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TANTALUM-NIOBIUM INTERNATIONAL STUDY CENTER

PRESIDENT'S LETTER

Our General Assembly held in Kyoto in October was a lively and interesting meeting, well attended in spite of the current state of the industry, which is less than vigorous. I should especially like to thank the people of Nichicon for organising a tour of their tantalum capacitor plant at Adogawa, and also the ten Japanese member companies which sponsored the splendid Gala Dinner. The speakers who contributed to the technical programme were to be congratulated on the high quality of their papers, both in terms of content and presentation. The city of Kyoto provided a fine backdrop to our meeting, with historic and ancient temples, gardens and palaces alongside wide avenues and bright modern buildings.

Dr Axel Hoppe of H.C. Starck GmbH finished his term of office at this Assembly, and on behalf of the association I thank him for steering the T.I.C. through a year which has not been an easy one. We are also grateful to his colleagues at H.C. Starck - V Tech for their support in arranging the meeting.

Now our thoughts begin to turn to the Forty-fourth General Assembly, which will be held in Lisbon, in Portugal, in October 2003 as part of a meeting from October 12th to 14th, based at the hotel Le Meridien Park Atlantic. The plant tour will be a field trip to Evorá to visit the capacitor factory of my own company, EPCOS.

I call on the readers of this Bulletin to propose technical papers for the programme to be given at the meeting in Lisbon. We need a range of papers to extend the audience's knowledge of tantalum and niobium, so please give this matter some serious thought and send us your suggestions for speakers and topics, from member companies but also from suppliers, clients, or associates. We hope to hear from you and we welcome your ideas.

Along with greetings for this festive season, I send you my best wishes for the New Year of 2003, and let us trust that it will be a good year for our industry and the world around us.

Josef Gerblinger, President

CONTENTS

ASSEMBLY IN KYOTO

The Forty-third General Assembly of the association was held on Monday October 7th 2002 in Kyoto, Japan. The event opened on Sunday October 6th with a cocktail reception for all delegates and guests and those accompanying them, over 240 people in all.

Following the business meeting of the T.I.C. on Monday morning, an excellent programme of technical presentations was offered during the rest of the day. The paper by our Technical Promotions Officer is printed in this Bulletin, other papers will be included in the next issues.

In the evening a fine Gala Dinner was sponsored by ten of the member companies of the T.I.C. in Japan, with entertainment of traditional dance and music to delight both visitors and local residents. We should like to thank these companies for their support of the event:

Nichicon
Cabot Supermetals
Fujitsu Media Devices
Hitachi AIC
Matsushita Electronic
Mitsui Mining & Smelting
NEC Tokin
Nippon Chemi-con
Sanyo Electronic Components
H.C. Starck-V Tech

On Tuesday a large group was welcomed at the tantalum capacitor plant of Nichicon at Adogawa for a tour of the plant. The visit had been most carefully prepared by Nichicon staff, with minute attention to detail, and coherent explanations of each process. For those who had not seen a capacitor plant before, this was a revelation, with its quiet hum of automated machinery and the amazing output of components neatly organised for immediate use by the customer. The T.I.C. arranged lunch at a nearby hotel on the shores of Lake Biwa, as well as transport to and from the factory.

Sightseeing tours of Kyoto and Nara, with an informative English-speaking guide, were enjoyed by all who took part.

Forty-fourth General Assembly

The next General Assembly meeting will take place in Lisbon, Portugal, from Sunday October 12th to Tuesday October 14th 2003

GENERAL ASSEMBLY

The General Assembly of members approved the Minutes of the Forty-second General Assembly, and the audited accounts for the year ended June 30th 2002. Ten companies were elected to membership, and four resignations were accepted (see Member Company News).

Dr Axel Hoppe, H.C. Starck GmbH, completed his term of office as President of the association. Dr Josef Gerblinger of EPCOS was elected to succeed him for the coming year.

Mr Charles Culbertson II and Mr Yoichiro Takekuro had resigned from the Executive Committee during the year: the T.I.C. thanked them for their service. Mr David Reynolds, Kemet, was elected to the Executive Committee, and the other members were re-elected: Mr Tadeu Carneiro, Dr Josef Gerblinger, Mr Michael Herzfeld, Dr Axel Hoppe, Mr John Linden, Mr Peter Maden, Mr William Millman, Mr Thomas Odle and Mr Yeap Soon Sit.

TECHNICAL PROGRAMME

The current state of the Japanese economy and industry policy of Japanese government
by Mr Hiroki Ishigaki, Nonferrous Metals Division, Manufacturing Industries Bureau, Ministry of Economy, Trade and Industry (METI)
Mr Ishigaki discussed the position of Japan's electronics and IT industries in 2001 and forecasts for 2002. The strategies being instigated for reviving industrial competitiveness, with particular reference to research and development in nanotechnology and materials, were described.

Tantalum and niobium – a review of industry statistics
by Mr Ed Mosheim, Technical Promotions Officer, T.I.C.
The data collected by the T.I.C. were presented graphically, and comments were made on the trends observed. (Mr Mosheim's paper is printed in this Bulletin.)

Issues in anti-oxidation coating of niobium-based superalloys
by Professor Toshio Narita, Hokkaido University
The creation of a duplex layer coating for these superalloys using nickel and rhenium subsequently treated with aluminium and chromium was found to be very effective in preventing degradation of the superalloy surface at high temperatures.

Status of niobium-based superalloys development
by Dr Akio Kasama, JUTEM – Japan Ultra-High Temperature Materials Research Center, now at the Department of Materials Science and Technology, Kurume National College of Technology
Dr Kasama reviewed the development in mechanical properties of niobium-based superalloys which resulted from a six-year research project, and the prospects for further improvements.

Alternative reduced tantalum powders
given by Dr Karlheinz Reichert, H.C. Starck GmbH
Dr Reichert introduced an advanced tantalum powder for capacitors prepared by a new magnesium vapour reduction process.

The effect of metallurgical properties of tantalum target on sputtering performance
by Mr Ichiroh Sawamura, Innovative Materials Development Center, Nikko Materials Co., Ltd
Tantalum films formed by sputtering are used in microchips as a barrier layer against copper diffusion. The conditions required for success were discussed by Mr Sawamura, whose company produces copper foils, sputtering targets and compound semiconductor wafers.

The development of solid organic polymer niobium electrolytic capacitor
by Mr Koichi Mitsui, Director of Engineering, Nichicon Corporation
The use of niobium in capacitors instead of tantalum is the subject of various fields of research: Mr Mitsui described the approach and achievements of Nichicon.

