TITANIUM SCRAP SITUATION AND LATEST TRENDS IN TI SCRAP DEMAND & SUPPLY

21ST Annual International Titanium Association Applications Conference & Exhibition
September 25-27, 2005
 Titanium Scrap

Extremely Important Part of Titanium Production Cycle:

- Ti Scrap provides about 50% of feedstock for Ti ingot production, US producers. Less in Russia and Japan;
- Ti Scrap can provide 50-100% of feedstock in castings production;
- Ti Scrap constitutes more that 90% of raw materials in Ferro-Titanium production;
- Also used for Al-Ti master alloy manufacturing for aluminum industry and direct steel addition in stainless steel manufacturing.

Vasily I. Semeniuta, Igor B. Krjenitski, GRANDIS TITANIUM
Types of Scrap

- **By Origin:**
  - Mill Scrap (generated by Ti companies during the melting, forging, rolling operations);
  - Fabrication Scrap (mainly turnings generated by machine shops, also stamp-outs, etc);
  - Old Recycled Scrap (from dismantled aircraft, heat exchangers, nuclear submarines, etc).

- **By Usage Types:**
  - “Vacuum” Quality (acceptable by ingots manufacturers):
    - Bulk Weldable;
    - Crushable;
    - Turnings.
  - “Ferro” Quality (used for production of Fe-Ti and direct steel alloying)
Types of Scrap (Unprepared)

- Bulk Weldable
- Crushable
- Ferro-Quality
Ti Ingot Production, Sponge and Scrap Consumption in the USA, MT/Year

[Graph showing Ti Ingot Production, Sponge Consumption, and Scrap Consumption from 1970 to 2005]

Share of Scrap

Vasily I. Semeniuta, Igor B. Krjenitski, GRANDIS TITANIUM
Ti Ingot Production and Sponge & Scrap Prices in the USA, 2002 = 100%
Import of Titanium Scrap Into the USA

Vasily I. Semeniuta, Igor B. Krjenitski, GRANDIS TITANIUM
Vasily I. Semeniuta, Igor B. Krjenitski, GRANDIS TITANIUM
US Import of Ti Scrap Excluding CIS Scrap
Reported Yearend Stock of Ti Scrap, MT

Vasily I. Semeniuta, Igor B. Krjenitski, GRANDIS TITANIUM
Global movements of Ti Scrap
Cycle 1995-1998

Vacuum Quality Scrap

“Ferro” Quality Scrap

Vasily I. Semeniuta, Igor B. Krjenitski, GRANDIS TITANIUM
Global movements of Ti Scrap, Current Cycle
World Steel Production, Mln Tons

Vasily I. Semeniuta, Igor B. Krjenitski, GRANDIS TITANIUM
World Fe-Ti Production, Thousand Tons
Recent FE-Ti Price History, Jan 2003 = 100%
Explosive growth of Fe-Ti industry in Three years, $Mil per year
Recent Ferro-Quality Ti Scrap Price History, Jan 2003 = 100%
Ferro-Quality and Vacuum Quality
Ti Scrap Price History
Main Driving Forces of Two Latest Titanium up-cycles

■ **Cycle of 1995-1998**
  ■ Main Factor: 
    - Aerospace Industry demand
  ■ Secondary Factor: 
    - Sharp increase in Consumer Applications (mainly Golf)

■ **Cycle of 2004-20??**
  ■ Main Factor: 
    - Industrial Demand from China.
  ■ Secondary Factor: 
    - Recovery and Demand from Aerospace Industry.
Worldwide Titanium Units Consumption, Thousand Tons (Approx)
Scrap Generation Cycles

Vasily I. Semeniuta, Igor B. Krjenitski, GRANDIS TITANIUM
Current Margin of Ti Sponge Production

Vasily I. Semeniuta, Igor B. Krjenitski, GRANDIS TITANIUM
Acknowledgements

- US Geological Survey
- International Titanium Association
- Metal Bulletin
- Metal Pages
TITANIUM SCRAP SITUATION AND LATEST TRENDS IN TI SCRAP DEMAND & SUPPLY

1. Presentation at 21st Annual International Titanium Association Application Conference.
   By Vasily I. Semeniuta, Igor B. Krjenitski, GRANDIS TITANIUM

