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TANTALUM-NIOBIUM INTERNATIONAL STUDY CENTER

PRESIDENT'S LETTER

Friends,

My predecessor as President of the T.I.C., Hubert E. Hutton, is a highly capable man who combines a decade of experience in the tantalum-niobium business with long-standing ties to the T.I.C. On behalf of all the member companies, I would like to take this opportunity to thank him once again for his untiring efforts during the difficult times of his term of office.

As during the past presidencies, the T.I.C. will continue to play an important role in meeting the challenges facing the tantalum and niobium industries in our changing world economy.

Business has clearly improved in the wake of the recession, which one can only hope has now been overcome. Nevertheless, a lot still has to be done to increase sales and to keep prices competitive and calculable in the long term.

Thus our main goal for the future must be to take an active part in stimulating ideas for new applications by working with end-users themselves and by promoting intensive cooperation at all levels - which means both inside and outside the T.I.C. organization. The Symposium in September 1995 in Goslar will without doubt offer an excellent forum for this kind of exchange.

This year's General Assembly in Aizu-Wakamatsu was a great success, and not only because of the interesting presentations; Nature herself was no less successful in producing magnificent autumn colours at this splendid setting for our meeting. These days spent in Japan - not least thanks to the hospitality of Showa Cabot Supermetals, Mitsui Mining & Smelting and Vacuum Metallurgical Company - will remain truly unforgettable.

My dear friends, Nature is not alone in her need to take a break at this time of the year. During the coming holiday season, we, too, will have the chance to recover from the strains of 1994. I wish all of you and your families a peaceful and merry Christmas and a healthy and successful 1995.

Sincerely,

Peter Kählert,
President

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CONFERENCE IN JAPAN

The annual meeting of the T.I.C. took place in the superb surroundings of the lakes and volcanic hills of Fukushima Prefecture, at the Nekoma Hotal amid the forest on the shore of Lake Hibara. The setting was wonderfully peaceful, and those present had an opportunity to enjoy the clear air, reflections in the calm water, and the gold and red of autumn leaves.

Hosts of the meeting were member companies Showa Cabot Supermetals, Mitsui Mining & Smelting and Vacuum Metallurgical Company, with the help and support of the Japan Society of Newer Metals.

The Thirty-fifth General Assembly was held on Tuesday October 25th, chaired by Mr Hubert E. Hutton of Sogem-Afrimet, the President of the T.I.C. The business of the association was carried out, including reports on the work of the Committee and of the Technical Adviser, and the approval of the audited accounts for the year ended June 30th 1994. Three companies were elected to membership: A&M Minerals and Metals Ltd, Tan Ceramics Ltd and Trademet S.A.: the members then numbered fifty. The T.I.C. was pleased to admit the first individual, associate member, and looks forward to receiving more applications for this category, as well as for full membership.

The resignation of Dr Harry Stuart from the Executive Committee was accepted, with thanks for all his work for the T.I.C. as President and Committee member. The other members were re-elected for a further term: Mr Robert Barron, Mr Jacques Hennevaux, Mr Hubert Hutton, Mr Peter Kählert, Mr John Linden, Mr Peter Maden, Mr David Maguire, Mr David Ratcliffe, Mr Yoichiro Takekuro and Mr Yeap Soon Sit. Mr Peter Kählert, of H.C. Starck GmbH & Co KG, took over as President at the end of the meeting, to serve for the coming year.

The high point of the social programme was the gala dinner on Tuesday evening, generously offered by Showa Cabot Supermetals and Cabot Performance Materials: a remarkable performance of Japanese drumming crowned the evening's entertainment.

On Wednesday participants visited the Higashinagahara plant of Showa Cabot Supermetals, where they benefited from a meticulously prepared tour of the tantalum facility. Another group visited the plant of Shotic.

The group of ladies accompanying delegates was treated to a taste of Japan, with tours of historic sites in the area, such as the castle of Tsurugajo, as well as visits to a lacquerware factory and a saké winery.

