Management of Mercury from Decommissioning of Chlor-Alkali Mercury Cell Plants

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Chlor-Alkali Plant Manager – Flix (Tarragona)
## Key Figures

<table>
<thead>
<tr>
<th><strong>Headquarters</strong></th>
<th>Av. Diagonal 593-595 08014 Barcelona (Spain)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Incorporation</strong></td>
<td>1989 merger between ERT and CROS</td>
</tr>
<tr>
<td><strong>Social structure</strong></td>
<td>Stock company. Shares quoted on The Spanish stock exchange</td>
</tr>
<tr>
<td><strong>Share capital</strong></td>
<td>34,23 million Euros (100% free float)</td>
</tr>
</tbody>
</table>
| **Divisions**     | - Chlorine Related Businesses (Basic Chemicals and Plastics)  
                    - Intermediate Chemicals  
                    - Pharmaceuticals |
| **Workforce\(^1\)** | 1,369 workers/11 facilities |
| **Sales\(^2\)**   | 618.27 million Euros |
| **Exports\(^2\)** | 49% of sales |

\(^1\) Average year 2015  
\(^2\) Year 2015
Flow of the Activity

What do we buy?

- Electricity
- Methanol
- Gas
- Ethylene
- Potassium Chloride
- Other products

What do we sell?

- Chlorine
- PVC
- Pentaetritol
- Paraformaldehyde
- Fusidic acid
- Moulding compounds
- Glues and resins
- Potash
- Chloroisocyanurates
- Caustic soda
- Paraffins

Where do we sell?

- Spain
- World
- OECD
- EU

To which sectors do we sell?

- Chemical
- Pharmaceutical
- Food
- Paints
- Wood
- Construction
- Rest: 11%

1. Except Spain
2. Except EU countries
3. Rest of the world
## Industrial Structure

<table>
<thead>
<tr>
<th>Division</th>
<th>Facilities</th>
<th>Products</th>
<th>Applications</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Basic Chemicals</strong></td>
<td>Cardona, Flix, Tarragona, Sabiñánigo and Vila-Seca I</td>
<td>Caustic potash, Caustic soda, Chlorine, Chloroisocyanurates, Hydrochloric acid, Sodium chlorate, Sodium chloride, Sodium chlorite, Sodium hypochlorite</td>
<td>Chemical industry, General industry, Derivatives manufacturing, Swimming pools, General industry, Paper pulp bleaching, Chemical industry, Water treatment, Water treatment</td>
</tr>
<tr>
<td><strong>Plastics</strong></td>
<td>Monzón and Vila-seca II</td>
<td>EDC, PVC, VCM</td>
<td>VCM manufacturing, Construction, PVC manufacturing</td>
</tr>
<tr>
<td><strong>Intermediate Chemicals</strong></td>
<td>Almussafes, Cerdanyola and Tortosa</td>
<td>Formaldehyde, Glues and resins, Moulding compounds, Paraformaldehyde, Pentaerythritol, Sodium formate</td>
<td>Derivatives manufacturing, Wood industry, Electrotechnics, Resins, Paints, Tanning industry</td>
</tr>
<tr>
<td><strong>Pharmaceuticals</strong></td>
<td>Aranjuez</td>
<td>Erythromycin, Fusidic acid, Phosfomycin</td>
<td>Antibiotic, Skin infections, Antibiotic</td>
</tr>
</tbody>
</table>
Outline of the Business
Chlorine-Caustic Soda Chemistry