2. Titanium scrap is extremely important part of the titanium production cycle.
   -- Ti Scrap provides about 50% of titanium units for Ti ingot production for the US producers.
   Technological processes developed in 1970-80s and installed in 1980-90s allow at some plants,
   like THT plant of Timet and IHM plant of Allvac to use up to 100% of scrap in their charge.
   Producers in other countries, mainly in Russia and Japan much less equipped for scrap utilization
   and rely more on sponge in their consumption of titanium units.
   -- Ti Scrap can provide 50-100% of feedstock in castings production;
   -- Ti Scrap constitutes more than 90% of raw materials in Ferro-Titanium production;
   -- Also used for Al industry and as direct steel addition in steel manufacturing.

3. All titanium scrap roughly can be divided into three major groups by origin:
   - “Mill Scrap”, which is generated by titanium producers in the process of melting, forging and
     rolling.
   - “Fabrication Scrap”, generated in manufacturing of titanium parts, mainly in the form of turnings.
     Mill Scrap and Fabrication Scrap could in most cases be traceable to origin and usually, if
     handling is correct, is not contaminated with other metals, plastics and paint. These two groups
     of scrap constitute most of scrap being recycled back into ingot or casting production. Prices for
     this type of scrap normally higher than for third type of scrap (but it was not the case in the
     beginning of 2005).
   - “Recycled Scrap”, such as scrap recycled from dismantling of old aircrafts, heat exchangers, or
     other equipment. This type of scrap is not normally traceable to original producer, and often
     consists of mixture of different titanium grades. It could be contaminated with other metals, paint,
     plastics, or other contaminants. Until the beginning of 1990s this type of scrap was used for
     ferro-titanium production only. However, development of Cold Hearth technology allows now
     much better removals of contaminants, both high density and low density, and utilization of old
     recycled scrap back into titanium industry. Leaders in reuse of recycled scrap are THT and IHM
     plants, also Paton plant in Ukraine and Titech plant in Italy.

4. Based on usage, industry named two categories of scrap:
   (1) “Vacuum” grade scrap – scrap that can be used by vacuum melters:
       - Bulk Weldable Scrap, heavy pieces, which can be welded into electrodes for vacuum-arc
         melting;
       - Crushable Scrap/Feedstock, which can be crushed into smaller pieces for feeding into
         Cold Hearth furnaces;
       - Turnings.
   (2) “Ferro” grade scrap – scrap that is not acceptable for return into titanium industry –
       untraceable scrap, contaminated scrap, exotic grades, etc.

5. Several following graphs represent statistics of titanium production and consumption of raw
   materials in the United States. Graphs were compiled using data published by US Geological
   Survey. Using this opportunity we would like to thank Mr. Joseph Gambogi for doing this fine
   work of compiling and publishing these valuable data for already great number of years.
   Graph on the page 5 represents statistics of ingot production and scrap consumption in the USA
   over the last 35 years. From the graph we can clearly see high peaks and deep valleys of
   titanium cycles. Cycles are rather consistent and very predictable, but somehow, industry never
   comes prepared neither for up-cycles nor for down-cycles. Looking at the graph, we see that
pattern of scrap consumption clearly follows pattern of ingot production. Both lines have solid consistent upward trend.

6. Next graph presents same data with the line of sponge consumption added. Graph below presents share of scrap in raw materials charge in US titanium industry. Share of scrap in raw materials charge in US industry grew from about 30% in 1970s to about 50% now. Two main reasons – (1) accumulation of titanium units in the economy and (2) better scrap utilization technologies, mentioned above.

7. On the graph on page 7 we tried to combine the numbers of ingot production in US and sponge and scrap prices. Over the many years of past statistics, scrap prices followed US titanium industry cycles rather closely.

8. In the next following graphs we will try to give very brief analysis of scrap supply situation in previous cycle and from there go to current cycle and see how it is different. Page 8 presents the statistics of import of titanium scrap into the USA. United States, thanks to being world leader in Ti scrap utilization technologies, is net importer of titanium scrap and major world market for titanium scrap. Graph indicates growing trend of scrap import into the United States. With increased growth of titanium production outside the US, and accumulation of titanium units outside US accordingly, as well as integration of Soviet titanium industry into world titanium economy, United States is using more imported scrap every year. Share of imported Ti scrap in US scrap consumption grew from under 10% thirty five years ago to more than 40% now. With shutting down and dismantling sponge production plants at RTI and later by ATI at old Oremet plant, US industry became extremely dependable on foreign raw materials. It seems that ATI realized that dismantling sponge plant was a mistake and now started program of building new plant at the same location where old plant was. It is unlikely that RTI will rebuild sponge plant, so it will be mostly dependent on import of Ti sponge.