The Thirty-sixth General Assembly will be part of the **International Symposium on Tantalum and Niobium**, to be held in Goslar, Germany, from September 25th to 28th 1995: a most impressive draft programme was presented, which promises an appealing and wide-ranging conference. An informal meeting will take place in Brussels on April 25th 1995.

Technical programme

The scientific session on October 25th 1994 comprised the presentations listed in our Bulletin number 79, followed by a panel discussion on the Basel Convention and its effect on the tantalum and niobium industry.

As many as possible of these papers will be published in the quarterly Bulletin: the paper given on behalf of MITI and the overview by Dr Korinek are printed in this issue.

POLICIES ON NON-FERROUS METAL INDUSTRIES

by Mr Toshihiko Takahashi, Deputy Director, Non-Ferrous Metals Division, Basic Industries Bureau, Ministry of International Trade and Industry (MITI)

I am going to discuss briefly the industrial policy of the Japanese government and then talk about the non-ferrous metals subjects.

In my view the year 1994 is of great significance for Japan.

Firstly the significance refers to the historical implication of the fact that half a century has elapsed since the end of World War II. Japan has achieved its economic growth at a very high rate since the end of the War. However, we have begun to think that its societal systems that have sustained the evolution appear to have become no longer adaptable to the ongoing changes in international circumstances and in domestic situations after the past 50 years.

Another point of significance is the revolutionary changes worldwide. The philosophy to advocate and propagate liberal economics is still being supported in the world, but its centripetal allure has faded as a result of the Cold War termination and there is an increasing trend for countries primarily to pursue their own short-term economic benefit. Hence, the global situation has posed anxiety about the introvert tendency of economic policy in each country as evidenced by the upswing toward protectionism and controlled trade.

The third point rests on domestic problems. According to the IMF report, the world economy appears to be gaining solidity in the first half of 1994. Western Europe has begun to rise from one of the most serious recessions in the past 50 years. In Australia, the UK and Canada, the upturn of the economy is getting into gear. In the US, a high level rate of operation has been restored. In the meantime Japan has come into the economic adjustment process after the longest ever economically brisk period since the end of the War. Although some economic indicators show auspicious signs, economic recovery as a whole is still quite unpredictable.

In view of the vital importance attached to the future of the Japanese economy for stimulating the world's economic growth and its employment expansion, Japan's economic growth led by its domestic demand and modification of the structure of its economy and society to harmonize with international relationships are required.

For the foregoing reasons MITI is implementing measures such as (1) promotion of reform to create an affluent economic society open to the rest of the world, (2) furtherance of industrial restructuring through pioneering new economic fields and the like and (3) construction of harmonious international economic relationships and dealing with global issues.

Here I will talk about recycling as dealing with global issues in connection with this last point.

Awareness of the environment has recently been growing throughout the world. Thus in Japan we have thought about the importance of waste disposal and extended recycling of resources under the embarrassment due to the increasing quantity of waste and the shortage of disposal facilities.

It is momentous to organize systems for waste disposal and recycling of resources, based on proper sharing of responsibilities for the role played by the consumers, national government, local governmental bodies and business enterprises. Recycling of non-ferrous metals is thus actively promoted.

As an example, the recycling rate of aluminum cans in Japan has reached 58%. In Japan cans for drinks are a mixture of steel cans and aluminum cans in the ratio of 2 to 1. For this reason, sorting of cans is quite cumbersome. So we think this percentage is worthy of favorable remarks in light of the fact that there is no institutional plan, such as a "deposit".

We are shooting at 60% as the targeted rate of recycling for the present. We have also taken into account tantalum recycling as part of the non-ferrous metals recycling.

