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TANTALUM-NIOBIUM INTERNATIONAL STUDY CENTER

PRESIDENT'S LETTER

Friends,

Once more we find ourselves in a reflective mood after another eventful year in the lives of our membership and of the T.I.C. organisation. We also look ahead in the full knowledge that the New Year will bring us all further new challenges and opportunities in our businesses and lives.

Upon reflection it has been a year of change for the T.I.C. with its continuing growth to the highest number of member companies ever, thanks in large part to the dedication and spirit of its members, staff and Executive Committee. We say goodbye and offer our thanks to the retiring Technical Promotions officer Mr William Serjak for his fulsome contribution over the past two years and our appreciation for his efforts. We also welcome to our family Mr Ulric Schwela in the position of TPO. I feel sure he will receive the kind support and guidance from the membership in all of its diverse range of activities and interests.

Highest amongst those contributions throughout the past year has been the stewardship of Judy Wickens as Secretary General. I would like to take this opportunity to thank her again on the behalf of all of the members for her professional and personal assistance in making this yet another successful year in the life of the organisation. Under Judy's guidance and in collaboration with its members through the Executive Committee and the Office of the President and staff we can look back at the past year with some satisfaction. It was enjoyable for me to receive such kind compliments and positive feedback on the Pattaya meeting, its organisation, social activities, the papers delivered and the tours provided. I would also like to take this opportunity to thank the staff and people of H.C Starck for their unstinting efforts in making such a great contribution to another successful Symposium.

Two members of the Executive Committee have recently resigned, and my warmest thanks go to Tadeu Carneiro and Josef Gerblinger for all their contributions to the efforts of the Committee.

Finally I would wish you all the Season's greetings and look forward to seeing you in the New Year.

William Millman
T.I.C. President

TANTALUM AND NIOBIUM WORLD

The International Symposium 'Tantalum and Niobium World' was held at the Royal Cliff Grand Hotel in Thailand from October 16th to 20th, and was a great success. Two hundred delegates took part, from both member companies and non-members, benefiting from an excellent technical programme and enjoying the social events as well as the delightful surroundings. Many also toured the processing plant of H.C. Starck (Thailand) at nearby Map Ta Phut and learned much from this interesting visit.

General Assembly
The Forty-sixth General Assembly was held on Monday October 17th, with almost all member companies represented. Ten new members were elected, bringing total membership to 90, the highest it has ever been. These companies are based in no less than 23 different countries.

Mr Tadeu Carneiro retired from the Executive Committee after six years of very active participation in the work of the Committee and the association, including hosting a General Assembly in Rio de Janeiro with a tour to the CBMM mine at Araxá. Mr José Isildo de Vargas, also of CBMM, was elected to the Executive Committee. Dr Josef Gerblinger had resigned from the Committee shortly before the Symposium, and the T.I.C. appreciates his contribution, which included serving as President and hosting the General Assembly in 2003 with a plant tour of Epcos.

Mr William Millman was elected to a further term as President, and the other members of the Executive Committee were re-elected to serve for the coming year: Mr He JiLin, Mr Michael Herzfeld, Dr Axel Hoppe, Mr David Reynolds, Mr Michael Tamlin and Mr William Young.

Symposium
The technical Symposium comprised no less than 31 papers, in sessions on

- The association working for the industry
- Compounds and their applications
- Using metals and alloys
- Raw materials and the supply chain

CONTENTS

- Tantalum and niobium in the world – serving mankind and the environment
- Capacitors and capacitor powder

The T.I.C. is grateful to all speakers, authors, session chairs and everyone who contributed to the programme. The T.I.C. intends to publish the Proceedings, and selected papers will be reprinted in the quarterly Bulletin, beginning with this issue.

Complementary programme
The visitors who toured the plant of H.C. Starck (Thailand) were greatly impressed by the facility and the processing carried out there, as well as the thoughtful hospitality and careful planning of the company in organising the trip. A small group visited the adjoining Bayer polycarbonate plant. The programme was completed by an introduction to the Map Ta Phut industrial zone and a view of the zone from the Tower, and lunch at a hotel nearby on the seashore.

A welcome reception by the T.I.C. to open the event gave everyone an opportunity for networking and to sample the splendid food and drink provided by this first-class hotel.

The gala dinner was generously sponsored by the Thailand and Convention Bureau and by the H.C. Starck companies, the latter gave sound support and assistance throughout the Symposium and its preparation. The hotel surpassed even its own high standards of cooking and service with this dinner. Entertainment was provided by the extraordinary puppets of the Joe Louis Theatre from Bangkok. Although a thunderstorm unfortunately prevented us from having the dinner outside under the stars, we were able to float our Loy Krathong boats with their flickering candles on the water of the pool after dinner, and make a wish.

Forty-seventh General Assembly
The General Assembly in 2006 is planned for Monday October 16th, as part of a meeting from October 15th to 17th in Innsbruck, Austria, including a plant tour to the metallurgical facility of Plansee.

REVIEW OF STATISTICS AND INDUSTRY NEWS

by William A. Serjak, Tantalum-Niobium International Study Center
This paper was presented on October 17th 2005 at the International Symposium

Introduction
At the last International Symposium of the T.I.C. in 2000 in San Francisco, all sectors of the tantalum business were at record high levels due to the demand for new electronic products. The industry was feeling 'unrestrained exuberance'. Some people in the electronic end markets thought the electronics growth would never end. That period is now called the 'electronics bubble'. Those of us who have been associated with the tantalum business for many years know that there are up cycles followed by down cycles, which are followed by up cycles and down cycles.

Today, we are faced with a different situation. Today we see the electronic engine that drives the tantalum business, as measured by worldwide semiconductor sales, has returned to its 2000 peak and looks as though it is continuing to grow. But tantalum sales to this end market are significantly lower than the peak of 2000. The tantalum industry is not recovering to the same extent as the electronics industry as a whole.

The niobium half of the association continues to grow. The use of niobium in high-strength, low-alloy (HSLA) and stainless steels continues to be an important application. Niobium growth is driven by applications in the automotive, energy transmission piping, turbines, medical, structural steel and alloy businesses. The worldwide economic expansion led by the rapid growth in China and the rest of Asia over the last three years has given niobium a good basis for growth.

In this presentation, the statistical data of the T.I.C. are the data that have been submitted by the member companies and compiled by the auditors to provide totals for release to the association. The T.I.C. data are no longer estimates. The data for 2002, 2003 and 2004 have been revised. The graphs are plotted in periods of six months rather than in years. Presenting the data in the smallest increment, six month periods, makes trends easier to see. Comments on each of the industry segments will be presented with the graphs. Also any important news associated with that segment of the business will be presented. The news of the industry that has been presented in the quarterly Bulletin will not be duplicated. The data in the graphs, except for the semiconductor and tantalum capacitor data, are the actual data submitted by members. The statistical data are no longer ruled by the dart board of the Technical Promotion Officer.

Tantalum Raw Materials - Primary Production
The major tantalum raw material producer is Sons of Gwalia. During 2004 and 2005, Sons of Gwalia created news headlines when, in August 2004, it was taken over by administrators because of problems with its hedging of gold contracts. It appears that the tantalum operation has run normally since then and the administrators have even allowed money to be spent on expansion of the mines. Other major producers are Tanco in Canada, Highland Africa's Morrua mine, the Marropino mine in Mozambique, the Kenticha mine in Ethiopia, Metallurg and Mamoré in Brazil, and smaller mines elsewhere in Africa, Australia, and China. The Morrua mine became operational in 2004. Michael Tamlin will cover the subject of raw materials in much more detail in his presentations.