Tantalum supply chain and problems of management
by Mr David Paull, General Manager – Business Development, Sons of Gwalia
An analysis of the supply chain in the tantalum industry was made by Mr Paull, who recommended improvements in communication which should remedy the weaknesses disclosed by recent events.

Tantalum capacitors – applications review
by Dr Philip Lessner and Mr John Prymak, Kemet
The performance of tantalum capacitors has made them the component of choice for many applications, and Kemet explained why they should maintain this position.

TANTALUM AND NIOBIUM A REVIEW OF INDUSTRY STATISTICS

by C. Edward Mosheim, Technical Promotions Officer, Tantalum-Niobium International Study Center. This paper was presented at the meeting associated with the Forty-third General Assembly, held in Kyoto on October 7th 2002.

INTRODUCTION

The Tantalum-Niobium International Study Center collects industry statistics that are consolidated to track mining, processing, and shipments of niobium and tantalum products in various forms, including chemical intermediates. The data are collected semi-annually from the member companies, and reported on the same basis to the membership.

A number of changes have recently been made to the data collection process in comparison to previous years. Most involve a renaming of categories to reflect current industry definitions or separation of a specific category into two distinct descriptive entities. These modifications were implemented beginning with the first six months of 2001. The graphs being presented in this article contain 18 months of these re-defined categories. The categories of niobium chemicals and vacuum-grade ferro- and nickel-niobium are presented in separate graphs for the first time.

It is important to note that the niobium and tantalum statistics are presented in graphical form with the quantities designated either as pounds of the contained metal or as pounds of contained metal oxide. The Y-axis labelling provides this information in each graph along with the definition of the units shown in parenthesis. The latest data representing the period of January 1st through June 30th 2002 are shown only as a six-month statistic. None of the six-month statistics have been doubled to provide an estimate for the year 2002 due to the current period of volatility, especially for tantalum.

It should also be noted that the year 2002 marks the 200th anniversary of the discovery of the element tantalum by Anders Gustav Ekeberg, a Swedish chemist. He found this new element in a tantalite specimen from Kimito, Finland and in a sample of yttrotantalite from Ytterby, Sweden. The actual identity of tantalum was confused for about 40 years due to the similarity of its properties to those of niobium (columbium) and the difficulty of isolating pure compounds. Heinrich Rose, during the period 1840 to 1845, was able to establish a firm identification of these two elements, naming them columbium and tantalum. Marignac was the first to develop a commercially acceptable separation scheme based on the differences in solubility of the fluoride complexes of the two elements. Siemens and Halske developed the first commercial use of tantalum. Tantalum was used as 0.05 mm diameter filament wire in the incandescent lamp during 1902 through about 1911. The development of equivalent tungsten technology quickly replaced the use of tantalum.

It was during the 1920s that Clarence Balke, working in the Fansteel laboratories, developed and patented the sodium reduction process for the production of pure tantalum metal powder. The availability of the pure metal and the systematic development of the properties of the element led to applications for rectifiers and a replacement for batteries in the early radio systems. The technology advances eventually led to its use in capacitors, corrosion resistant equipment, spinnerets for the production of synthetic fibres, and tantalum carbide for cutting tools.

TANTALUM RAW MATERIALS PRODUCTION

Tantalum-bearing minerals are found predominantly in Australia, the tin belt of Southeast Asia, Brazil, Canada, and in Ethiopia, Congo-Kinshasa, Rwanda, Burundi, Uganda, and other countries in Africa. Resources also occur in a number of areas in China, and in the former Soviet Union. The area of Southeast Asia, primarily Thailand and Malaysia, was the source of high-grade tin slags (10 to 15% tantalum oxide) in the past resulting from the processing of cassiterite ores for the extraction of tin. These are no longer available. Low grade slags containing 4% or less tantalum oxide (with some less than 2%) have been available in the past due to the high level of tin production in that area, but those resources are limited today in terms of new production. Excavation of old slag dump areas and reprocessing those materials has made available about 500 000 lb of contained tantalum oxide per year to this industry.

The only high volume mining operation is the Sons of Gwalia mines, headquartered in Perth, Western Australia. The Greenbushes and Wodgina mines, located in the southern and northern extremes of this State respectively, are the world's leading producers. Capacity expansions have brought production levels up to a combined output of 1 797 879 lb of tantalum oxide in mineral concentrates during the first six months of 2002, or almost 3.6 million lb on an annualized basis. Most other mining operations are processing material at levels not exceeding 250 000 lb per year of contained tantalum oxide as a mineral concentrate.

The production in the central African countries of Congo-Kinshasa, Rwanda, Burundi, and Uganda during this recent period appears to have dropped considerably, due not only to the exposure of the illegal mining inside National Park areas by alluvial miners that were under the control of renegade militia, but also to the severe drop in demand for spot ore purchases. Significant quantities were reported to have come out of that four-country area during the time of reported high consumption in 2000 and extending into the early part of 2001. There are no reliable data on production.

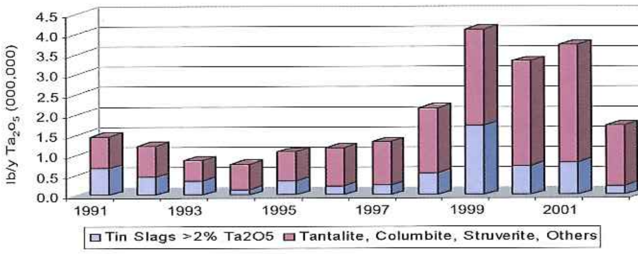


Figure 1: Tantalum raw material production

Actual data for the first six months of 2002 are shown in Figure 1. The first half of 2002 shows that the production of mineral concentrates reached 1.507 million lb of tantalum oxide in comparison to 1.357 million lb in the previous six months. A total of 211 000 lb of tantalum oxide in tin slag was also produced in comparison to the 270 000 lb reported during the previous six month period. The trend suggests that a total in excess of about 3.4 million lb of tantalum oxide in raw material production should be expected for the entire year.

It should also be stated that except for Sons of Gwalia in Australia, the Tanco mine in Canada, and the Kenticha Mine in Ethiopia most small mining operations do not report production data to the T.I.C. since they are not members. Some of the production data from those mines are obtained through member trading companies which purchase the material, but obviously some of the production from small mines is not counted in the 'production' section.

TANTALUM PROCESSOR RECEIPTS

Tantalum processor receipts are reported from two different sources. They are mineral concentrates plus tin slag and secondary sources containing tantalum, such as chemicals, scrap, ingot, etc., or any other tantalum bearing material that is considered to be feedstock by a processor. The mineral concentrates category could include receipts from member and non-member trading companies as well as mineral concentrates purchased directly from small mining operations that are not members of this organization. These receipts should contain a high percentage of the tantalum raw materials not reported in the tantalum raw materials category.