Let me turn to the current situation of the non-ferrous industry field in Japan. In terms of production volume, its aluminum products are ranked second in the world, its copper wires, cables, and elongated copper products are also second. In terms of smelting volume, its nickel ranks third and its titanium ranks second in the world. In light of Japan's position in the non-ferrous metals field it is necessary for Japan to take the lead in the technological aspect of the industry.

MITI has therefore formulated the project called MINERVA 21 in the non-ferrous metals realm to study the technological course of action for the future. MINERVA stands for Metal Industry Engineering Research Vitalization. It was named after Minerva, goddess of technology, wisdom and challenge in Roman mythology. Part of the project deals with aluminum-lithium alloy. It is necessary to improve sharply the high strength characteristics of the conventional aluminum alloy in anticipation of the space development and ultra high speed transport network to be installed. Although aluminum-lithium alloy has excellent characteristics, it has so far several problems in alloy design, in melting and in the casting process among others, because lithium is an extremely active metal. As another example, titanium is characterized by its light weight, high strength, and great corrosion resistance, but its demand has reached only 1% of stainless steel. This is due to the high production cost of titanium ingots because the current smelting method is a batch process, which is slow in production speed and expensive in production costs.

In order to seek expansion of demand for titanium toward the next century such smelting technologies as the continuous process of smelting and innovative melting techniques for cost reduction need to be developed in our view.

Finally, I should say that technological exchange is important and international conferences such as yours and various types of workshops and interchange meetings are of great significance. Information exchanges during such activities, of course, are also invaluable. The visitors from the CIS and China are particularly requested to understand the importance and signficance, in view of the fact that these nations are producing large quantities of non-ferrous metals.

THE TANTALUM AND NIOBIUM INDUSTRY: AN OVERVIEW

by Dr George J. Korinek, Technical Adviser to the T.I.C.

INTRODUCTION

The consumption of tantalum world-wide from 1989 to 1992 held steady at approximately 2.0 million lbs of Ta contained per year. In 1993 consumption increased by over 10% to 2.27 million lbs, and based on the consumption of the first nine months of 1994, this year's figure is about 4% behind the corresponding figure for 1993 (1.670 vs 1.738). Unless there are some unforeseen changes during the last three months of 1994, which seems fairly unlikely, 1994 will be similar to 1993.

It is interesting to look at the demand according to the major product groups.

I would like to begin with the electronics segment, since this is still the largest user of tantalum for electrolytic capacitors. Figure 1 shows the tantalum powder demand over the last few years. There was an increase of over 10% between 92 and 93, but overall we see a very modest growth. The demand for the first three quarters of 1994 is ahead by about 3% compared to the corresponding period for 1993, 0.806 million lbs in 1994 against 0.780 million lbs in 1993.

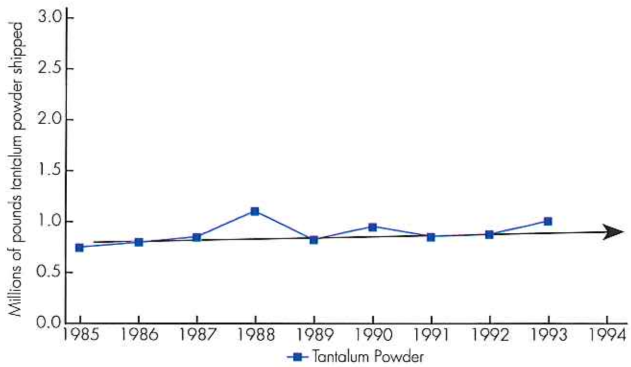

Figure 1 : Tantalum powder demand, 1985-1993 (Based on T.I.C. statistics)

Figure 2 shows the demand for tantalum powder and tantalum capacitors for the years 1985 to 1993. This is a very interesting figure. As can be seen, the number of capacitors roughly tripled over the last eight years, whereas the demand in lbs of tantalum powder grew at most by 10%, and one could even make the argument that the demand remained constant.