Tantalum raw materials come from three sources; tantalite, columbite and struverite, and tin slag. Figure 1 shows that total production is at a yearly rate of 3.5 million pounds (lbs) (tantalum pentoxide contained) in the first half of 2005. Tantalite is 80% of the total tantalum raw material production. Tantalum in tin slag reached a peak in 2001 and after a dramatic drop-off is making a small recovery. The small increase recently may be due to the increase in tin mining brought on by the increase in worldwide demand for tin and other metals, although it is believed that the active tin mines do not contain much tantalum. It is probable that some tantalum is being recovered from old tin slag

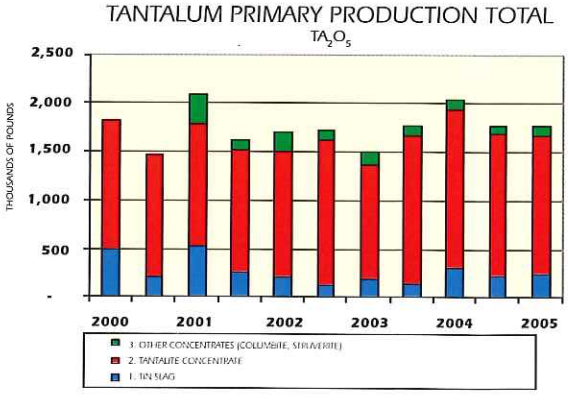

Figure 1: Tantalum primary production

Figure 2 presents the production of tantalite. Sons of Gwalia produces roughly 50% of the tantalum mined in the world from its Greenbushes and Wodgina mines in Australia. Shipments have increased only slightly since 2000 and did not reflect the major downturn as did other tantalum products because SOG's production is based on long term, fixed quantity contracts.

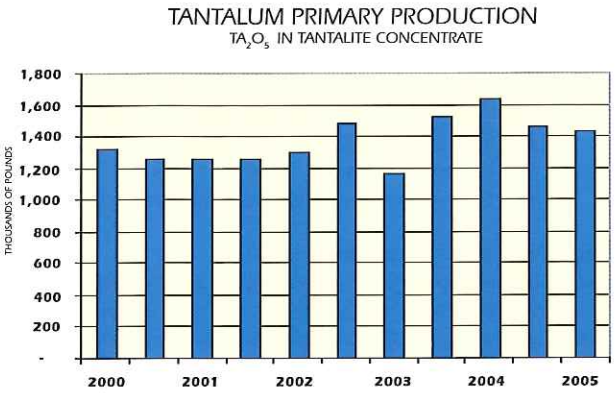

Figure 2: Tantalite production

Tantalum Processors' Receipts of Raw Materials

Tantalum processors convert ore into intermediate products such as K-salt (potassium fluotantalate) and then into finished products such as capacitor grade powder and wire, sheet, ingot, chemicals, carbides and many others. The products made by processors are rarely the end-use products, but are raw materials for the supply chains of the electronics, automotive, chemical process and other industries. The three largest processors are Cabot Supermetals, Ningxia Non-ferrous Metal Smelter and H.C. Starck.

Total processor receipts are currently at the yearly rate of about 5.0 million lbs as shown in Figure 3. Tantalite raw materials are about 80% of the materials received by the tantalum processors. The other source of raw materials is 'secondary materials', a fancy name for capacitor and other scrap and intermediates such as K-salt. Recovery of the anode and wire in scrap capacitors is achieved by separating the tantalum from the non-tantalum part and then purifying by melting. Products made from this recovered material are ingot, sheet, wire and other mill products. These products are also made from the internally generated scrap of the processor. The recycling of scrap in this industry is critical in times of high demand.

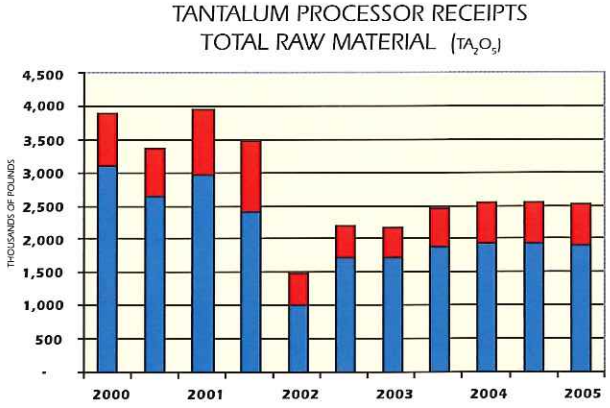

Figure 3: Tantalum processors' receipts

Figure 4 is a comparison of Tantalum Primary Material Production and Tantalum Processor Receipts. The receipts by processors (blue line) are higher than the production data (red line) because they include purchases from non-T.I.C. members and purchases from the U.S. Defense Logistics Agency, whereas 'production' is the reported data of the T.I.C. members involved in mining, smelting and trading. In the fiscal year ended September 30th 2004, the D.L.A. reported sales of more than 700 000 lbs of tantalum contained in minerals. D.L.A. announced plans to sell about 500 000 lbs of tantalum minerals in fiscal 2005. In all, in 2004, the D.L.A. sold: 40 000 lbs capacitor grade powder, 24 000 lbs ingot, 700 000 lbs tantalum contained in minerals and 11 000 lbs in oxide. In fiscal 2005, the D.L.A. has sold: 20 500 lbs ingot, 515 000 lbs tantalum contained in minerals, 14 000 lbs capacitor grade powder and 20 000 lbs in oxide.

One of our members, KAC Kazatomprom, has accepted the 'leader of Russia's economy' award.

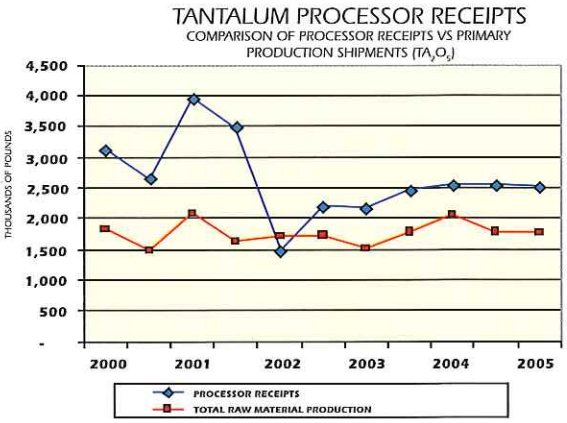

Figure 4: Total receipts by processors compared with primary material production

Tantalum Processors' Shipments - Chemicals

Tantalum in chemicals, Figure 5, has shown solid growth. Most of the chemicals shipped are in the form of oxide. Optical-grade oxide is sold for optics in digital cameras and digital video equipment. This market has seen rejuvenation with the change from film to digital format. High-purity oxide is used for surface acoustic wave-guide (SAW) filters which are used in cell phones.

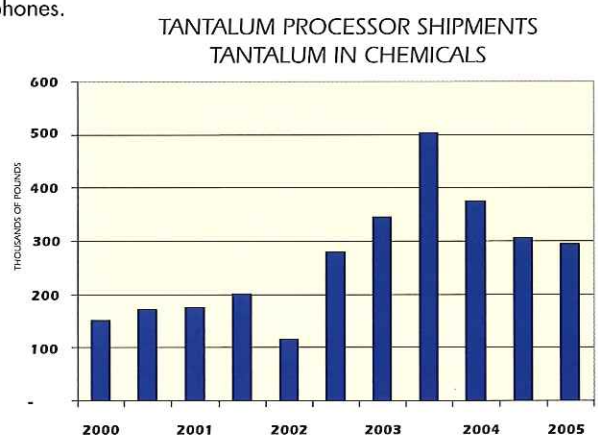

Figure 5: Tantalum processors' shipments – chemicals

Total chemical shipments more than tripled between 2000 and 2003, but have now returned to a more normal growth rate. Some of the growth in 2003 may be attributed to shipments of intermediates such as K-salt.

Tantalum Processors' Shipments - Carbides

Tantalum carbides shipments have remained level for the last five years. This business is dependent on the machining of precision parts, primarily in the auto industry. Thus, the growth follows that of the worldwide auto industry.