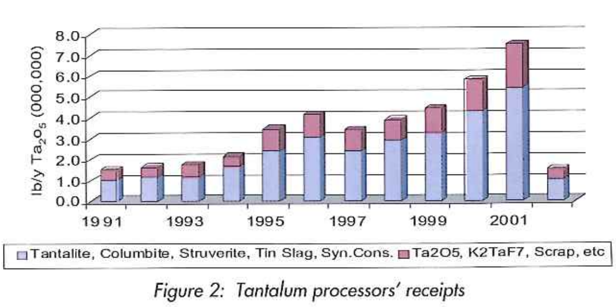


Figure 2: Tantalum processors' receipts

Total tantalum processor receipts show a significant reversal in the trend established during the previous five years (see Figure 2). The first half of 2001 saw a total of almost 4 million lb of tantalum oxide received in mineral concentrates plus secondary materials compared to about 3.5 million lb for the second six months of 2001. The first six months of 2002 contain a reported 1.5 million lb of receipts of tantalum oxide by processors. This is a drop of 57% from the second half of 2001 to the first six months of 2002. Expectations are for similar quantities for the balance of the year.

An examination of a chart of tantalum ore/tin slag production versus processor receipts (Figure 3) provides some startling comparisons that accentuate the drastic drop in demand for tantalum materials.

In all of the years between 1991 and 2001, the ore plus slag processor receipts were greater than the indicated production by those miners and traders that report data to the organization. The total processor receipts were always significantly greater than the ore plus slag production figures. For the first time in this 12 year period, the first half data of 2002 show that total processor receipts are less than reported raw material production

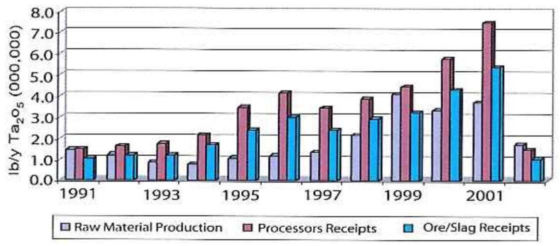


Figure 3: Production of tantalum ore and slag versus processors' receipts

and actual raw material receipts are only 66% of raw material production. Any 'excess' raw materials are probably being used to replenish normal above ground inventories that were depleted during the period of excessive demand.

PROCESSOR SHIPMENTS – TANTALUM

The categories of data collection for processor shipments have been modified to reflect changes in the industry and also to place additional emphasis on growing market segments in terms of product shipments. The category previously known as 'Powder/Anodes' is now designated as 'Capacitor Grade Powder'. The category previously known as 'Tantalum oxide, potassium tantalum fluoride, and other chemicals' is now designated as 'Tantalum chemicals'. The category known previously as 'Tantalum alloy additive' has been changed to 'Tantalum ingot' and materials that have been previously been placed in that category are now reported under either 'Mill products' or 'Metallurgical powder, unwrought metal, scrap, other'.

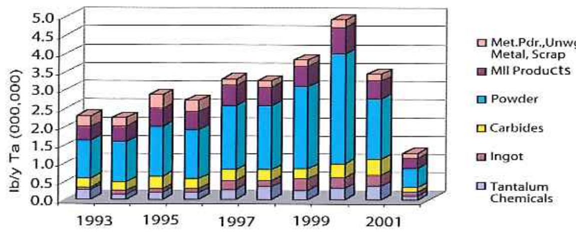


Figure 4: Processors' shipments - tantalum

Figure 4 provides a comparison of the tantalum product shipments of each data collection segment up through the first six months of 2002. It is obvious that the greatest impact on reduced demand has come from the capacitor powder segment while Figure 5 illustrates the overall reduction of demand in total. A 64% reduction in total tantalum shipments occurred from the first half of 2001 to the second half of the year, followed by another 5% reduction from the second half of 2001 through the first half of 2002. The impact of the downturn was felt by each segment in turn, either in the second half of 2001 or delayed until the first half of 2002. These changes can be seen in the graphs of the shipments for each category of reported data.

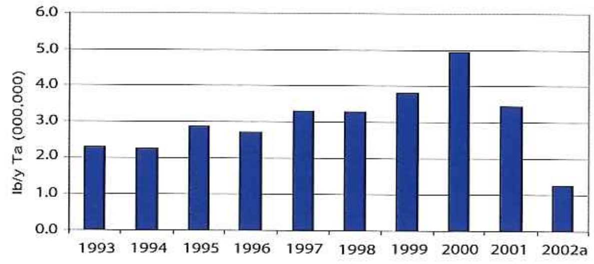


Figure 5: Total processors' shipments - tantalum

CAPACITOR GRADE TANTALUM POWDER

Shipments of tantalum powder for capacitor applications were down 43% from 2000 to 2001 and would be down another 41% on an annual basis from 2001 to 2002. This is clearly shown in Figure 6. The shipments (on an annualized basis) represent a drop from about 3.0 million lb in 2000 to only perhaps 1.1 million lb in 2002.

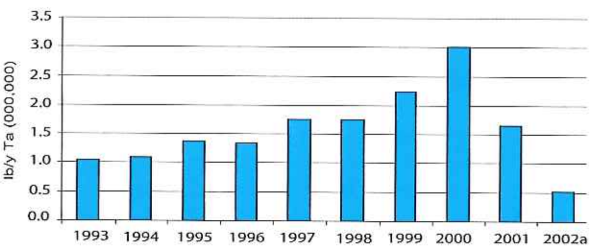


Figure 6: Processors' shipments – tantalum capacitor powder

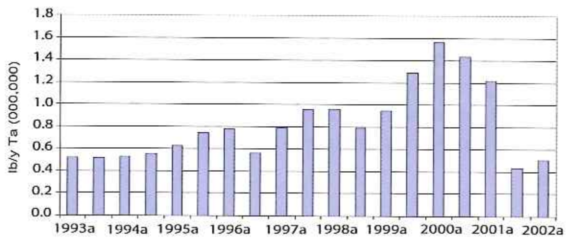


Figure 7: Processors' shipments – tantalum capacitor powder (six-monthly)

Figure 7 shows the same data for processor shipments of tantalum powder, but on a six-month basis, the time frame for the data collection process. The tantalum capacitor powder normally represents about 60 to 65% of the total tantalum shipments to world markets. In the second half of 2001, it represented only 32% with a slight increase to 40% in the first half of 2002.

The dramatic increase in demand during 2000 up through the end of that year and into the first half of 2001 was the result of double and triple ordering of components for circuit boards, which affected not only tantalum capacitors but passive components in general. The fear of a shortage of tantalum developed when the industry had difficulty meeting these unrealistic demands for product, driving 'spot prices' of raw materials to their highest level in history followed by a similar escalation in prices for capacitors and other passive components in general.

