Global Trends in Industrial Markets
ITA Conference – Chicago - Sept 22, 2014

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We have used for this presentation among other sources:
- a questionnaire on market trend filled by all major Titanium suppliers of the Industrial market
- a questionnaire on desalination trend and needs filled by all major Desalination engineering companies

We want to thank all of them for their contribution.
Industrial Titanium

- Perimeter / 2014 Market
- Forecast Issues
- Zoom on Desalination
- Zoom on Nuclear
- Ti differentiation
- Trend 2014-2019
Industrial Titanium – Perimeter considered

Power Generation
- Nuclear Power Plant
- Thermal Power Plant

Desalination
- Thermal MSF/MED

Process
- Chemical
- LNG
- Oil & Gas
- PTA
- Pool Heater
- District Cooling
Industrial Titanium – 2014 Market

**QUESTIONNAIRE**

Strongest segment in 2014?

**OUR ANALYSIS**

- **Power**: 57% (+1500MT)
- **Desalination**: 14% (-3000MT)
- **Process**: 29%

Different trends according to segments

Industrial Titanium – 2014 Market

QUESTIONNAIRE
Trend 2013-2014?

OUR ANALYSIS

Demand has globally decreased

Industrial Titanium – Trend 2014-2019

QUESTIONNAIRE

Trend 2014-2019?

- Power
  - 0%
  - 15%
  - 85%

- Desalination
  - 20%
  - 40%
  - 40%

- Process
  - 0%
  - 40%
  - 60%

- Majority of optimists mainly for power and desalination markets
- Still significant discrepancies between answers
Industrial Titanium

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Industrial Titanium Demand - Why is this market so difficult to predict?

- Capital intensive projects
- Strategic applications
- Projects location
- Alternative technologies
- Alternative materials

French EDF temporarily halts Rybnik coal-fired plant construction

January 11, 2013 14:58 CET

(SeeNews) - Jan 11, 2013 - French state-run energy group EDF (EPA: EDF) has suspended for three months the construction of its supercritical coal-fired power plant in Rybnik, Poland, newsportal Enerzine said today, citing the company’s bulletin Vivre EDF ’Hebdo.

The group will make a decision on the fate of the plant within three months.

The reason behind the move is that "the economic and financial conditions that founded this project worth EUR 1.8 billion (EUR 2.388bn) are no longer met today."

The Rybnik plant, with a total capacity of 900 MW, like most such projects in the country, did not make it to the list of facilities that will receive free CO2 emission quotas from the European Union. What is more, the bill on renewable energy in Poland
Industrial Titanium Demand - Why is this market so difficult to predict?

- Capital intensive projects
- **Strategic applications**
- Projects location
- Alternative technologies
- Alternative materials
Industrial Titanium Demand - Why is this market so difficult to predict?

- Capital intensive projects
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- Alternative materials

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*Water Demands of Coal-Fired Power Drying Up Northern China*

The coal industry withdraws 15 percent of China’s water, much of it in arid northern China

Mar 25, 2013 | By Coco Liu and ClimateWire

SHANGHAI -- The world’s biggest coal consumer now has a new incentive to take a cleaner energy path, as China’s coal-fired power plants are drying up the country’s already scarce water resources.

A report published today by Bloomberg New Energy Finance notes that the top five Chinese power generators -- China Huaneng Group, China Datang Corp., China Huadian Corp., China Guodian Corp. and China Power Investment Corp. -- have hundreds of gigawatts of coal-fired power plants in the country’s dry north and that...
Industrial Titanium Demand - Why is this market so difficult to predict?

- Capital intensive projects
- Strategic applications
- Projects location
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Indonesia ban keeping nickel price on the boil

Frik Els | June 17, 2014

Indonesia surprised the mining world in January putting into effect an outright ban on nickel ore exports.

After a relatively subdued initial reaction on nickel markets – no-one thought the Asian nation would go through with the ban and when it did, the expectation was that the rules would be water down substantially – the price of the steelmaking raw material is now up 33% in 2014.

Hienphono, New Caledonia

Indonesia accounted for around a fifth of global supply at an estimated 490,000 tonnes of contained metal so the potential was there for a big impact on the price.
Industrial Titanium Demand - Why is this market so difficult to predict?

- Titanium consumption per project highly depending on the application

<table>
<thead>
<tr>
<th>Industry</th>
<th>Demand (MT)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Desalination plant</td>
<td>Up to 6000</td>
</tr>
<tr>
<td>Nuclear power plant</td>
<td>Up to 250</td>
</tr>
<tr>
<td>Thermal power plant</td>
<td>Up to 100</td>
</tr>
<tr>
<td>Chemical plant</td>
<td>Up to 25</td>
</tr>
</tbody>
</table>
Industrial Titanium

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**Zoom Titanium in desalination: MSF & MED**

**MSF Technology (Multi-Stage Flash)**
- Water inside the tubes
- Titanium as substitution to Copper Alloy
- Specific dimensions for tubes

**MED Technology (Multi-Effect Distillation)**
- Water outside the tubes
- Titanium as substitution to Al Brass
- Standard Power dimensions for tubes

*Vallourec Heat Exchanger Tubes – Global Trends in Industrial Markets – 22/09/14*
Zoom Titanium in desalination: MSF & MED

QUESTIONNAIRE
MED versus MSF in the long run?