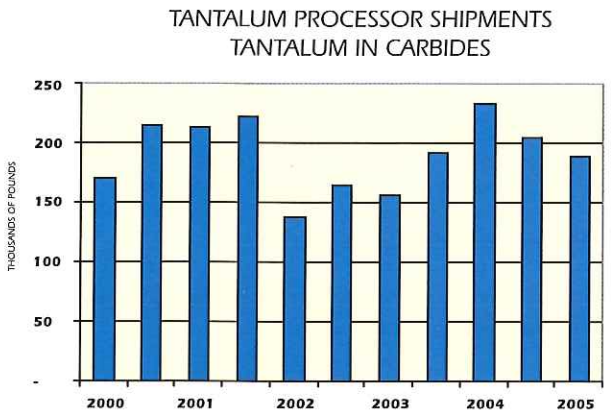

Figure 6: Tantalum processors' shipments – carbides

Tantalum Processors' Shipments - Capacitor Grade Powder
Shipments of capacitor grade powder by the processors, as seen in Figure 7, have been the life blood of the industry. This figure also highlights the double purchasing that occurred in 2000 and 2001 in anticipation of demand that did not materialize. Although there has been good growth from the new demand for disk, ingot and targets for sputtering, as will be shown in later graphs, this has not replaced all of the powder demand lost because of weak demand for tantalum capacitors.

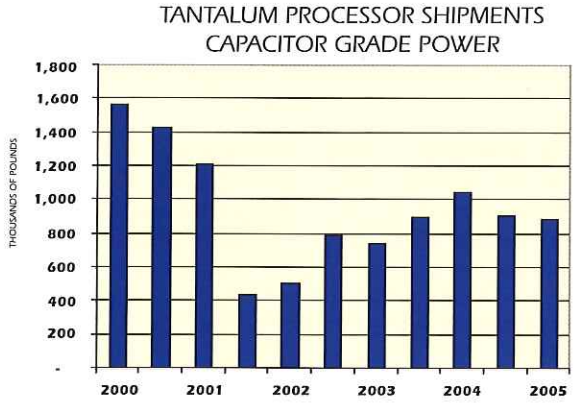

Figure 7: Tantalum processors' shipments – capacitor grade powder

The loss has come because of substitution of other capacitor dielectrics such as ceramic and aluminum for tantalum. All capacitors, including tantalum, are becoming smaller and require less material. Tantalum capacitors had nearly disappeared in cell phones, but they have made a comeback with the introduction of the enhanced function picture phones.

Tantalum Processors' Shipments - Mill Products
Tantalum mill products, Figure 8, are finally approaching the levels reached in 2000, although the composition of the business has changed. One of the largest components of this business is tantalum capacitor grade wire. The requirement for tantalum wire has decreased in the same way as the requirement for tantalum powder. In the year 2000, mill products were used extensively for sintering of tantalum anodes. Since then, the tantalum for this application has decreased because of lower sintering temperatures and substitute materials. Tantalum mill products are also used in the Chemical Process Industries as they resist corrosion. Sheet and tube are used for heat exchangers, tantalum lined tanks, valves and other chemical process equipment.

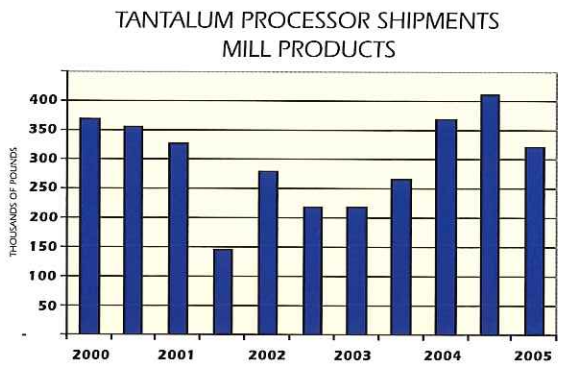

Figure 8: Tantalum processors' shipments – mill products

Tantalum Processors' Shipments - Ingot
Shipments of tantalum ingot, as shown in Figure 9, have increased over the last four years because of the increasing market for sputtering targets for semiconductors and the renewed requirements of the alloy additive business. Tantalum used for deposition on semiconductor substrates has caused this business to grow since 2003. As the semiconductors become smaller, thinner and faster, tantalum can play an important role in this market. Both tantalum and niobium are used to make components for turbine blades and parts. The upturn in the aircraft and turbine business is therefore reflected in the demand for ingot and mill products.

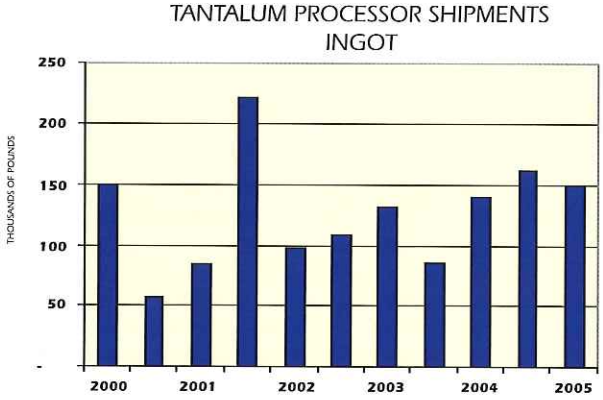

Figure 9: Tantalum processors' shipments – ingot

Tantalum Processors' Shipments - Metallurgical Powders, Scrap and Unwrought Metal
Shipments of metallurgical powders, scrap and unwrought metal, as shown in figure 10, are generally to intermediaries and fabricators. These materials may also be used to make carbides and tantalum alloys. This business is more dependent on the overall world economy. All three product groups may serve the same markets and in many cases the purchaser may not care which form of the product is supplied.

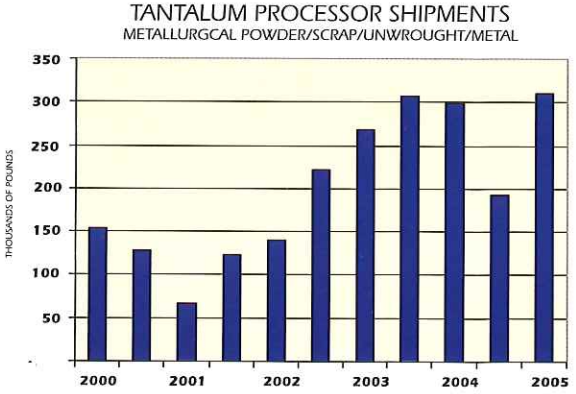

Figure 10: Tantalum processors' shipments – metallurgical grade powder, scrap, unwrought metal

Figure 11 shows the total tantalum shipped by processors. This figure shows that capacitor powder is still very important to the tantalum business, but not as important as in 2000. In that year, capacitor grade powder shipments were more than 60% of the total tantalum shipped by processors. By the first half of 2005 the percentage had dropped to 41%.

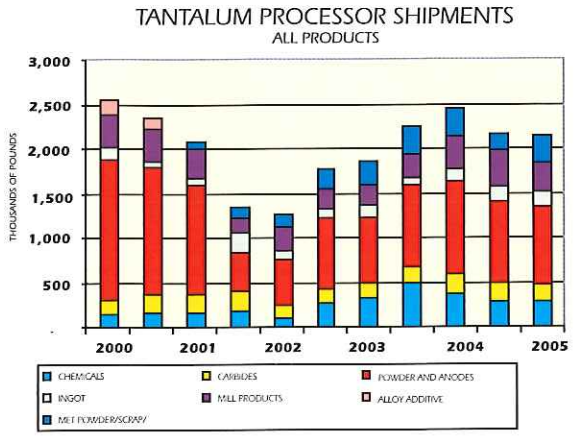

Figure 11: Tantalum processors' shipments – all products

This trend shows that tantalum capacitors are of less importance to the electronic industry than they were five years ago.