This phenomenon has been widely reported in the electronic press during 2000 and 2001. The downturn during the first six months of 2001 has been dramatic. It has resulted in a period of 'inventory reduction' throughout the entire manufacturing pipeline, which is continuing into the second half of 2002.

All evidence strongly suggests that a tantalum shortage never existed.

Tantalum capacitors find application in circuitry for cellular phones, computers, video and still cameras, entertainment systems, and automotive, military, and medical electronics.

PROCESSOR SHIPMENTS - TANTALUM INGOT

This category was previously known as 'Alloy Additive', however, the material was primarily ingot designated for alloy

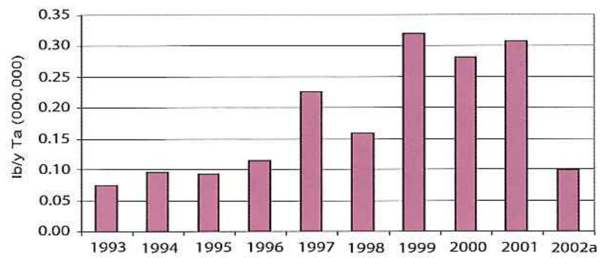


Figure 8: Processors' shipments – tantalum ingot

manufacture, with additional quantities of relatively pure tantalum scrap also being reported in this segment for the same applications. The name was changed to reflect more accurately a product sold by a processor instead of material designated for a specific application.

The shipments of tantalum ingot during 2001 were not affected by the perceived shortage of tantalum as over 300 000 lb were produced and shipped. The first half of 2002 now reveals a significant drop in shipments, resulting from the cancellation of many orders for land-based turbines used for power generation as well as air-based turbines for jet aircraft. The tantalum content of these alloys ranges from 2 to 12% with the most common being in the 5 to 9% range.

PROCESSOR SHIPMENTS - TANTALUM CHEMICALS

The six month period of July through December of 2001 shows shipments of tantalum chemicals to be about 202 000 lb of contained tantalum, while shipments in the first half of 2002 dropped about 42% to about 116 000 lb (Figure 9). The largest volume chemical is most probably tantalum oxide.

Tantalum oxide sees significant consumption in electronics, medical, optics, and as a sputtered film to form a capacitor in integrated circuitry. Lithium tantalate is used in SAW filters. The oxide is a component of an yttrium tantalum formulation that is applied as a layer in the composition of X-ray films providing image enhancement with a reduction in X-ray intensity. It is also utilized in ceramic capacitor formulations.

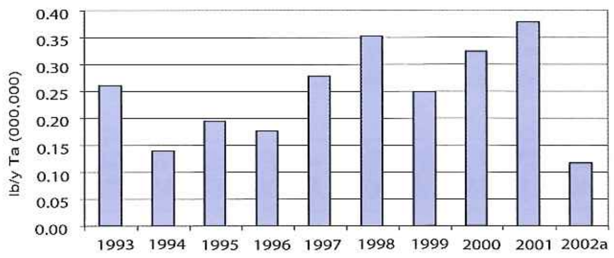


Figure 9: Processors' shipments – tantalum chemicals

PROCESSOR SHIPMENTS - TANTALUM CARBIDE

Tantalum carbide (Figure 10) has exhibited a growth rate of about 5% per year. Shipments during 2001 did not indicate any downturn in demand as shipments during the July through December 2001 period actually increased over the previous six-month period. The first six months of 2002 brought a different picture, with a drop in shipments for tantalum carbide totalling 38%. This material is an additive to cemented carbide formulations used in the preparation of tool steels for cutting steel and cast iron machining.

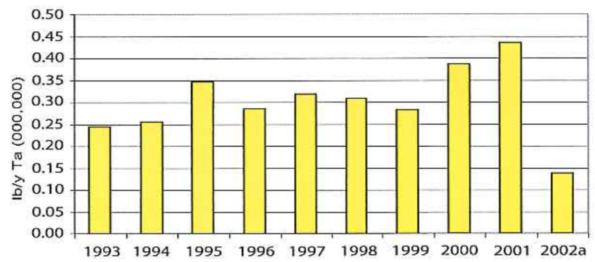


Figure 10: Processors' shipments – tantalum carbide

PROCESSOR SHIPMENTS - TANTALUM MILL PRODUCTS

The mill product shipments (Figure 11) are affected by the requirements for the capacitor industry due to the use of tantalum wire as the lead wire in the capacitor anode, and the use of tantalum furnace shielding and sintering trays and other fixtures in high temperature anode sintering furnaces. One would expect any downturn in the capacitor powder shipments to also reflect the same behaviour in the mill products segment.

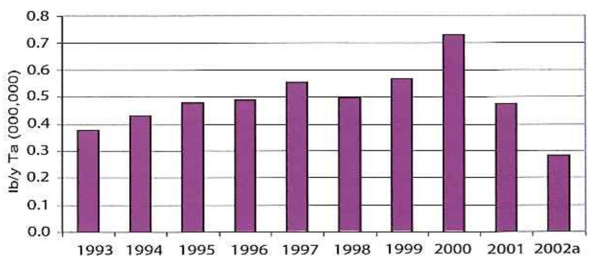


Figure 11: Processors' shipments – tantalum mill products

The shipments for the last three six month periods were 329 000 lb during January through June 2001, 148 000 lb in July through December 2001, followed by somewhat of a rebound to 282 000 lb in the first half of 2002.

About half of the tantalum in this category is wire used in the fabrication of the tantalum anode for capacitors. Mill products also include tantalum sputtering targets as well as sheet and other forms, such as piping and tubing for the fabrication of chemical processing equipment.

PROCESSOR SHIPMENTS - METALLURGICAL POWDER, UNWROUGHT METAL, SCRAP, ETC.

This area seems to be quite variable, with the use of these materials showing no discernible pattern in the shipments. It is conceivable that there are shipments of materials that are not being reported. Annual shipments range from about 175 000 lb to a maximum of 380 000 lb per year.

TOTAL TANTALUM RECEIPTS VERSUS PROCESSOR SHIPMENTS

A comparison of the total tantalum receipts by processors and their shipments during 2001 does not indicate a shortage of tantalum materials (see Figure 12).