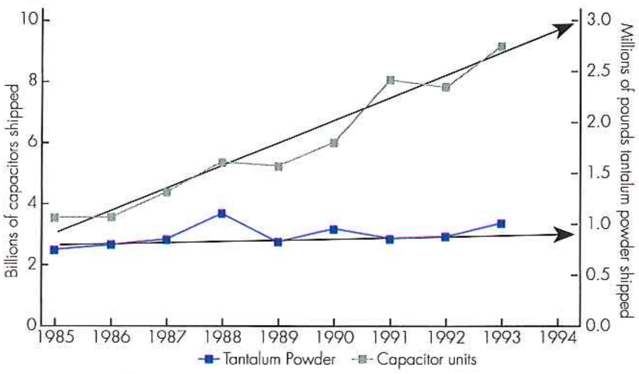

Figure 2 : Tantalum capacitor and powder demand, 1985-1993 (Based on T.I.C. statistics)

There are three main reasons for this development:

1) new technological developments are leading to ever higher capacitance powders;
2) tantalum capacitors with the highest growth rate are the very small sized chip types; and
3) capacitor producers are steadily improving yields and are using the powders close to their full potential.

Let us briefly discuss these three factors.

TECHNICAL DEVELOPMENTS

Today we have available powders from a commercial production with a CV/g value of 40-50 K. Developmental samples of even higher CV/g have been prepared. The development of high CV powders has been a complicated process made possible by using finer powders, the introduction of sophisticated agglomeration techniques and deoxidation. The high capacitance powders require lower sintering temperatures and/or shorter times to preserve the large surface area, in addition to the use of dopants during sintering to preserve the porous structure in the sintered anodes. Modern high capacitance powders have an FSSS of less than 1 to 2 micron. Low capacitance powders were often sintered at temperatures just below 2000°C, and high capacitance powders are sintered at temperatures that are about 500°C lower. The substantial lowering of the sintering temperature has resulted in decreasing the purification effect during sintering. Because the quality of the anodic oxide layer (dielectric) depends very much on the purity of the underlying metal, high capacitance powders are much purer to begin with than the low capacitance powders of the past.

The total impurities which are especially undesirable in tantalum powder, namely Fe, Ni, Cr, Na, K and carbon, decreased from about 150 ppm to less than 50 ppm over the last few years. In modern powders, sodium is desired to be less than 3 ppm. Considering that molten sodium metal is used as a reducing agent during the reduction of potassium fluotantalate (K_2TaF_7) to tantalum metal, and the reduction of the molten fluoride salt is conducted in nickel or Inconel equipment, this reduction of impurities is certainly very impressive. The introduction of new powders obviously requires very close cooperation and an exchange of technology between the powder and capacitor producers.

SMALL CHIP CAPACITORS

Originally, tantalum capacitors were used in military and aerospace applications, which required high reliability, and hermetically sealed units. These capacitors were relatively large and expensive. As the application of tantalum capacitors expanded to professional and entertainment electronics, the development has been toward smaller units which have had to be produced much more economically. The push toward miniaturization in electronics reinforced this development toward small unit sized chip capacitors.

