>
<td>SO₂</td>
<td>NA</td>
<td>NA</td>
</tr>
</tbody>
</table>
Conclusion:

Pollutants Emissions requested by QATALUM are among the lowest in the world and the measured ones (by a third party) are for all GTCs 3 to 6 times under the Required values:

<table>
<thead>
<tr>
<th>Pollutants Emissions</th>
<th>Mean Value for 4 GTCs after Wet Scrubber (mg/Nm³)</th>
<th>Required figures @ Stacks (mg/Nm³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gaseous Fluoride</td>
<td>0.03</td>
<td>✓ 0.1</td>
</tr>
<tr>
<td>Particulate Fluoride</td>
<td>0.03</td>
<td>✓ 0.2</td>
</tr>
<tr>
<td>Total Dust</td>
<td>0.4</td>
<td>✓ 2.0</td>
</tr>
<tr>
<td>SO₂</td>
<td>7.4</td>
<td>✓ 35</td>
</tr>
</tbody>
</table>
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Turn-key supply on 2 Anode Baking Furnaces of:

- 2 Firing Control Systems
- 1 FTC treating 220,000 Nm³/h of both ABFs fumes and consisting of:
  - 1 Cooling Tower with water injection system
  - 7 TGT-RI filters
  - 4 ID Fans
  - 1 main stack
  - 2 (1 per ABF) emergency by-pass stacks and emergency Diesel fans
  - Amumina handling systems
3- Carbon Area Emissions
FTC, Fluoride & PAH Emissions
3- Carbon Area Emissions
FTC, Fluoride & PAH Emissions
Guaranteed Values:

Pollutants Emissions Required by QATALUM, among the most stringent in the world:

<table>
<thead>
<tr>
<th>Pollutants Emissions</th>
<th>Raw gas concentration at furnaces outlets (mg/Nm$^3$)</th>
<th>Required figures @ Stack (mg/Nm$^3$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gaseous Fluoride</td>
<td>20 to 100</td>
<td>0.5</td>
</tr>
<tr>
<td>Particulate Fluoride</td>
<td>20 to 100</td>
<td>0.5</td>
</tr>
<tr>
<td>Total Dust</td>
<td>20 to 200</td>
<td>5</td>
</tr>
<tr>
<td>16 PAH* (NS9815)</td>
<td>10 to 65</td>
<td>1</td>
</tr>
</tbody>
</table>

* The 16 PAH according to NS 9815 are:
  1. Phenanthrene
  2. Anthracene
  3. Fluoranthene
  4. Pyrene
  5. Benzo (a) fluorene
  6. Benzo (b) fluorene
  7. Benzo (a) anthracene
  8. Chrysene / Triphenylene
  9. Benzo (b) fluoranthene
 10. Benzo (k) fluoranthene
 11. Benzo (e) pyrene
 12. Benzo (a) pyrene
 13. Indeno (1,2,3,-cd) pyrene
 14. Dibenzo (a,h/a,c) anthracene
 15. Benzo (g,h,i ) perylene
 16. Dibenzo (a,e/a,h/a,i) pyrene
3- Reduction Area Emissions
FTC, Fluoride & PAH Emissions

Measured values during Performance Test of FTC (December 2011):

<table>
<thead>
<tr>
<th>Pollutants Emissions</th>
<th>Measured Values</th>
<th>Comply with Required figures</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean mg/Nm³</td>
<td>Maximum mg/Nm³</td>
</tr>
<tr>
<td>Gaseous Fluoride</td>
<td>0.18</td>
<td>0.31</td>
</tr>
<tr>
<td>Particulate Fluoride</td>
<td>0.01</td>
<td>0.02</td>
</tr>
<tr>
<td>Total Dust</td>
<td>1.9</td>
<td>2.3</td>
</tr>
<tr>
<td>16 PAH (NS9815)</td>
<td>0.25</td>
<td>0.7</td>
</tr>
</tbody>
</table>

Conclusion:
› Pollutants Emissions Required by QATALUM are among the lowest in the world and the measured ones (by a third party) are far underneath the guaranteed values.
3- Carbon Area Emissions
EOLIOS, PAH Emissions

- 60 T/h GAP including Fives Solios Pitch Fumes Treatments called EOLIOS

- EOLIOS, the right treatment for the right source:
  - 45,800 Nm\(^3\)/h of low PAH concentration fumes treated in conventional coke dry scrubber
  - 5,200 Nm\(^3\)/h of high PAH concentration fumes treated in Regenerative Thermal Oxidizer (RTO)

- This combination minimizes the energy consumption and the PAH emissions.

- Facility started in 2010.
3- Carbon Area Emissions
EOLIOS, PAH Emissions

EOLIOS SYSTEM FOR GAP EMISSIONS

- 10% of the flow
- 90% of the PAH

Dry Scrubbing System

- 90% of the flow
- 10% of the PAH

Others suction point (anode forming area mixer...)
Measured values during Performance Test of EOLIOS

<table>
<thead>
<tr>
<th>Pollutants Emissions</th>
<th>Measured Values mg/Nm³</th>
<th>Comply with Required figures mg/Nm³</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Dust</td>
<td>4.52</td>
<td>✓ 10</td>
</tr>
<tr>
<td>16 PAH (NS9815)</td>
<td>0.96</td>
<td>✓ 1.0</td>
</tr>
</tbody>
</table>

Conclusion:

Pollutants Emissions Required by QATALUM are among the lowest in the world and the measured ones (by a third party) are in conformity with the guaranteed values.
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Fives Solios has treated successfully the main sources of emissions in the QATALUM Smelter,

QATALUM has settled a new environmental standard for primary aluminium smelters.