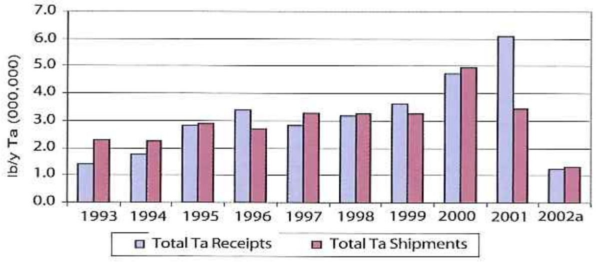


Figure 12: Total tantalum receipts versus total shipments – tantalum processors

This graph shows the difficulty faced by the tantalum industry. During 2001 there was an inventory build of 'raw materials' of approximately 2.6 million lb of contained tantalum. The contribution was 1.1 million lb in the first half of 2001 and an additional 1.5 million lb in the second half of 2001. The first six months of 2002 seem to indicate a return to what has been the 'normal' pattern seen during 1993 through 2000 comparing Processor Receipts and Processor Shipments.

The 2.6 million lb of contained tantalum probably represents a replenishment of the normal above ground inventories held by processors.

CONCLUSIONS - TANTALUM STATISTICS

The deterioration in demand for tantalum products appears to have bottomed during the first six months of 2002 with a return to levels not seen since the 1993-1994 period.

Evidence strongly suggests that overly optimistic forecasts, plus the double and triple ordering of tantalum capacitors during 2000, caused excessive demand on capacitor manufacturing, processing, and mining. The perception of a shortage was created which carried over into non-capacitor markets, such as high temperature alloys, further escalating demand for products. All market segments were affected with the greatest impact seen in the capacitor industry requirements for tantalum powder, wire, and furnace hardware.

Processor receipts of an 'excess' of about 2.5 million lb of tantalum will probably be utilized to replace normal above ground inventories of raw materials at processors' facilities that were consumed during the escalation of demand during 1999 and 2000.

There was no shortage of raw materials. In addition, expansions were completed throughout the entire manufacturing chain to meet real - and even the excess - demands.

The general deterioration of the economy worldwide added to the reduction of demand for products.

It is difficult to predict how soon the electronics business will return to some level of normalcy. A period of extreme demand normally results in a search for substitute materials. Realistic and reliable forecasts of capacitor demand are needed to project tantalum requirements throughout the entire manufacturing chain for all market segments if stability is a common goal.

NIOBIUM ORE PRODUCTION

Pyrochlore concentrates, mined in Brazil and Canada, supply about 90% of the world's niobium requirements. Additional niobium-bearing raw materials, including columbite, are being furnished from mineral concentrates obtained primarily for their tantalum content in Africa, Australia, Brazil, China and Canada, with additional quantities being obtained from the tin slags accumulated in Southeast Asia and Brazil. The breakdown of the niobium content supplied by the tantalum-bearing minerals is estimated at about 7.5% from columbite and the remaining 2.5% from struverite, tantalite, and tin slags.

The first six months of 2002 saw the niobium oxide content of mined ore concentrates increase to 54.0 million lb from 50.8 million lb of contained niobium oxide during the last six months of 2001 (Figure 13).

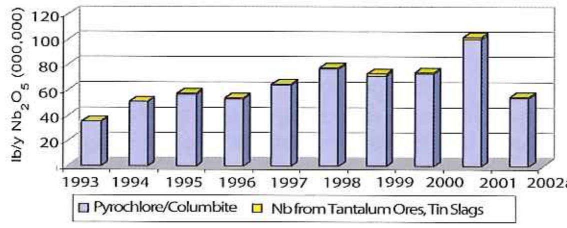


Figure 13: Niobium raw material production

Expansions at the Araxá Mine in Brazil have been completed and demonstrated during 2001. In addition, the mining facilities of Cambior in Quebec, Canada have also been expanded by 30%.

The yellow section on top on each of the columns represents the niobium oxide content contributed by that found in tantalite, columbite, struverite, and tin slag. It is a small percentage of the total and is managed by the processors of those materials for tantalum. It is not a competitive material as a feedstock for the HSLA ferro-niobium (FeNb) product.

NIOBIUM ORE VERSUS NIOBIUM IN PROCESSOR SHIPMENTS

The same companies that mine the ore, namely, CBMM and Mineração Catalão de Goiás Ltda in Brazil, and the Cambior Corporation in Canada, carry out the conversion of pyrochlore to HSLA ferro-niobium. The largest columbite processor is Paranapanema in Brazil. Both pyrochlore and columbite are upgraded to a 55 to 65% niobium oxide concentrate before conversion into FeNb.

A comparison of niobium ore receipts up through 2001 (converted into contained-Nb from Nb_2O_5) shows that there is a reasonable balance between receipts and shipments. For the first six months of 2002, mined ore contained 32.4 million lb of contained niobium compared to shipments of 27.8 million lb (Figure 14). This suggests that the mining capabilities of the expanded capacities are more than sufficient to take care of demand in the near term.

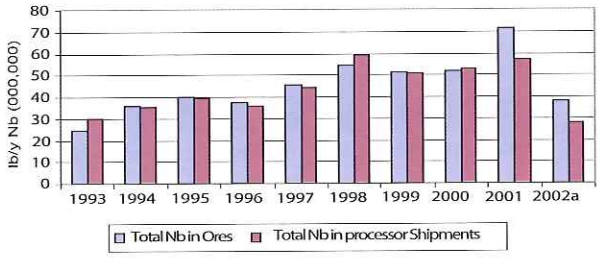


Figure 14: Niobium in ore versus niobium in processors' shipments

Shipments throughout the remainder of 2002 are expected to be similar to those achieved during the first half of the year.

PROCESSOR SHIPMENTS - NIOBIUM

The impact of the production and shipments of HSLA FeNb is readily seen in Figure 15. Assuming a repeat of the first six months of 2002 during the second six months, shipments are expected to reach about 55 to 60 million lb of contained Nb. Approximately 89% of the total Nb shipments are contained in HSLA FeNb. The remaining three categories comprise 11%, with the segment designated as chemicals and vacuum-grade FeNb representing 8.9% of those total pounds. Each of the four categories will be looked at separately.

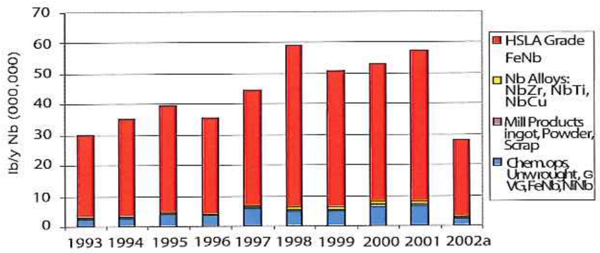


Figure 15: Processors' shipments - niobium

Interpretation of the same data as illustrated by the six-month plot in Figure 16 suggests that a growth rate of about 7% for niobium shipments is relatively consistent up through 1999 with perhaps some flattening of the growth rate afterward. The only categories impacted by the recent downturn seem to be those with those products utilized by the electronics and high temperature alloy industries.