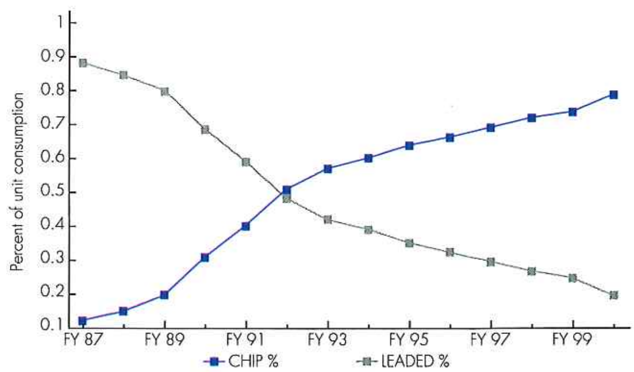

Figure 3 : Unit tantalum consumption, world excluding Japan

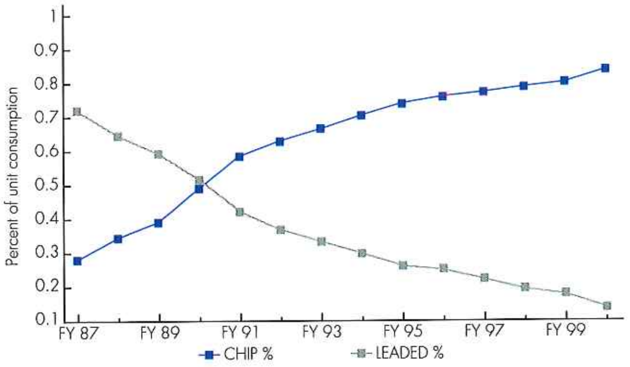

Figure 4 : Unit tantalum consumption, world including Japan

Figures 3 and 4 demonstrate this development:

1) the robust growth of chip capacitors in the last few years and their further growth in the near future;

2) also the leading role which Japan played in the introduction and application of these units;

3) and show the importance of participating promptly in new technological developments.

IMPROVED YIELDS

In addition the tantalum capacitor producers continually improved the production yield of capacitors and therefore minimized the loss of tantalum during processing. They also continued to learn how to use high capacitance powders closer to their nominal CV product.

Figure 5 shows the world tantalum consumption including Japan in millions of dollars. Today the tantalum capacitor industry has the size of about $ 1.2 billion per year. The latest expectations for 1994 are $ 1.25 billion and 9.65 billion pieces. That corresponds to a growth of about 6% over 1993 in units and about 1% in $.

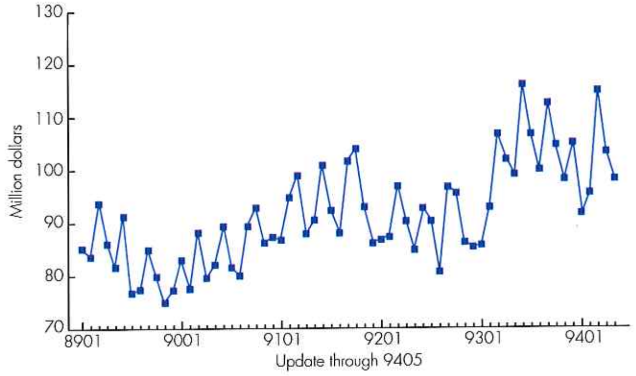

Figure 5 : Solid tantalum consumption in $, world including Japan

Whereas the United States and Europe should grow in units by about 20% and the rest of the world by less than 10%, Japan expects a contraction of about 10%. We have to remember that many electronic companies in the rest of the world (i.e. mainly the Pacific Rim) are related to Japanese companies. Trends predicted two years ago are still valid: good growth of tantalum capacitors, mainly the chip variety, modest growth of tantalum powder, because of the three underlying technological developments discussed above.

TANTALUM CARBIDE

T.I.C. statistics for the consumption trend of tantalum carbide over the last eight years are shown in Figure 6.

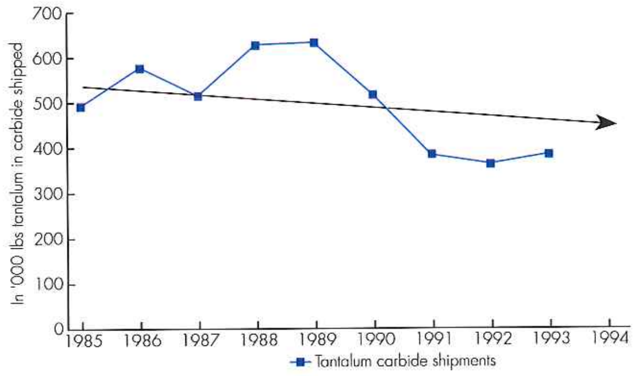

Figure 6 : Tantalum carbide demand, 1985-1993 (Based on T.I.C. statistics)

The addition of tantalum carbide improves mainly the high temperature strength of cemented carbide tools, and is used only for the metal cutting grade. The mining grades of cemented carbide, the oil drilling grades, and the grades for wear parts do not contain TaC, except for a small amount of approximately 0.3% sometimes added as a grain growth inhibitor.