9-10. Graphs 9 and 10 show statistics of import of titanium scrap into the United States by country of origin. Last up-cycle was a one-time phenomenon when really major growth of Ti industry in the US was fully supported by availability or raw material from collapsed Soviet titanium industry. This is not happening during current up-cycle. Instead, European share of scrap supply to US increased significantly.

11. This graph presents statistics of stock of raw materials, it just one more illustration, that while Titanium cycles are regular and predictable (truly every major executive in large titanium companies knows and tells correctly what will happen in the next one-two years), in reality companies come unprepared again and again. You can see from the graph, in 1997-1998 companies held large stock of expensive scrap, when everyone saw and everyone predicted downturn in production and drop in prices of future scrap supply. However, in 2003-2004, when scrap was extremely plentiful and cheap, major producers were not very interested in scrap accumulation, while clearly predicting coming up-cycle. This could be caused by enormous pressure on public traded companies to reduce inventory during bad years.
12. Next two graphs present difference in global scrap supply pictures of mid-1990s cycle and current cycle. Graph of 1990s presents two major users of scrap – United States for "vacuum" quality scrap and United Kingdom for "ferro" quality scrap. Russia and CIS are major suppliers of scrap. China is not on the map at all, with virtually no scrap going into the country, and very little scrap being exported.

13. Graph on this page presents very different picture of global scrap supply today. Russia is not exporter of scrap at all (while Russia continues to be major supplier of titanium products, but not raw material any more). China is becoming a big player in consumption of titanium units. While China is not yet really consuming titanium scrap for remelt, however it is consuming significant quantity of titanium units. While not tremendous, but noticeable quantities of reusable materials from Japan, US and Western Europe, what used to be prime quality remelt materials (we estimate may be more that 2000-3000 tons per year), previously used for remelt in United States, now going for direct reuse in China. Also, China is growing importer of titanium sponge now.

14. All that was about history, now we will try to talk about what is happening right now. We will have less data and graphs now, it is obvious, everything is happening before our eyes, not enough data still accumulated. Here on the graph you see rather obvious explanation to what drove "to stratosphere" prices of titanium scrap and sponge this year. Owing to unprecedented growth of economy in People's Republic of China, production of steel grew up every year since 1999, and especially sharply in 2003, 2004 and first half 2005 to cover needs in steel to support this growth. After recovery from crisis of 1997-1998, starting about 2001-2002 we saw growth in prices for all commodities needed in China for Chinese economy development. Due to continuing downturn in Ti industry consumption of titanium units for the industry was slow, availability of scrap and sponge was great, inventory of scrap and sponge was good, buying by major Ti producers very low. While consumption of Ti units for steel industry grew from year 2002, prices kept very low due to good availability of scrap.

15. Graph on this page presents estimated world production of ferro-titanium. Increased demand for titanium units in steel industry lead to significant increase in ferro-titanium to cover this requirement. We estimated growth of fe-ti production from year 2003 to 2004 from 45.8 thousand tons to 57.7 thousand tons, which is growth of 26%. We don't have data for year 2005 yet, but we estimate production of fe-ti this year to be at par or slightly below last year. Additional 12 thousand tons of fe-ti produced required approx 8.4 tons of titanium contained or about 9.5 thousand tons of additional titanium scrap. Total shipments of titanium scrap for ferro-titanium production in 2004 to cover needed quantity of titanium units were approx 46 thousand tons.

16. Significant growth in demand for ferro-titanium allowed ferro-titanium producers to keep increasing price for ferro-titanium. Ferro-titanium price historically stable for many years, seeing growth in demand from steel industry, increased by about 70% during 2003, then doubled during 2004. By March of 2005 price was about 9 times average historic level.

17. Ferro-titanium industry grew from tiny $110 million a year industry as recently as 2002 to $1 billion a year extremely lucrative business in 2005.