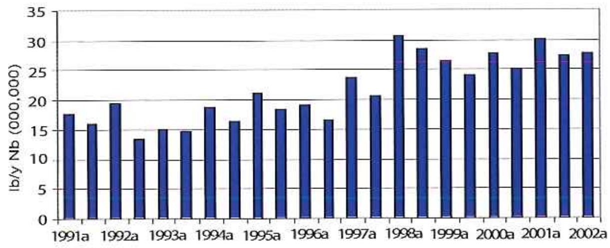


Figure 16: Processors' shipments – niobium (six-monthly)

PROCESSOR SHIPMENTS - NIOBIUM CHEMICALS, METAL, AND ALLOYS

Looking at the three market segments of product shipments exclusive of the HSLA FeNb, it is obvious that the chemicals/vacuum grade FeNb and NiNb/unwrought metal group is the largest volume category. The blue segment in Figure 17 represents a six month total of 2.4 million lb of contained niobium with 1.1 million lb of niobium as vacuum grade FeNb and NiNb at 60% Nb content, and 1.3 million lb of niobium as found in various chemicals, with the largest volume most probably being pure niobium oxide. The unwrought metal has been removed from this category and the data collected in the segment designated as mill products, ingot, alloys, and scrap.

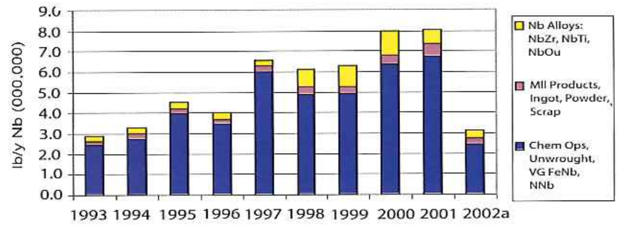


Figure 17: Processors' shipments – niobium chemicals, metal and alloys

PROCESSOR SHIPMENTS - HSLA GRADE FENB

The growth rate for HSLA grade FeNb (Figure 18) continues to average about 7.0% with the US and European markets consuming about 70% of the total production. The largest potential market is in China, the largest steel producing country in the world. The concentration of niobium in steel in China is only about 15% of that found in the US and Europe today. Annual shipments are projected at about 50 million lb of contained Nb in 2002.

Major applications are pipeline steel, the automotive industry, and micro-alloyed steels for structural requirements.

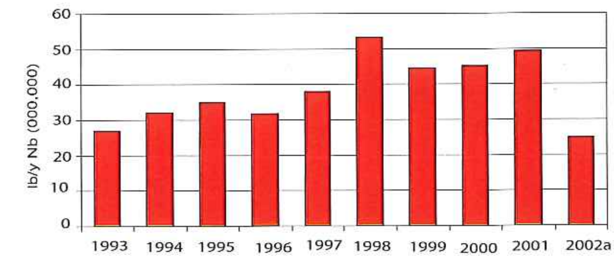


Figure 18: Processors' shipments – HSLA grade ferro-niobium

PROCESSOR SHIPMENTS - CHEMICAL COMPOUNDS, UNWROUGHT METAL, VACUUM GRADE FENB, NINB

Unwrought niobium is not included in this segment for the data representing 2001-2002 shipments. The data are strictly for niobium chemicals and vacuum grade alloys with almost 60% of the Nb values now being in the chemicals category due to the economic downturn in the alloy segment. The niobium chemicals segment is composed of such chemicals as niobium carbide, niobium oxide, niobium chloride, and possibly some organic compounds containing niobium, such as niobium ethoxide. (Figure 19)

Uses are found in optics with high index of refraction, ceramic capacitor formulations (MLCC), cutting tools, lithium niobate for surface acoustic wave filters (SAW), as well as other minor applications.

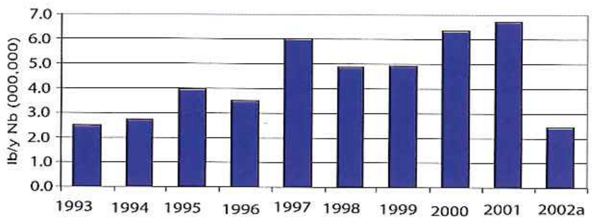


Figure 19: Processors' shipments – chemical compounds, unwrought metal, vacuum-grade ferro-niobium, nickel-niobium

The primary application for vacuum grade ferro- and nickel-niobium is for alloys used in the turbines for jet aircraft and land based power generation facilities.

These two groups have been separated with the data collection beginning in 2001.

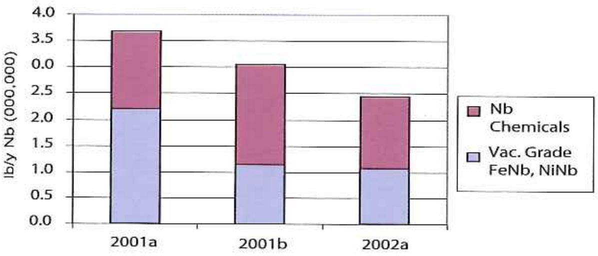


Figure 20: Processors' shipments – niobium in vacuum grade alloys and chemicals

These data show a 42% drop in shipments of the alloys in the second half of 2001. Chemicals do not seem to have been affected, but the data are not sufficient to draw any conclusions.

PROCESSOR SHIPMENTS - MILL PRODUCTS, INGOT, ALLOYS, SCRAP

The components of this segment (Figure 21) are generally used either as pure metal or as an additive to high temperature alloy formulations. The nominal growth rate is 15%.

The primary uses for pure metal are sputtering targets, cathodic protection systems, chemical processing equipment, medical applications, and jewellery. One of the largest uses for niobium in this category is for the production of superalloys, primarily in the family of inconels as well as niobium-based alloys for high temperature applications in both land and air-based turbines.

This category now contains 'unwrought niobium' in the 2001-2002 data but not in the prior years.

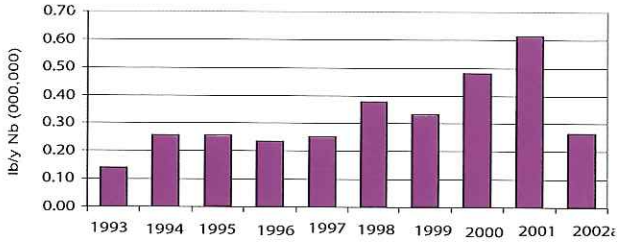


Figure 21: Processors' shipments – niobium in mill products, ingot, alloys, scrap

PROCESSOR SHIPMENTS - NIOBIUM ALLOYS (NBZR, NBTI, NBCU)

The estimated total annualized shipments for these alloys in 2002 are expected to exceed those of 2001. The Large Hadron Collider project near Geneva, Switzerland required 400 tonnes of contained niobium-titanium alloy over the 1998-2000 time period. The application is a 26 km diameter accelerator tunnel for the European Laboratory for Particle Physics, known as CERN.