Tantalum Capacitor Producers - Receipts of Powder and Wire

The data from the companies which produce tantalum capacitors are shown in Figure 12. These are companies such as AVX, Daewoo, Epcos, Firadec, Hitachi, Kemet, NEC/Tokin, Nichicon, Marcon and Vishay. In 2004 the retirement of Dave Maguire was announced. Dave was one of the early members of the T.I.C. and a frequent presenter at the T.I.C. meetings. During the last five years, there has been a shift of manufacturing from high cost economies to lower cost economies, mostly in Asia. Most notable is the closing of the Vishay plant in Sanford, Maine. At one time this operation may have been the largest consumer of tantalum powder in the world.

Figure 12 shows the dramatic decline in the powder and wire received by the capacitor producers. Again, the high levels of receipts in 2000 and 2001 were for capacitor sales that did not materialize. Although not shown in a graph, from 2000 to 2005 the ratio of wire to the total of capacitor producer receipts has increased from 12% to about 15%. This reflects the requirement for smaller anodes and less powder. Because the function of the wire is structural in an anode, the amount has not decreased at the same rate as powder.

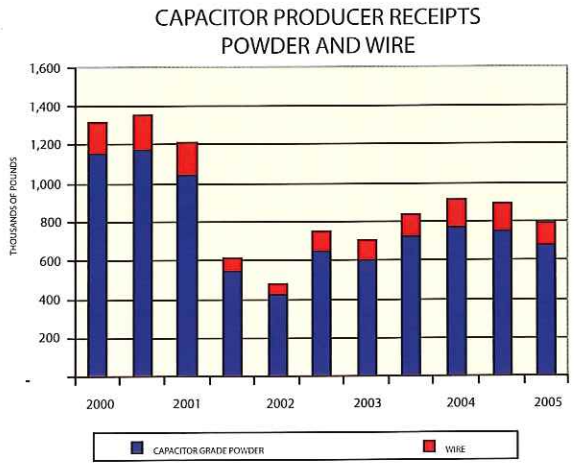

Figure 12: Receipts of tantalum powder and wire by capacitor producers

Tantalum Capacitors

Figure 13 shows the estimated data for the consumption of tantalum capacitors, by worldwide region, for the last six quarters. From the first quarter of 2004 to the second quarter of 2005, the total consumption is very steady indicating little growth in tantalum capacitors. The trend by individual regions shows that the manufacturing of electronic equipment, and hence the consumption of tantalum capacitors, is moving from Europe, Japan and North America to the region listed as 'Rest-of-World', which includes Korea, China, Taiwan, Israel, and others.

CONSUMPTION OF TANTALUM CAPACITORS

MILLIONS OF UNITS						
	2004				2005	
	1	2	3	4	1	2
ROW	2700	3250	2850	2750	3200	3500
Europe	744	740	600	550	600	550
Japan	1300	1400	1200	1000	1000	850
North America	625	625	550	500	500	500
Total	5369	6015	5200	4800	5300	5400

Figure 13: Consumption of tantalum capacitors (estimated)

Tantalum: Summary

Figure 14 illustrates the change in the relationship between semiconductors and tantalum capacitors. This figure is a plot of the capacitor producer powder receipts (red bar columns) and dollar value of worldwide semiconductor sales (light blue squares on the right axis). Historically, tantalum powder tracks fairly well with the sales of semiconductors worldwide. In this figure we observe that after the electronics bubble of 2000 and 2001, semiconductors fell about 33% while tantalum capacitors fell by 75%, as measured from the highest six months to the lowest six months. This is not unusual. We can also see in the data of 2004 and 2005 that semiconductors are continuing to grow while tantalum powder has remained stagnant.

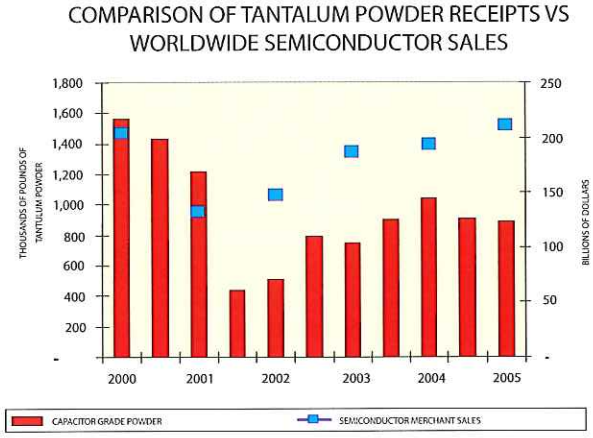

Figure 14: Comparison of tantalum powder receipts with worldwide semiconductor sales

Total tantalum shipments have not fully recovered from the bubble of 2000. And although the other product groups such as chemicals and metallurgical powder have increased, they have not made up the shortfall caused by the drop in tantalum capacitor grade powder.

Niobium Primary Production

The world's largest deposit of pyrochlore is mined by Companhia Brasileira de Metalurgia e Mineração (CBMM), which supplies between 65% and 70% of the world demand for niobium products. Its mine at Araxá contains 460 million tonnes of ore. The other significant mines are operated by Anglo American in

Brazil and by Cambior, which in 2004 purchased the remaining 50% of the Niobec Mine, in Quebec, Canada, and now owns 100% of the Niobec mine. It is estimated that Anglo American and Cambior each produce between 14 and 18% of the niobium raw materials.

T.I.C. statistics, especially Figure 21, primary production, show the demand for niobium is driven by the end markets for HSLA and stainless steels. Figure 15 shows that primary production of niobium has grown at a rate of about 12% per year from about 70 million lbs per year to about 120 million lbs per year Nb2O5 contained. The major factors behind this growth are: the growth in the world economy, the growth of the petroleum industries around the world, the growth of new markets in Asia and the substitution of existing metals in cases where supply and or pricing has been a problem, such as with vanadium.

A small portion of the niobium raw material production is recovered from tantalite minerals. If you look very closely at the bottom of the bars you can see a hint of blue. That is the contribution of niobium from the tantalite sources - much less than 1%.

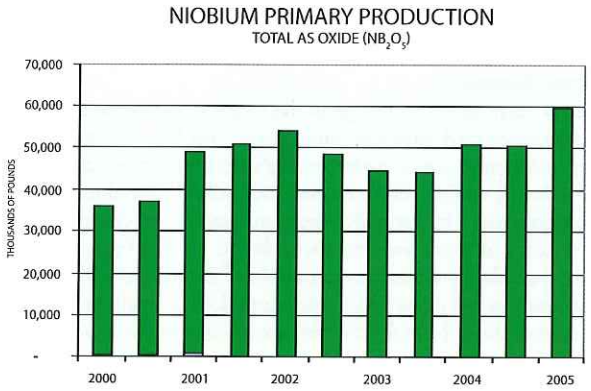

Figure 15: Niobium primary production

Niobium Processors' Shipments - HSLA

The largest application for ferro-niobium is in high-strength, low-alloy (HSLA) and stainless steels. The data are shown in Figure 16. HSLA steels are used in large diameter pipelines for transmission of natural gas and oil. It is expected that the recent run up in the prices of oil and the disaster in the Gulf of Mexico will cause demands for more exploration and new transmission equipment. HSLA is also used in frames and wheels of automobiles and trucks, and in structural applications as micro-alloyed steel. Europe and the U.S. account for about 73% of the world's ferro-niobium applications. Shipments of ferro-niobium for HSLA and stainless steels, which are the largest application, accounted for 89% of the total processor shipments. HSLA consumes about 75% and stainless the remainder of the niobium produced. HSLA is growing at a rate of about 8% per year.