Electricity

Common salt

CAUSTIC SODA

CHLORINE

ELECTROLYTIC UNIT

Market

Caustic soda Derivatives

Own consumption
Sodium hipochlorite

Chlorine Derivatives

Sodium hipochlorite
Hydrochloric acid

PVC

Ethylene

Rock phosphate

Dicalcium phosphate

Market

Market

Formaldehyde Chemistry

Metanol

FORMALDEHYDE

Paraformaldehyde

Acetaldehyde
Formic acid
Caustic soda
Polyols

Melamine
Urea
Cellulose
Moulding compounds
Glues and resins

Phenol
Melamine

Urea

1 Pentaerythritol, dipentaerythritol and sodium formate
Production Facilities
### Chlor-Alkali Facilities

*Installed Chlorine production capacities (2014)*

<table>
<thead>
<tr>
<th>Site</th>
<th>Products</th>
<th>Technology</th>
<th>Capacity (kt Cl$_2$/year)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sabiñánigo</td>
<td>Cl$_2$-KOH</td>
<td>Membrane</td>
<td>30</td>
</tr>
<tr>
<td>Vila-seca</td>
<td>Cl$_2$-NaOH</td>
<td>Membrane</td>
<td>55</td>
</tr>
<tr>
<td>Vila-seca</td>
<td>Cl$_2$-NaOH</td>
<td>Mercury</td>
<td>135</td>
</tr>
<tr>
<td>Flix</td>
<td>Cl$_2$-NaOH</td>
<td>Mercury</td>
<td>88</td>
</tr>
</tbody>
</table>
Ercros in Flix (Tarragona): recent experience

Electrolytic Unit IV-A (commissioned in 1975, shut-down in 2009)
Technology: Mercury cathode, DeNora cells 14M2 y 14M3
Design Capacity (after expansion in 1986): 70,000 t/year
AERIAL VIEW OF THE DECOMMISSIONED FACILITIES
Electrolytic Unit IV-A Decommissioning

Major Milestones

Previous phase:
- Safe shutdown (emptying and cleaning of all the equipments)
- Transferring clean mercury into suitable containers and temporal storage in a restricted area of the cell room
- Disassembling of equipment containing mercury (skilled maintenance personnel under supervision of technical production personnel)

Decommissioning:
- Creation of Decommissioning Project Team (multidisciplinary, with internal auditory)
- Decommissioning Project based on technical Guidelines (EuroChlor), internal procedures) and HSE requirements
- Construction of a temporary mercury Storage according to legal requirements and transport of mercury containers inside
- Decommissioning of the cell room and auxiliary installations (subcontracted) with specific decontamination procedures depending on the material
Flix Site Temporary Mercury Warehouse

**Mercury Recovery:**
- Emptying decomposers, cells and mercury pipes
- Recovery from equipment (sodium hydroxide and hydrogen pipes and vessels)
- Recovery from cell room during dismantling

**Cleaning with water to achieve purity criteria**

**Filling into suitable containers (steel made, drop and impact resistant, tight closure)**

**Building a storage according to legal requirements:**
- Secondary containment for retaining 110% of any single container
- Well lit and weatherproof
- Impervious and resistant floor
- Fire alarms
- Mercury concentration monitoring
- Restricted area and periodically monitored
Temporary Mercury Warehouse
Flix Facility
Close future

November 2017: Mercury plants will shut down

RECOVERY OF ALL MERCURY COMING FROM CELL ROOM EQUIPMENT BEFORE AND DURING DECOMMISIONING

MAIN PROBLEM: METALLIC MERCURY BECOMES A RESIDUE

- Enough suitable containers for temporary storage
- Conditioning of temporary warehouse/s
- Monitoring, maintenance and surveillance of temporary warehouse/s
- **Mercury disposal**
Temporary mercury storage

**Requirements:**
- Technical (Directive 2011/97/EU and BAT specifications)
- HSE (Seveso III Directive obligations)
- Integrated Environmental Authorisation
- Operational (monitoring, maintenance and surveillance)
Company Approach about Mercury Disposal

- EU regulatory compliance
- Technically and safe disposal process to transform mercury in an irreversible and stabilized material
- Legal certainty of transferring of responsibility over the residue
- Need for Availability of treatment capacity within a reasonable period of time (limited by regulatory authorities ?)
- Phased plan of disposal (high cost operation)
Thank you for your attention

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