The most common application for niobium-titanium alloy is for the superconducting magnets in the Magnetic Resonance Imaging Equipment (MRI) that is used to detect abnormalities in soft tissue. The alloy contains 53 to 54% Nb.

Additional applications are magnetic levitation (NbTi) and sodium vapour lamps (NbZr). Shipment patterns appear to be quite variable.

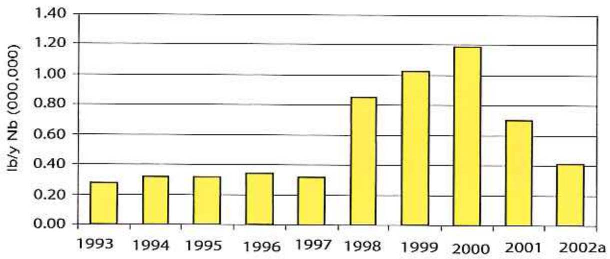


Figure 22: Processors' shipments – niobium in niobium alloys (NbZr, NbTi, NbCu)

SUMMARY - NIOBIUM

Worldwide demand for niobium products grew at an estimated rate of 6 to 7% per year up through about 1999. Beginning in 1999, demand on average appears to be relatively flat averaging about 55 million lb per year. Raw material availability is not a matter of concern since expansion projects in Brazil and Canada at existing mines have been completed and have demonstrated those capacity increases.

Additional pyrochlore resources are being evaluated in Africa and Canada, specifically, the Mabounié Deposit in Gabon and the Niocan Deposit in Oka, Quebec, Canada with targets of

4000 tonnes Nb and 2800 tonnes Nb per year, respectively, as HSLA grade FeNb. It is not known if and when these two deposits may be brought into production.

Shipments of HSLA grade ferro-niobium during 2002 are expected to reach the same level as shown by the 2001 data.

Shipments in the various segments indicate no significant downward trends, except for those categories where the final applications are in high temperature alloys. The 50% drop in shipments for vacuum grade ferro- and nickel-niobium and a possible 10% drop in the shipments for mill products, ingots, unwrought metal, and scrap indicate this.

Demand for superconducting and lighting alloys in 2002 is projected to equal or exceed the level of shipments exhibited during 2001. Overall demand for niobium-containing products remains strong worldwide with minimal impact seen from the economic slowdown.

NFPA STANDARDS

The US National Fire Protection Association has issued a new edition of NFPA 484 which includes a specific chapter on tantalum. 'NFPA 484 Standard for Combustible Metals, Metal Powders, and Metal Dusts – 2002 edition' was published with an effective date of August 8th 2002. Tantalum industry leaders worked together to develop the standards and contribute the new Chapter 7.

Anyone using or wishing to install equipment to process tantalum or who is building a new facility should refer to this standard for tantalum to provide proper design and installation and avoid fire and explosive conditions. Information includes storage, handling, dust collection, fire protection and day-to-day aspects of working with finely-divided metal particles, with the aim of providing a safe working environment for personnel and reducing the risk of damage to equipment and facilities. Recommendations are given for safe handling of powder not only of tantalum but also of other metals which exhibit similar behaviour, such as aluminium, magnesium or titanium, and also 'consolidated forms' whose processing by grinding or turning may produce powder or dust which might be combustible. The NFPA standards are widely adopted outside the US as well as within the United States, and all processors and users of tantalum materials should be aware of the provisions in this document.

'NFPA 86D Standard for Industrial Furnaces Using Vacuum as an Atmosphere' also applies to a number of processing steps in the manufacture of tantalum powder and other forms of the metal as well as anode manufacturing in the capacitor process, and is also relevant.

The NFPA web site at http://www.nfpa.org provides information on the Standards, availability, price and how to order copies.

UN REPORT

On October 15th 2002 a further 'Report by the Panel of Experts on the Illegal Exploitation of Natural Resources and Other Forms of Wealth of the Democratic Republic of the Congo' was submitted to the Security Council of the United Nations. The published report bears the number S/2002/1146.

IoM3 MEETING ON TANTALUM

The Institute of Materials, Minerals and Mining will hold its 26th Annual Commodities Meeting on Thursday January 23rd 2003 at the Geological Society, Burlington House, Piccadilly, London from 10a.m. and its subject this year is Tantalum.

Speakers include Ed Mosheim, the T.I.C.'s Technical Promotions Officer, Robin Andrews of Angus and Ross, Richard Burt of Cabot, David Rowe of H.C. Starck UK and Bill Millman of AVX. Other papers will come from the British Geological Survey, Wardell Armstrong, Roskill and Gartner Consultants. Lunch and a social evening with buffet supper and live music will complete the programme.

Registration forms and further details may be obtained from IoM3, 1 Carlton House Terrace, London SW1Y 5DB, fax +44 20 7451 7319.

DLA

The Defense Logistics Agency announced on October 1st 2002 that its FY 2003 Annual Materials Plan had come into effect. The amounts of tantalum and columbium (niobium) materials available are as follows, although by November 21st no announcement had been made of specific offerings or dates:

Columbium carbide powder	21 500 lb Cb
Columbium concentrates	560 000 lb Cb
Columbium metal ingots	20 000 lb Cb
Tantalum carbide powder	4 000 lb Ta
Tantalum metal ingots	40 000 lb Ta
Tantalum metal powder	50 000 lb Ta
Tantalum minerals	500 000 lb Ta
Tantalum oxide	20 000 lb Ta

On October 30th the Defense National Stockpile Center (DNSC) put out a notice requesting all who wished to remain on its list to be sent information regarding sales opportunities and awards should contact it. If you wish to be, or to remain, on the list you should contact the Office of Planning and Market Research, DNSC-M, by fax to +1 703 767 6528 without delay.

The next article on the history of tantalum has been held over for lack of space.

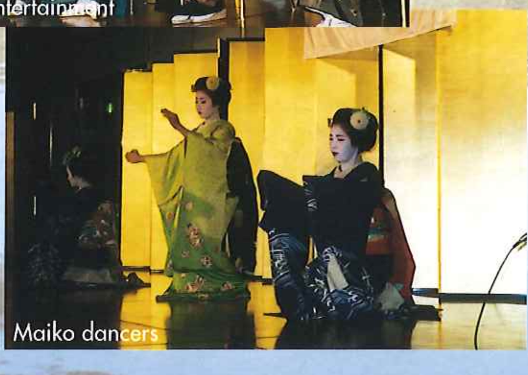

Enjoying the gala


Dr Axel Hoppe, President of the T.I.C.