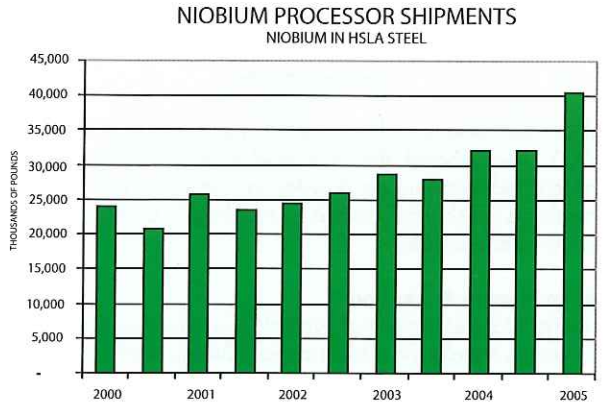

Figure 16: Niobium processors' shipments – HSLA steel

Niobium Processors' Shipments - Niobium chemicals

The shipments shown in Figure 17 are mostly in the form of niobium oxide, chloride and carbide. The oxides are used in optical formulations and allow lenses to be thinner and lighter. As with tantalum, use of these optical formulations is increasing with the growth of digital still and moving photography. High purity niobium oxide is also used in single crystal lithium niobates for surface acoustic wave filters because they convert electrical energy into light waves with good efficiency. Lithium niobate is also used in many other electronic applications. Niobium oxide is also used to coat glass materials. The oxide had once found an application in ceramic capacitors, but because it is a lead formulation it will decrease in use as the electronics world becomes 'lead-free'. Niobium oxide powder has found an application in capacitors as a substitute where the circuit requires 10 volts or less. Although no exact number can be found for this business, one industry expert believes that sales are greater than 1.5 billion units per year. Another source said the business is doubling each year quarter to quarter.

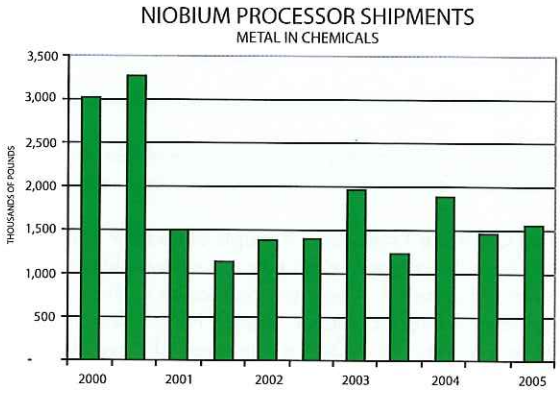

Figure 17: Niobium processors' shipments - chemicals

Niobium Processors' Shipments - Vacuum Grade NiNb and FeNb

Vacuum grade niobium alloys are used to make land and aircraft power generation equipment. Niobium-containing Inconel 718 is used in aircraft engines. Typically these alloys are sold to special fabricators for additional processing. With the recent upturn in orders for new aircraft, niobium alloys should continue the recent growth. These vacuum melted FeNb materials also use FeV as an additive to strengthen steel products such as rebar and the unexposed structures of automobiles.

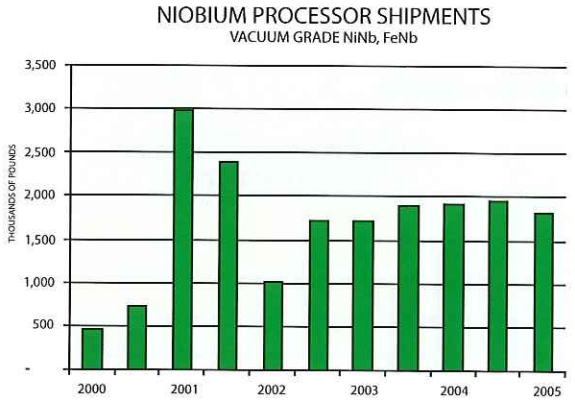

Figure 18: Niobium processors' shipments – vacuum grade nickel-niobium and ferro-niobium

Niobium Processors' Shipments - Niobium Pure Metal

Niobium as a pure metal, Figure 19, is material that is usually shipped to converters who may be outside the T.I.C. These converters make finished products such as superconducting wire for Magnetic Resonance Imaging (MRI) and sputtering targets for the semiconductor industry. Niobium is used, because of its

corrosion resistant properties, in the Chemical Process Industry. This business has more than tripled from 2000 to the first half of 2005 and the rate of expansion is about 15% per year. But it still is a very small part of niobium shipments. The shipments to the superalloy business may take the form of pure metal, ingot, alloys or even scrap. The demand depends on many factors including availability and economics of the decision.

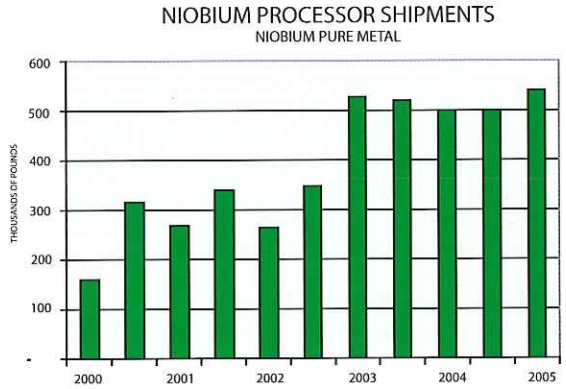

Figure 19: Niobium processors' shipments – pure metal

Niobium Processors' Shipments - Niobium alloys NbZr, NbTi and NbCu

The application of niobium-titanium alloy in wire for superconducting magnet coils has found a major market in the field of MRI. The cost effectiveness and practicability of the application has made MRI one of the most common medical tools for diagnosis. In addition, niobium alloys are used in aircraft engine components. With the recent upturn in orders for new aircraft, niobium alloys should continue the recent growth.

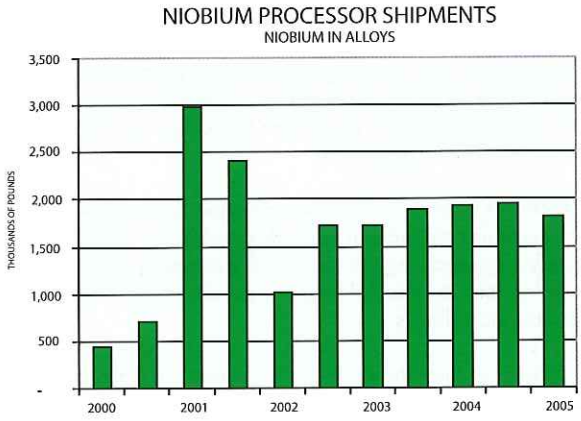

Figure 20: Niobium processors' shipments - alloys

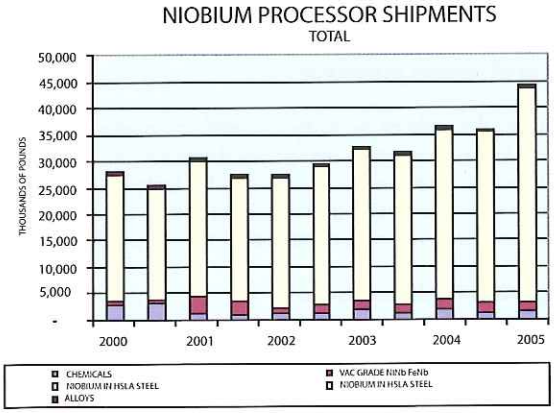

Figure 21: Niobium processors' shipments – all products

Niobium: Summary

The niobium business continues to grow. It has gone from 55 million lbs per year in 2000 to a rate as high as 90 million lbs in 2005. Niobium has been a classic growth business that has never suffered the problems associated with shortages of materials.

Thank you

During the last two years there have been changes in the job of the Technical Promotion Officer. In 2004, with the help of an associate, I presented a paper dealing with the safe transport of tantalum and niobium scrap. This paper contains very important guidelines and I hope that all of you read them. Also during the last two years, we have made great strides with the Transport Committee, which I have chaired. We have gone from a committee that had to read the regulations published by the International Atomic Energy Agency to a committee which has made a proposal to the IAEA. The proposal has been accepted and will be part of a Coordinated Research Project which will study the nature of Naturally Occurring Radioactive Materials and assess the risk, if any, that they represent. The IAEA will conduct this study to determine if they should change their regulations concerning NORM, which include tantalum raw materials. A consultant, Dr Douglas Chambers of SENES, has been retained by the T.I.C., and he will write a final report for submission to the IAEA with the goal of changing the current regulations for the handling of tantalum raw materials.
(A paper by Dr Chambers was also presented at the Symposium.)