60%

MSF

MED

20%

20%

OUR ANALYSIS

There will be larger number of MED units installed but MSF units will be larger & with higher Ti ratio

Titanium consumption should be equivalent for both designs
Zoom Titanium in desalination: MSF & MED

Qatar
470,800 m³/d

UAE
678,500 m³/d

Kuwait
1,180,900 m³/d

Saudi Arabia
2,993,000 m³/d

New capacity addition 2015-2024 MSF/MED

Qatar
UAE
Kuwait
Saudi Arabia

Other potential areas??
Zoom Titanium in desalination: MSF & MED

QUESTIONNAIRE

Other markets for MED-MSF?

20% S. AMERIC.

40% AFRICA

60% CHINA

N. AMERIC. Others ASIA

- Capacity installed to be doubled by 2019 with 35% using thermal technologies

Zoom Titanium in desalination: Comparison Ti vs. alternative materials

QUESTIONNAIRE

Titanium competitiveness vs. alternative materials?

MORE COMPETITIVE

LESS COMPETITIVE

40%

60%

OUR ANALYSIS

- Indexation issue
  - Lack of objective index to compare titanium to nickel or copper
  - Escalation risk unable to be shared with final customer
Zoom Titanium in desalination: Comparison Ti vs. alternative materials

- Copper
- Nickel
- Aluminum
- Sponge Ti metalprices
- Titanium

Price Base 100 in Oct 2010

Ras Az Zour

Yanbu 3

Next projects

Titanium competitiveness confirmed
Industrial Titanium

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Zoom: Nuclear Power Generation market

- **North America**: 2 GW
- **Europe**: 13 GW
- **Middle East**: 15 GW
- **India**: 9 GW
- **Russia CIS**: 15 GW
- **China**: 68 GW
- **Rest of Asia**: 16 GW
- **Latin America**: 1 GW

New capacity addition 2015-2024, Nuclear
Zoom: Nuclear in China

- Ambitious new build project confirmed
  6 to 7 units per year till 2020
- Localization is clearly a national strategy
  Focus on design and nuclear island
- Two in-house designs CAP1400 and ACC1000
  To serve local and target export
- Still no clear decision concerning inland project
  Titanium could be affected
Zoom: Other significant Nuclear developments

RUSSIA

- Nuclear capacity to increase by 14 GW by 2020
- Large long term ambitions

SAUDI ARABIA

- Gradual offsetting of fossil energy
- Nuclear target is to reach 17.6 GW by 2032

- Site selection
- First concrete pouring
- First reactor connected to the grid
- 9.6 GW connected to the grid
- 17.6 GW connected to the grid

- 2013
- 2017
- 2022
- 2027
- 2032
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Titanium differentiation – Commodity threat

**QUESTIONNAIRE**

Titanium differentiation?

- **60%** UNDER COMMODITIZATION
- **30%** COMMODITY
- **10%** DIFFERENTIATED

**HOW TO ESCAPE FROM COMMODITY**

- **Innovation**
  Process, Product Efficiency
- **Adapt the design rules to Ti**
  Thickness, Lifetime
- **Address new applications**
  Substitution, revamp, OTEC, Geothermal

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\lambda = 1.6 \times 10^{-6} \frac{\Delta H_L D^6}{\rho L Q^2}
\]
Titanium Differentiation - Opportunities

**QUESTIONNAIRE**
Differentiation opportunities?

**PROCESS**

- **86%**

**DESALINATION**

14%

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**PTA MARKET**

China PTA installed capacity (MT)

- Market remaining with important Ti needs:
  - Ti clad for reactor
  - Ti Grade 2 for the 3 condensers
  - Ti Grade 9 for preheaters

+40% by 2019

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Titanium Differentiation – Customers feedback

QUESTIONNAIRE

Titanium strengths?
- Corrosion resistance
- Less maintenance
- Welding quality
- Productivity
- Durability
- Choice imposed by process

OUR ANALYSIS

- Not enough communication toward industrial stakeholders
- Too much aeronautics & military oriented
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Industrial Titanium Demand till 2019

- No growth expected on Power globally despite Nuclear rebirth
- Positive trend 2015-2016 thanks to desalination mega projects in Middle East
- Confirmed flat trend on long term around 30kT

- Nevertheless we believe there is room for opportunities through
  - Reliable Ti indexation
  - Technical promotion targeting industrial stakeholders
  - Innovation
  - Focus on process market
Industrial Titanium Demand till 2019

- Desalination
- Process
- Power

THANK YOU