18. Here is the statistics of ferro-quality scrap price since beginning of 2003, when they were on approximately average historical level. Prices doubled by the end of 2003, then doubled again during the course of 2004. But real explosive growth happened in the first quarter of this year. In March of 2005 prices for ferro-quality scrap were approximately 9 times the average historical level.

19. In the beginning of 2004, vacuum melters, even not having support from the demand side yet, had no choice but to increase purchasing price for the scrap. Accordingly, melting plants had to increase selling price for the ingots and mill products. By the same time titanium industry already reached it's low point in titanium cycle. Boeing and Airbus started to sell more aircrafts.
Forgers and parts manufacturers, after downsizing of years 2002-2003 had lowest inventory of titanium raw materials, so they needed to buy more seeing coming increase in orders from Boeing and Airbus, to cover for production, as well as rebuild downsized inventory. As soon as they started to see increase in titanium prices, and having now support from demand side of the demand-supply equation, they started to buy material forward. Purchasing of titanium products changed from very low to very healthy rather quickly. Melters, seeing healthy increase in demand and competition for raw materials from steel industry, continued increase in scrap prices and products prices. Ti 6-4 ingot price reached level of four times the price of just two years ago. And when ferro-titanium price dropped by July of this year by 67% from March, healthy aerospace and industrial demand kept vacuum quality scrap from sharp drop. Price decline for vacuum scrap not exceeded 15-20%. After summer slowdown prices for vacuum quality scrap started to increase and practically recovered to the same level.

20. Trying to summarize, we see that for current up-cycle driving force was very different from any previous up-cycle in titanium industry. Driving force off all previous cycles in titanium industry was aerospace, and this is the reason titanium industry cycles were always independent from other metals cycles and from general economy cycles. This time main reason for titanium cycle was industrial demand from China (conducted via demand for titanium units for steel production). Titanium cycle this time started in unison with other resources cycles and titanium price graph is practically identical this time to other metals price graphs, which never happened before.

21. On the next slide we tried to compile numbers of worldwide consumption of titanium units (sponge + scrap). The numbers are approximate, it is difficult to compile precise statistics, but we believe they correctly represent the trend and situation of last year and first half of this year. While in 2001 share of titanium units used outside of titanium industry was estimated by us at 26%, which is historical average, last year and first half of this year this share was approximately 33%. Which means that in 2004-2005 share of titanium units lost for the industry forever was significantly higher than average, which was one of reasons of shortage of raw materials and explosive price growth. While the amount of available sponge was about the same as in previous years, amount of available scrap was sharply lower.

22. Will we have this situation forever? Of course not. Shortage is temporary. There will be more sponge and scrap available in the future. On the page 22 we indicated schematically six years cycles, with three years between peaks and valleys. Scrap requirement is current year production minus current year sponge availability. These two lines are going in approximately same cycle. Green line is generation of scrap. This line’s ups and downs are about 6 months to a year behind of production cycles. During up-cycle there is relative shortage of scrap, which drives scrap prices up. Shortage is partially filled up by speculators who invested into cheap scrap during low prices and selling scrap during high market. Soon after peak in production, availability of scrap still increases but demand for scrap decreases. Prices are going down. We need to mention that this cycle is different because large amount of titanium units in scrap was removed from titanium industry by demand from outside, so we expect it would take longer than normally for the equation to stabilize and for prices to start coming down.

23. There is another reason why prices for raw materials will not stay that high for long time. While most of the sponge is still being sold per long term contracts where prices currently are lower than today’s market price, current spot sponge price today is several times the historical level. At this price margin level for US and Japanese sponge producers is close to 70% and for Russian, Kazakhstan and Ukraine producers current margin close to 80% of selling price. No market will exist for long time without new entrants and maximum increase of output from existing producers. Already ATI announced plans for building sponge plant, and all major producers announced plans to increase sponge output in 2006. So we believe that situation will normalize, as always does, and probably sooner than many people believe now. Supply of raw materials will increase, melting and processing capacity is already in place. Prices for titanium products will keep staying high, but we think that we should see slightly lower prices for raw materials already in the first quarter of 2006 if not earlier. Accordingly, it looks like year 2006
should be very profitable year for titanium producers, very well could be most profitable year on records.

24. In conclusion, we would like to thank everyone who provided information and helped in preparation of our presentation.