SUSTAINABILITY ASSESSMENT OF METALS - THE CHALLENGES OF INCREASING REGULATION

By Ms Kay Nimmo, Manager of Environmental Affairs, ITRI-Tin Technology Ltd. This paper was presented at the International Symposium 'Tantalum and Niobium World' on October 18th 2005. There have been more developments in the EU legislative process since the Symposium.
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SUMMARY

Legislation around the world is increasingly being based on the principles of sustainability: economic growth achieved in tandem with the development of communities and respect for the environment. Related concepts such as producer responsibility, product liability and product stewardship are forcing manufacturers to focus on the entire life cycle of their product, from raw material supply, through manufacturing processes, to customer use and recycling at the end-of-life. All sectors of the metals industry should be prepared to address the significant questions raised by the increasing focus on sustainability assessment.

One factor in sustainability assessment is ensuring product safety, and the new EU Chemicals Policy (REACH) is an example of impending regulation that will have a very significant business impact on the metals industry. REACH is a process requiring the Registration, Evaluation and Authorisation of the use of Chemicals within the EU in order for their safety to be proven and for their continued use to be permitted. All metals, such as tin, niobium and tantalum, are classed as substances requiring registration, and industry therefore needs to prepare for the detailed technical environmental and human health assessment data required for REACH registration to ensure continued access to the EU market.

This paper summarises background information on legislation

arising from sustainability issues, describes the requirements of the draft REACH Directive, and discusses, as examples, some of the actions now being taken by ITRI and the tin industry as part of their sustainability programme.

SUSTAINABILITY AND THE METALS INDUSTRY

Business is increasingly expected not only to provide quality, competitively priced goods and services, but also to play a responsible role in society and take environmental and social issues seriously. In a globalised world, customers and the public also want to feel sure that the businesses are acting in a sensitive and responsible way in both developed and developing countries, i.e. that they are 'sustainable'.

The simplest description of sustainability is 'the capacity for continuance into the long term future'. Anything that can go on being done in the same way on an indefinite basis is sustainable – anything that cannot is not sustainable. Sustainability in general terms involves the balanced interaction of three aspects of performance based on the economy, society and environment, each of which contain a wide range of sub-parameters that are used for assessment purposes.

Sustainability encompasses many ideas on a variety of areas relevant to industry but overall aims to achieve:

- Maintenance of high and stable levels of economic growth and employment
- Effective protection of the environment
- Prudent use of natural resources
- Social progress that meets the needs of everyone

While the definition of sustainability is vague, and the methods to achieve and monitor performance rather ambiguous, it is very evident that a communications and management strategy on sustainable development is now essential to all businesses and sectors. Action on sustainability is essential to deal with increasing pressure from campaign groups, government regulation, as well as employees and shareholders. It also can bring tangible financial gains and will assist in ensuring the long-term future of a business.

Example of Aluminium

The aluminium industry has done a great deal of work to promote the metal and the industry as sustainable. Its very effective programme was launched in 1997 to address what were seen to be key areas of criticism at that time:

- Concerns over the material – a waste of energy, packaging that is not recyclable, bad for health, unsustainable etc
- Concerns over the industry – little information provided, low visibility, lack of industry attention to sustainability

A major drawback of primary aluminium production is the energy requirements of the process. This issue has been minimised by action to obtain as much energy from renewable resources as possible (such as hydro-electric power), and to concentrate on the recycling potential of the metal and the much lower energy demands of the recycling process. Efforts to promote recycling of cans have been very successful so that now it is often believed that aluminium cans are recycled to a greater extent than steel cans. This is generally not the case – but illustrates very well the benefits of good communication.

EXAMPLES OF LEGISLATIVE INFLUENCES

It has been stated many times by the EU that the 'Use of current materials and energy sources at the current rate is not sustainable. By environmental innovation, and reduction in resource use, objectives of sustainability can be achieved sooner and at less cost. This means reduction in primary demand, waste generation, pollution, material use, and increases in recycling and technical innovation (good eco-design of products)'.

A range of policies are being developed in the EU that aim to address the concerns above. The EU is often seen to be a leader in environmental policy and any strategies adopted by that region tend also to be considered by other regions of the world.

In order for legislators to carry out the assessments that they aim for, a significant amount of data must be generated and made available. If the data are not available then there is a significant danger that legislators take the 'worst case' approach introducing more severe regulation than may realistically be required. The importance of data availability should not be underestimated and industry should be prepared to be more transparent over all its activities.

Natural Resource and Recycling Strategies

The EU thematic strategy on the sustainable use of natural resources attempts to break the link between economic growth and increasing resource use. The strategy is based on the following concerns:
Resources are the backbone of every economy. In using resources and transforming them, capital stocks are built up which add to the wealth of present and future generations. However, the extremes of current resource use are such that the chances of future generations - and the developing countries - to have access to their fair share of scarce resources are endangered. Moreover, the consequences of our resource use in terms of impacts on the environment may induce serious damage that goes beyond the carrying capacity of the environment.

The EU strategy on the prevention and recycling of waste also aims to reduce resource use through the promotion of recycling. The work aims at developing a comprehensive strategy which includes waste prevention targets and methods that can be used to achieve them. For recycling, the aim is to promote methods that encourage recycling, to consider additional environmental benefits and select options to achieve recycling objectives in the most cost-effective way possible.

Manufacturers of end products, encouraged by legislation, are increasing their demands for secondary material. Legislation and pressure groups require the use of increasing percentages of scrap/reclaimed material in major product sectors such as electronics and vehicles.

One of the most important benefits of metals use is the fact that material is not consumed; it does not deteriorate in any way and can be infinitely reused as long as waste and other losses are prevented. Recycling is therefore a significant positive. Metal in use today represents an investment of environmental resources on which the highest possible return is required – this means increasing the amount of recycled material at the expense of primary production.

Of course, if supply of currently available secondary metal is not sufficient new metal is still required and all non-ferrous metals sectors promote the need for both. Data on both the primary reserves of metal and the sources and quantities of recycled material are requested more and more frequently.

Mining Metal Production Issues

Traditionally, the metals industry has been widely regarded as 'dirty' and 'polluting'. Moreover, some stakeholder groups do not distinguish between the metals and mining industries and wrongly attribute assumed and perceived environmental shortcomings to the mining sector, and by association to the metals themselves – particularly when data are lacking. As a result, the substantial and continuing improvements in the

environmental performance of the non-ferrous metals industry have not been generally appreciated. Improved communication and the provision of comprehensive information to all stakeholders would ensure that the industry's continuing environmental improvements are recognised.

The EU has also recently agreed a Directive on mining waste.

Social and Economic Considerations
Information on social and economic benefits of metal production industries is sometimes hard to come by, however, but it is also an important factor in sustainability assessment. These considerations are more and more often being incorporated into other pieces of legislation and can be found, for example, in REACH (see later). Positive contributions of industry to the community and the economy can be used to balance any 'negative' factors related to the environment and the availability of data on the subject can therefore have a significant influence.

Product Life-Cycle
Life-cycle thinking is also being incorporated into many aspects of EU policy. In general terms, the environmental impact of a product must be considered throughout its whole life-cycle from production to end-of-life and recycling, i.e. 'from the cradle to the grave'. Such an examination is a Life-Cycle Assessment (LCA).

Minimising the environmental damage caused by goods and services in the market economy is a key challenge facing the EU's Integrated Product Policy (IPP). IPP is an approach that begins by examining how the environmental performance of products can be improved more cost-effectively. It seeks to reduce the environmental impact of products throughout their life-cycle, from the natural resources from which they come, through their use and marketing to their eventual disposal as waste. It is a relatively new approach to environmental policy but requires a significant amount of data and information to be made available to assessors and consumers alike.

