TiO₂ Chloride Process

www.Ti-Cons.com
General Process

Chloride Process (Base Material)

Post-Treatment (TiO₂ Pigment)
Chlorinity

Overview

Oxygen
Ore
Coke
Chlorine

from TiCl₄ Oxidation

Chlorinator

Recycled Chlorine

Metal Chlorides, Inert Dust

to Dust Treatment

to Condensation

Cyclone (Dust Separation)

TiO₂ Chloride Process

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Overview

Crude TiCl₄
from Chlorination

Direct Condensation

Indirect Condensation

Low Temperature Cooling System

Offgas (CO, CO₂, HCl, TiCl₄)

to Offgas Treatment

Crude TiCl₄ Tank

to TiCl₄ Purification
Overview

### TiCl₄ Purification

**Rectification Column**

- **TiCl₄ Condensation**
- **Pure TiCl₄**
- **Cooling Water**
- **Pure TiCl₄ Tank**
- **Crude TiCl₄ Evaporator**
- **from Condensation**
- **to TiCl₄ Oxidation**
TiCl₄ Oxidation

TiCl₄ from TiCl₄ Purification

Aluminum

Chlorine

Fuel

Toluene

Oxygen

Fuel

AlCl₃ Generator

TiCl₄ Super Heater

Pre-Combustion Chambers

Main-Combustion Chambers

Cooling Water

Oxygen Super Heater

Cooling Duct

Bag Filter

Recycled Chlorine

to Chlorination

Base Material (TiO₂) to Post Treatment

Overview
1st Dust Treatment

**Overview**

- Metal Chlorides, Inert Dust
- Water, Lime
- Water
- Dust Repulp
- Filtration and Washing
- Neutralized Waste Water to Sewer
- Insoluble Solids to Land Fill
- to 2nd Dust Treatment
- Metal Chloride Solution
- Coke Rich Solids e.g. for Iron Industry

Option 1: Dust Repulp

Option 2: Dust Repulp
Overview

Metal Chloride Solution

from 1st Dust Treatment

Lime

Neutralization

Filtration and Washing

Neutralized Waste Water to Sewer

Insoluble Solids to Land Fill
Offgas Treatment

Offgas (CO, CO₂, HCl, TiCl₄) from Condensation

TiCl₄ Scrubber

TiOCl₂ Solution

HCl Scrubber

HCl (28 %)

Chlorine Scrubber

Overview

Air

Incinerator

Stack
Advantages and Disadvantages of Chloride Process compared to Sulfate Process

<table>
<thead>
<tr>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>▪ Continuous Process:</td>
<td>▪ Higher safety requirements due to the use of Cl2, CO and TiCl4</td>
</tr>
<tr>
<td>▪ Good prerequisites for optimization of quality and utilization</td>
<td>▪ Higher degree of automation necessary</td>
</tr>
<tr>
<td>▪ Direct and stable process control</td>
<td>▪ Higher requirements to the qualification of the staff</td>
</tr>
<tr>
<td>▪ Better product quality regarding the optical and chemical properties</td>
<td>▪ Requires stable production environment and infrastructure</td>
</tr>
<tr>
<td>▪ In general, the production costs are lower, but in depends on the special circumstances</td>
<td>▪ Because of the closed loop the process is more sensitive to production short-fall</td>
</tr>
<tr>
<td>▪ Less environmental impact due to less waste</td>
<td></td>
</tr>
<tr>
<td>▪ Less man power necessary</td>
<td></td>
</tr>
</tbody>
</table>

Overview
Raw Materials

Ore:
- The higher the TiO2 content, the lower is the loss of chlorine and the amount of by-products
- The content of Ca and Mg has to be low
- The mechanical stability of the particles should be high
- The content of radioactive impurities should be low

Coke:
- Content of sulphur, hydrogen and water should be low
- The mechanical stability of the particles should be high
## Typical Consumptions

### Overview

<table>
<thead>
<tr>
<th>Number</th>
<th>Name</th>
<th>Unit</th>
<th>Quantity [Unit/tTiO₂]</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Electricity</td>
<td>kWh</td>
<td>360</td>
</tr>
<tr>
<td>2</td>
<td>Steam</td>
<td>t</td>
<td>0.5</td>
</tr>
<tr>
<td>3</td>
<td>Oxygen</td>
<td>Nm³</td>
<td>350</td>
</tr>
<tr>
<td>4</td>
<td>Nitrogen</td>
<td>Nm³</td>
<td>100</td>
</tr>
<tr>
<td>5</td>
<td>Compressed Air</td>
<td>Nm³</td>
<td>40</td>
</tr>
<tr>
<td>6</td>
<td>Clean Compressed Air</td>
<td>Nm³</td>
<td>2</td>
</tr>
<tr>
<td>7</td>
<td>Chlorine</td>
<td>kg</td>
<td>350</td>
</tr>
<tr>
<td>8</td>
<td>Fuel Gas</td>
<td>GJ</td>
<td>2.3</td>
</tr>
<tr>
<td>9</td>
<td>Refrigerant</td>
<td>t</td>
<td>0.6</td>
</tr>
<tr>
<td>10</td>
<td>Coke</td>
<td>kg</td>
<td>370</td>
</tr>
<tr>
<td>11</td>
<td>Slag</td>
<td>t</td>
<td>1.27</td>
</tr>
<tr>
<td>12</td>
<td>Toluene</td>
<td>kg</td>
<td>13</td>
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## Typical Consumptions - 2

### Overview

<table>
<thead>
<tr>
<th>Number</th>
<th>Name</th>
<th>Unit</th>
<th>Quantity [Unit/tTiO₂]</th>
</tr>
</thead>
<tbody>
<tr>
<td>13</td>
<td>NaCl</td>
<td>kg</td>
<td>8</td>
</tr>
<tr>
<td>14</td>
<td>NaOH 50 %</td>
<td>kg</td>
<td>25</td>
</tr>
<tr>
<td>15</td>
<td>Aluminum</td>
<td>kg</td>
<td>6.5</td>
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<tr>
<td>16</td>
<td>KCl</td>
<td>kg</td>
<td>0.05</td>
</tr>
<tr>
<td>17</td>
<td>Mineral Oil</td>
<td>kg</td>
<td>3.6</td>
</tr>
<tr>
<td>18</td>
<td>H₂O₂ 30 %</td>
<td>kg</td>
<td>1.8</td>
</tr>
<tr>
<td>19</td>
<td>Scrubbing Agent</td>
<td>kg</td>
<td>2</td>
</tr>
<tr>
<td>20</td>
<td>Ca(OH)₂</td>
<td>kg</td>
<td>500</td>
</tr>
<tr>
<td>21</td>
<td>Water</td>
<td>m³</td>
<td>2.5</td>
</tr>
<tr>
<td>22</td>
<td>D-I Water</td>
<td>m³</td>
<td>2.5</td>
</tr>
<tr>
<td>23</td>
<td>Makeup Cooling Water</td>
<td>m³</td>
<td>4.5</td>
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</tbody>
</table>
Typical Plant

Project data
- 100,000 tpa TiO₂-Pigment
- 4 buildings:
  - Main Building
  - Bag Filter Building
  - Waste Treatment
  - Tank farm
- 196 static equipments
- 134 rotating equipments
- > 14 km of pipes
- > 1,000 isometric drawings
- > 41,000 piping objects
Advantages of Ti-Cons CP Process

- Based on the most modern technology and equipment
- Sustainable technology regarding resources and environment
- Best technology available
- Proven technology (2 running installations in China)
- Very detailed engineering ready for construction (>20,000 documents)
- Long experience in planning, commissioning and operation