The Tungsten value chain @ H.C. Starck

DERA Industrieworkshop Wolfram, Berlin
Our Business Areas

Advanced Metal and Ceramic Powders
- processing technology metals (ore and scraps) into high tech, customized metal powders
- production of ceramic powders for spray coating
- 7 manufacturing sites in Germany, Thailand, Japan, China, Vietnam and Canada

Fabricated Products
- converting technology metal powders into customized semi-finished and finished products
- 6 manufacturing sites in US, UK, Germany, and China

Ceramics
- manufacturing specialized technical ceramic parts and films
- 1 manufacturing site in Germany

CS Energy Materials
- joint venture of H.C. Starck and Japan New Chisso Corp. for the production of cathode materials for lithium-ion batteries for electric and hybrid cars
- 1 manufacturing site in Japan

Leading know-how to process technology metals and advanced ceramics
Our Global Footprint – close to our customers

Our Manufacturing Sites and our Sales Offices
Tungsten (APT Notation ex Metal Bulletin)

APT, Ø-daily, Jul 2009 – ytd 2013
– € / $ / mtu WO₃ –

Sources: Metal Bulletin (Sep 2013) / ECB’s Euro foreign exchange reference rates

Last Update: 27.09.2013

APT Europe ($/mtu)  APT Europe (€/mtu)  APT China FOB ($/mtu)
Tungsten Chemistry – HCST process core aspects

H.C. Starck can process the full range of Tungsten raw materials

- **Ores & Secondary**
- **Grinding**
  - usage of energy efficient vibrating mills and **deforming of crystal lattice** to achieve a higher yield in leaching process (**mechanical activation**)
- **Leaching**
  - autoclaves with special designed agitators to achieve an **intense contact between reactant (NaOH) and mechanically activated ores**; usage of membrane filter presses to achieve maximum dewatered residuals (increased yield)
- **Purification**
  - two step **removal of critical impurities** like Si, P, Al, F, V, Cr, Mo … by lowering pH values; permanent automatic adaptation of parameters (feed-rates of precipitation reactants) according to continuously fluctuating impurity levels and therefore **preventing of co-precipitation of tungsten** (usage of specific online analytic systems); pre-requisite to dump raffinate in compliance with governmental requirements in extraction process step
- **Extraction**
  - solvent extraction (mixer / settler units) to achieve **high purity ATS**
- **Crystallization**
  - setting of process parameters to achieve a **high purity of APT**
Tungsten Dictionary

Explanation with regard to the usual abbreviations

- ST = Sodium Tungstate
- APT = Ammonium Paratungstate
- BTO = Blue Tungsten Oxide
- YTO = Yellow Tungsten Oxide
- AMT = Ammonium Metatungstate
- WMP = Tungsten metal powder
- WC = Tungsten carbide
- CTC = Cast Tungsten carbide
- FeW = Ferro Tungsten
Availability of Primary Raw Materials (1/2)

Raw material procurement becomes more difficult, due to lack of investments in new mines and reduced secondary raw material availability.

The majority of Tungsten primary raw material reserves are located in China or „politically instable“ regions.

Additionally, China’s secondary raw material imports from Western industrial nation have been increasing continuously.

Exploitation of Primary Raw Materials 2011*
~ % of 68,800 tons Tungsten content


*Figures do not include the United States
China is the major producer of primary Tungsten and has even grown its share in global supply from 2008 to 2010.

- During the crisis in 2009, non-Chinese supply has dropped significantly and not returned to pre-crisis level yet, further increasing China’s supply share to estimated 85% in 2012 (estimated by USGS).
- Due to continuously increasing demand some mines which have closed in Australia, South Korea an the USA are now considering re-opening.
- In addition, due to current high price levels, renewed interest is seen in a few new projects, which were put on hold during the crisis in 2009.
- It is still unclear when, if at all, these new projects will start operating.
- Besides primary supply, scrap recycling is an important factor in the world’s tungsten supply. It is estimated that today some 35% is recycled.
Our Raw Materials Supply – sustainable and conflict-free

Two success factors for a secure and stable raw material supply

Primary sourcing

Recycling

With growing recycling activities and certified procurement we ensure a safe, sustainable and competitive raw material supply.
Our Raw Materials Supply – sustainable and conflict-free

**Primary sourcing**

- H.C. Starck exclusively sources from **conflict-free suppliers**
- Affirmative **certification** by Electronics Industry Citizenship Coalition (EICC) on conflict-free Tantalum supply chain at H.C. Starck and **Tungsten Industry Conflict Materials Council** for the Tungsten supply chain
- **Responsible Supply Chain Management System (RSCM)** to ensure conflict-free raw material sourcing, implementation confirmed by external auditor Bureau Veritas
- Projects to **ensure supply from primary sources** through certified and reliable partners (e.g. joint ventures)
- **Long-standing supply relationships** ensuring sufficient supply at competitive prices in structurally tight markets
Our Raw Materials Supply – sustainable and conflict-free

Recycling

• Using **innovative technologies**, we are recycling **increasing volumes** of post-industrial waste, slags, and scraps and turning them into high quality and high-performance technology metals

• **Recycling** contributes continuously **increasing share** of raw material

• Recycling enables a **secure, long-term raw material supply with stable costs**
Tungsten Consumption in Europe

A fistful of countries consume about 85% of Europe’s Tungsten consumption.

~ 85% of European Tungsten Consumption
Tungsten Products Market Sectors

The main application are Hard Metals

**Tungsten Consumption, Europe, 2012**

~ % WO3 ~

- **Hard Metals**: 67%
- **Steel & Superalloys**: 11%
- **Heavy Metal & Mill Products**: 11%
- **W-Chemicals**: 7%
- **Surface Technology**: 4%
- **Round Tools**: 14%
- **Inserts**: 11%
- **Wear Parts**: 20%
- **Mining & Road Construction**: 30%
- **Oil & Gas**: 6%
- **Others**: 2%

*Source: H.C. Starck Market Research*
Market Development

Slow market growth projected in the next five years

- In 2013, external demand is the main driver for the European economy. By 2014, domestic demand will be taking over as main demand driver.
- Strong influence of the Tungsten market Europe on the global Automotive, Machine Tools and Mining Industry!
- As a result, Europe Tungsten market outperforms the European Union GDP growth.
Thank you for your attention!

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