Many metal industries are now developing up-to-date and detailed Life-Cycle Inventories (LCI). These databases provide those carrying out LCA's with more reliable and representative average figures for the resource or energy used in material production. A significant amount of the data contained in current LCI databases on metals is out of date or is poorly representative of the true situation and has often led to 'bad' assessments of products containing those metals. It is often more beneficial to provide accurate LCI information than to allow the continued use of current data.

Product Safety
The need to demonstrate that a product is safe is incorporated into many pieces of legislation. Increasingly, however, the burden of proof for that safety is being placed on the producer or importer of the goods or chemicals. This reverses the previous situation where Governments must prove there is a risk to the population in order to ban the use of a certain product.

The most important example is the EU New Chemicals Policy REACH described below.

THE DRAFT EU NEW CHEMICALS POLICY: REACH

REACH stands for Registration, Evaluation and Authorisation of Chemicals. The new EU policy will replace 40 existing pieces of EU legislation and create a single system for all chemicals as the current system distinguishes between 'existing' and 'new' chemicals, based on the cut-off date of 1981.

The main aims of REACH are improvement of protection of human health and the environment, increased transparency (e.g. public access to toxicity data) and integrating international efforts towards, for example, EU conformity under the World Trade Organisation (WTO).

REACH requires manufacturers and importers of substances already on the market before September 1981 to gather information on the substances they manufacture or import, and use the information for responsible and well-informed management of the potential risks of the substance. The toxicology of the substance itself and the risks associated with the use of the substance must be assessed as part of the registration and authorisation process.

Registration is required before sale of the product in the EU is permitted according to the policy of No data = No market.

Costs to the tin metal and inorganic chemical industry are estimated to be in the region of a minimum of ?3 million over the next two to three years.

Full details of the REACH proposal, including frequently asked questions, can be found on the European Commission website: http://europa.eu.int/comm/enterprise/chemicals/chempol/whitepaper/reach.htm

The EU has already held discussions with relevant international bodies to encourage adoption of a similar system of chemical authorisation requirements on an international basis. Similar regulations should be expected in markets outside the EU within a relatively short timescale.

The Stages of REACH
Registration is required for all substances produced or supplied in quantities over 1 tonne. Evaluation will be carried out for all substances over 100 tonnes and special Authorisation will be required for all substances of high concern or any so identified during the evaluation stage of the process.

Registration requires industry to obtain relevant information on chemical substances (metals included) produced or supplied in quantities greater then 1 tonne per year. It involves submitting as a technical dossier information on the substance and information how to manage the risk safely. Production quantities greater than 10 tonnes additionally require submission of a Chemical Safety Report (CSR) which documents the hazard classification of a substance and an assessment if the substance is persistent, bio-accumulative or toxic. Production or import quantities over 1000 tonnes mean classification of a substance as high priority for risk assessment.

Evaluation allows the regulators to assess whether the information provided by industry is sufficient, and also allows the estimation of the risk posed by a chemical in order to prevent unnecessary testing. Substances of very high concern (carcinogens, mutagens, substances toxic to reproductive system, persistent or bio-accumulative) will additionally require use Authorisation which can be granted if the applicant can demonstrate that the risk from the use is adequately controlled or that the socio-economic benefits outweigh the risk.

The legislation allows Restrictions on the marketing and use of substances to be agreed at Community level where there is an unacceptable risk to human health and the environment arising from the manufacture, use or placing on the market of the substance.

Different rules are proposed for chemical substances used in industrial processes which do not leave a manufacturing site. Various exemptions or other alternative requirements apply to, for example, polymers, hydrates, intermediates, as outlined in the full document.

Who needs to take action?
Producers and importers are obliged to register substances they produce or import for every specified downstream use in quantities of over 1 tonne per year. Failure to register means that the substance cannot be manufactured or imported to the EU market. Alloys are regarded as downstream uses of the metals from which they are made.

Downstream users have a right to make their use known to the manufacturer in order to make it an identified use and have that use covered in the risk assessment. The downstream user will have to provide sufficient information on the consumer exposure in the supply chain. Alternatively these users can conduct their own risk assessment and submit their own registration dossier. Failure to provide the information means that the use would not be registered and thus banned from the EU market.

The deadline for registration depends on the sales tonnage of the product: high tonnage materials of more than 1000 tonnes per annum must be dealt with first (within three years of the implementation of REACH). The actual date of implementation is not yet known but may be presumed to be during 2007: see estimated timescales in Table 1.

2004 – 2006	Interim period (before the regulation is implemented)
2007	**REACH is implemented ?**
2007 – 2010	Registration of high priority substances of consumption of 1000 tonnes and above, and **CMRs*** category 1 or 2
2010 – 2013	Registration of substances with consumption of 100 tonnes and more
2013 – 2018	Registration of substances with consumption of 1 tonne and more.

** Carcinogens, mutagens and substances toxic to reproduction*

Table 1: Estimated times for implementation of REACH

Currently each manufacturer or importer must register each substance individually. Possible changes to REACH mean that when the legislation is finalised the registration system may be 'OSOR' One Substance = One Registration. OSOR forces all manufacturers of each substance to work together to submit a joint dossier on that substance.

The REACH approval system is also being designed in order to prevent 'free-riders' within the industry, that is to say those who do not contribute to a co-ordinated submission, and do not complete their own submission, will not be permitted to market the substance within the EU. Alternatively, those who do not contribute are likely to be liable to compensate financially those who have submitted the substance dossier. REACH will apply to importers into the EU as well as manufacturers within the EU.

Information required for a REACH dossier
Manufacturers and importers are required to supply a technical dossier covering the information described below:

a) Identity of manufacturer or importer
b) Substance identity
c) Information on manufacture and use (at least 90% of volume)
d) Proposed classification and labelling
e) Guidance on safe use
f) Summaries of Annex V to IX toxicity information
g) Studies of annex toxicity V to IX
h) Statement on vertebrate animal testing
i) Proposals for further testing

Sections f) and g) require extensive reporting of known toxicological data, effects on human health and the environment in relation to likely exposure scenarios. Collation of these data is often particularly demanding.

This list covers many details of uses, tonnages, toxicity data, and recommendations for safe handling and risk reduction. Manufacturers are responsible for obtaining the relevant data from downstream users and incorporating them into the dossier.

Downstream users are required to examine the data provided by the manufacturer and importer to check relevance to their situation and ensure risk reduction is achieved. Downstream users must provide required information to the manufacturer for assessment of risk and must also submit a chemical safety report containing the information below:

a) Material safety data sheet
b) Intended uses
c) Exposure scenarios
d) Safety assessment and risk management measures

Risk Assessment of Metals
Metals are natural components of the Earth. Each has specific chemical and physical characteristics that determine its availability to the environment, and its interaction with humans and other living beings. Understanding the hazard and risks posed by any metal in the environment is the key factor in progress towards sustainability and is also now essential in anticipation of the implementation of REACH.

The new sustainable chemicals policies currently being developed by regulators inevitably involve assessing hazards from substances and evaluating the priority risks. Many regulators have underscored the need for industry to provide accessible, accurate and approved data sets that will allow informed, science-based decisions on substances to be made. International organisations such as the ICMM (International Council on Mining and Metals) actively support and recommend work towards risk assessment of all metals .

REACH is essentially a risk assessment process. Risk assessment addresses the equation that only the combination of hazard (toxicity) and exposure (to humans or the environment) leads to a risk that must be addressed by regulators.

A commitment to risk assessment and research on toxicological and environmental effects of all applications of metals is important to ensure their maintained use. Such work is potentially very costly and may usually be done on a cost-benefit basis. For this reason it is possible that lower tonnage uses or substances are not considered to be of sufficient priority to include in the risk assessment or the registration for REACH.

Many metals (Al, Cd, Cr, Co, Ni, Sb, Pb and Zn) have all already begun international risk assessment projects, many of which are well advanced. The possibility of carrying out a worthwhile risk assessment depends on the availability of data on areas of use. Other non-ferrous metals such as Pb, Zn, Ni and Cu have the benefit of statistics availability from their respective study groups, have already initiated risk assessments, and have funded human health and ecotoxicological studies for that purpose amounting to $3-5 million each.