Mr Ippei Takeda, Nichicon

Musical entertainment


Maiko musician talking to guests


Maiko dancers

MEMBERSHIP

The following companies were elected to membership by the Forty-third General Assembly on October 7th 2002:

Commerce Resources Corp

Suite 600, 789 Pender Street,
Vancouver,
British Columbia,
Canada, V6C 1H2.
Tel.: + 1 604 484 2700
Fax: + 1 604 484 2232
e-mail: info@commerce resources.com

Conghua Tantalum & Niobium

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Conghua City,
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e-mail: ctns@21cn.com

Duoluoshan Sapphire Rare Metal Co

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e-mail: DLS@DUOLUOSHAN.COM

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Cheshire SK10 2LP,
England.
Tel.: +44 1625 626 203
Fax: +44 1625 626 204
e-mail: info@tertiaryminerals.com

The following companies have resigned from membership:
Cluff Mining
Kennametal
Osram Sylvania
Vacuum Metallurgical Company

MEMBER COMPANY NEWS

Angus and Ross

In addition to continuing work on the Motzfeldt project in Greenland, Angus and Ross announced in September that it was about to be granted licences for two tantalite properties in the Rio Grande do Norte province of Brazil. Chief Operating Officer Mr Chris Parry expressed confidence that this would be a step towards the company's aim of becoming a significant low-cost producer of tantalum by 2005.

AVX

AVX released in October news of a range of niobium-based solid electrolytic ceramic capacitors which will 'fill the gap between higher-voltage tantalum caps and lower-cost aluminium electrolytics'. The 'Oxicap' series offers safe and professional reliability for uses involving high transient currents, says AVX.

Cabot/Kemet

Kemet announced on September 27th 2002 that it had received two rulings from the Massachusetts Superior Court on its contract dispute with Cabot Corporation. Cabot's argument that the agreement imposed upon Kemet any particular schedule for its purchases from Cabot was rejected by the Court, which ruled that the parties should attempt to agree on product mix, volumes and delivery periods for 2003. However, the Court dismissed Kemet's counterclaim that had alleged unfair and deceptive practices by Cabot during the negotiation of the supply agreement.

Cambior

On October 8th Cambior announced an increase in the mineral reserves of the Niobec mine. This increase of 21% in proven and probable mineral reserves from those identified at December 31st 2001 will extend mine life to 18 years at the current mining rate. Mineral reserves are estimated at 22 million tonnes at an average grade of 0.67% Nb_2O_5.

Sales in the quarter ended September were 371 tonnes of niobium in ferro-niobium, compared with 329 tonnes in the same quarter of 2001. This is 50% of the output of the Niobec mine.

Commerce Resources

Mr David Hodge has been appointed President of Commerce Resources, one of the companies just elected to membership of the T.I.C.; he is the firm's nominated delegate to the association. Mr Shaun Ledding was appointed to the board of directors at the same time.

Sons of Gwalia

The company's report on activities for the quarter ended September 30th 2002 showed that tantalum production was 742 328 lb Ta_2O_5 contained, whereas quarterly sales were 465 987 lb Ta_2O_5. Production had achieved its targets and forecasts. However, as a result of the 'current negative market and economic conditions' Sons of Gwalia said it had reduced tantalum sales for the year 2002/2003 to 2.0 million lb.

Subsequently on November 7th Executive Chairman Peter Lalor announced that production of concentrates would be reduced to approximately 2.2 million lb of Ta_2O_5 for the year ending June 30th 2003, compared with 2.4 million lb previously forecast. The high levels of production were exceeding market demand and would result in excessive inventory if production continued at the recent rate. Consequently earnings would fall, added the company.

Haddington International Resources

Tantalum raw material producer Haddington acquired a gold and copper project in Queensland in November, with a view to broadening its metals interests.

Metallurg

In November Metallurg reported a net loss of $5.25 million in the September quarter of 2002 on revenues of $108.6 million (net income of $0.1 million on revenues of $112.2 million in the same quarter of 2001). At the same time the company announced that Mr Alan Ewart had resigned as President and Chief Executive Officer, and that Mr Michael Standen had resigned as Vice Chairman of the Board of Directors and as a Director. Mr Heinz Schimmelbusch, Chairman of the Board, assumed the additional responsibilities of Chief Executive Officer, said the company, while Mr Arthur Spector became Vice Chairman. Mr Eric Jackson was appointed President and Chief Operating Officer. The new management team would continue to pursue operating profitability and 'build on its position as a leading performance materials company', added the company statement.

Silmet/Treibacher

Treibacher Industrie has acquired 25% of the shares of AS Silmet, and has secured an option on extending its share in Silmet to more than 50%. This partnership was finalised in August 2002 when the DG for Competition in the European Commission raised no objection.

H.C. Starck GmbH

H.C. Starck signed a non-binding letter of intent with the shareholders of InDEC B.V., ECN (Energy research Center of the Netherlands) and Planet Capital, all of The Netherlands, to secure a majority shareholding in InDEC. a fuel cell company. Starck 'intends to acquire a strategic and prominent foothold in the Solid Oxide Fuel Cell (SOFC) market'. Starck will bring to the venture its extensive experience in commercialising high-tech products.

Fuel cells can convert many gaseous fuels such as natural gas, green biogases and hydrogen in an efficient, environmentally benign and silent manner into electricity and heat. They are expected to contribute significantly to the reduction of carbon dioxide emissions for production of power and heat from carbon containing fuels, and in the long term are expected to form essential elements of the zero emissions hydrogen economy, says Starck.

Tantalum Australia

Tantalum Australia announced on October 2nd that it had signed its first tantalum sales contract with a Japanese customer. It hoped that continued negotiation would lead to a three-year agreement for quarterly deliveries beginning in 2003. The company had an existing contract for supply of tantalum concentrates to Thailand, and was also pursuing negotiations with companies in the United States, Europe, Russia and China. Tantalum Australia has patented a new processing technology (see Bulletin 110).

Tertiary Minerals

In November Tertiary Minerals reported the successful development and testing of an extraction and concentration process for the minerals from its Ghurayyah deposit in Saudi Arabia. SGS Lakefield Research had carried out the metallurgical processing tests, based on standard industry techniques of flotation and magnetic separation. Tantalum, niobium, yttrium and rare earths were recovered at rates considered commercially significant. The company also announced that it was receiving financial support from a firm which is a joint initiative of the UK Ministry of Defence and BAE Systems.

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