Two international projects are also addressing the need for methods of assessment relevant to the specific properties of metals as opposed to the methods used in REACH which are generally based on treatment suitable for organic chemicals.

The MERAG project addressed assessment methods for environmental exposure. This project has recently been completed and several fact-sheets are available on this website: http://www.euras.be/eng/project.asp?ProjectId=67

The HERAG project aims to address issues of human health assessment. This project has been running for several months. Guidance fact-sheets are not yet available but general information can be found here:
http://www.herag.net/

Specific Areas of Concern for the Metals Industry
Eurometaux represents the European non-ferrous metals industry and co-ordinates lobbying on the draft REACH proposal. A brief summary of the key issues can be found here:
http://www.eurometaux.org/files/REACHProt-160035A.pdf

In summary, it is hoped that changes can be made to the draft regulation to assist the metals industry by:

- Exempting minerals, ores and concentrates (other raw materials such as oil have been exempted)
- Exempting secondary feedstock materials (as such materials are extremely complex and unpredictable mixtures)
- Reducing the requirements on massive forms of metal (as has been done for polymers)
- Acknowledging that alloys have particular properties and should be regarded as special preparations
- Allowing risk-based prioritisation for assessment (based on exposure, volume and hazard) rather than the sole use of volume-based prioritisation

The Case of Alloys
Interpretation of the effects of REACH on alloys is complex. In the normal case, alloys are considered as a downstream use of the metals (i.e. 'substances', as REACH terms them) from which they are made. Alloys must therefore be included in the assessment of the individual alloying metals and information on the potential exposure of humans and the environment must be provided.

Let us take an example of an alloy made from metal A and metal B. The alloy AB would currently be assessed by combining the toxicological and ecotox properties of metal A and metal B. This does not always provide a realistic estimate of the properties of alloy AB in which one substance may be more reactive than the other.

If metal A is a substance of potentially high concern, then any alloy containing A may also be classified as a high concern. However, let us imagine that alloy AB contains 10% of A and that A is less reactive than B. In this case, it may be that A is less readily available to the environment, maybe through low corrosion or dissolution rates, and the actual risk from 10%A is much lower than the assumed 10%.

Parts of the metal industry are proposing a series of dissolution test for alloys to be carried out in a range of synthetic body fluids which will determine the 'true' effective concentration of each metal within an alloy. This will provide an improved scientific method of assessment for the classification of alloys as downstream uses under REACH.

Some other issues and areas of uncertainty exist:

- If metal B is a low tonnage substance only produced at levels below e.g. 1000 tonnes per annum in the EU then the registration of that substance may not be required for several years and even then, only a low level of information may have to be made available.
- If metal B is not produced or imported into the EU as a pure metal form and only as an alloy then difficulties may arise. Metal B will not be registered under REACH directly and toxicological information on that substance will therefore not be available.

It seems quite possible then that the importer of alloy AB into the EU will also have to carry out the registration of the substance metal B itself if that alloy is imported in large quantity (specifically above 1000 tonnes per annum).

EXAMPLE FROM THE TIN INDUSTRY

As has been discussed in this paper, materials such as tin are more and more often assessed by consumers and legislators on the basis of sustainability. For this reason an industry strategy on the issue has been developed by ITRI-Tin Technology and its member companies in order to deal effectively with impending legislation and competition from alternative materials.

The Industry Collaboration
ITRI member companies have agreed to charge a special levy of US$5 per tonne on all tin sales from January 1st 2005 and expect that all other tin producers will participate by collecting a similar levy for this essential work. Funds raised by the levy will be ring-fenced and managed by ITRI and will be directed towards funding of external projects that will contribute to the increased understanding of the environmental, scientific, social and business issues which make up the complex issue of sustainability.

Those producers participating in the programme will benefit from increased data availability, improved image and continued access to the marketplace. Studies funded by the environmental levy will be available to all participating tin producers and will be an essential part of data dossiers required to gain authorisation from EU regulators for metal sales from 2007 onwards.

Data will not be available to producers who do not participate in the programme. Non-participating producers run the risk of either needing to generate their own data, at high cost, or being excluded from the EU (and other) markets in the near future.

Members of ITRI are strongly committed to the concept of sustainability and have taken this leadership role to ensure the future of tin and those whose livelihoods depend upon it. Current ITRI members include Malaysia Smelting Corp Bhd (Malaysia), PT Koba Tin (Indonesia), Minsur SA (Peru), PT Timah (Indonesia), Thailand Smelting and Refining (Thailand), Sons of Gwalia Ltd (Australia), CESBRA (Brazil), Metallo-Chimique NV (Belgium), Bluestone (Australia) and Yunnan Tin (China).

ITRI's research organisation Tin Technology is dedicated to developing and supporting markets for tin-based technologies and will be the focal point for the entire programme. Tin Technology provides a unique link between producers, consumers and other interested parties such as legislators and NGOs, and will be organising industry-wide initiatives to deal with the relevant issues.

The Sustainability Project
Tin is a versatile substance which has an important role to play in many environmentally friendly technologies. The metal, and its inorganic compounds, are generally considered to be of low toxicity but work is necessary to demonstrate clearly and scientifically that fact in more detail than ever before. Consumers now demand not only a low cost, reliable product but one that they know has the minimum impact on the environment and health.

There is very little published information on aspects of tin production, use and disposal relevant to sustainability. Many preconceptions and perceptions of the industry and the metal itself arise from general public ignorance and lack of available information.

This materials stewardship project began in January 2005 and encompasses a number of activities aimed at demonstrating the safe production, use, re-use and recycling of the metal and its inorganic compounds. It will generate information to increase the understanding of the tin industry and the many vital applications of the metal, and will improve the scientific understanding of the interaction of tin with man and the environment.

Several Governments are introducing regulations that promote the use of 'safe' chemicals and materials that can be easily recycled. The tin industry is committed to meeting the ambitions of those societies and is planning a long-term programme of work on risk assessment. Understanding the hazard and risks posed by any metal in the environment is a key factor in progress towards sustainability. A commitment to risk assessment and research on toxicological and environmental effects of all applications of tin is vital for the continued use of all alloys and chemicals.

ITRI is already working to prove scientifically the safety of long-established applications of tin under the environmental principle of 'producer responsibility'. For example, although tin has been used in tinplate cans in contact with food for over 100 years, scientific studies have recently been performed on behalf of the tin industry to demonstrate categorically the safety of this use.

A full understanding of the applications of tin and the use supply chain is required in order to perform a risk assessment of those uses. Another part of the project is therefore designed to provide a complete understanding of the tin industry in order to illustrate benefits, developments and improvements in terms of sustainability. The initial programme will include gathering statistics on reserves, consumption and recycling, generating life-cycle inventory data, and estimating social and economic benefits of the industry.

FINAL COMMENTS

All industries should aim to generate the type of information described in this paper. This information must also be in a form that allows it to be used to provide a complete picture of the industry's activities and the safety of its products in an ever more transparent manner. Only in this way will it be possible to deal effectively with all the developing questions and requirements of regulators, and to avoid overemphasis on perhaps one negative aspect of an industry's business.

The net effects of all factors of sustainability need to be addressed and considered.

MEMBER COMPANY NEWS

The resignations of New Millennium and Nippon Chemi-con were announced. The membership of Daesung was terminated.

Ten new members were elected:

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EPCOS / KEMET
In December Kemet confirmed its October announcement that it was acquiring the tantalum capacitor business of EPCOS. It intended to continue production in Evorá, Portugal, but would discontinue manufacturing in Heidenheim – equipment purchased there would be shipped to China.

Tertiary Minerals
On December 7th Tertiary announced a preliminary agreement with two leading Saudi Arabian companies to fund the further development of the Ghurayyah deposit.

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