Tantalum carbide consumption in the cemented carbide industry should increase with a growth of the steel cutting grades. Unfortunately, several developments have taken place which will limit this growth for at least the next few years. The introduction of more effective coatings prolongs the lifetime of a tool or increases the speed at which the tool can be applied, but in either case it increases the amount of metal which can be removed per tool bit.

During times of high TaC prices, a fine tuning of the grades took place, and some of the very high TaC grades were completely eliminated from the market place.

Also the introduction of relatively vibration-free, numerically controlled modern cutting machines is helping to replace some of the tungsten-carbide-based cemented carbide tools with ceramics and Sialon type silicon-nitride-based cutting tools. In Japan these ceramic based cutting tools already achieved more than 30% penetration of the market, and although the percentage in the United States and in Europe is much smaller, it is increasing.

There are also developments in the entire field of the processing technology of metals, where the amount of metal needed to be removed is minimized by using powder metallurgical techniques, precision casting, and others. This, naturally, affects negatively the consumption of cutting tools containing cemented carbide. Based on these factors, strong growth of TaC consumption is not expected over the next few years.

The cemented carbide industry in 1994 is doing very well in the US, growth so far is more than 25% over 1993 in terms of kgs of sintered metal: 3.26 million kgs compared to 2.58 million kgs. It is also catching up in Europe, but it is lagging behind in Japan.

Tantalum carbide consumption is behind 1993 so far for 1994, and it is expected to be at best about even with 1993.

For the first nine months of 1993, the total of TaC, Ta_2O_5 and K-salt was 0.384 million lbs tantalum contained, compared with 0.298 million lbs tantalum contained for the first nine months of 1994, a drop of 20% for 1994. For 1995 the best forecast is a very modest increase.

To summarise, even when the cemented carbide industry and its steel cutting sector are growing, there is very little growth in TaC consumption.

MILL PRODUCTS

The consumption trend for mill products over the last eight years is shown in Figure 7. For the first 9 months of 1994 there is an increase of 12% as compared to 1993 (0.320 million lbs vs 0.282 million lbs). The largest single component is tantalum capacitor grade wire, which together with furnace hardware needed by the tantalum capacitor producers adds up to about 180 000 to 200 000 lbs p.a., about half of the total mill product consumption. The application for high kinetic energy projectiles in the form of sheet, discs, and similar forms, is included in this group. It is estimated at less than 50 000 lbs per year.

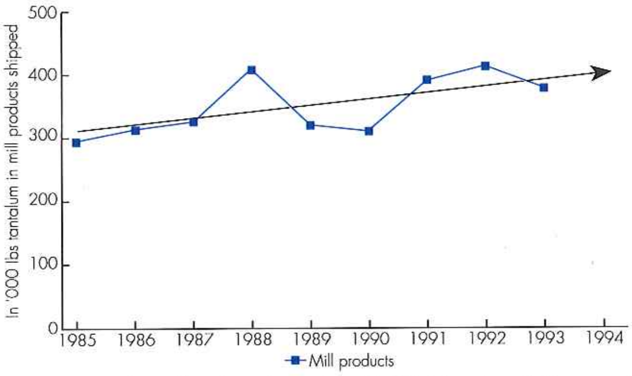

Figure 7 : Tantalum mill products demand, 1985-1993 (Based on T.I.C. statistics)

A relatively large application of about 40 000-50 000 lbs is connected with the use of tantalum in sulfuric acid production, and in the industry using sulfuric acid, in the form of heat exchangers, bayonet heaters, valves, cladding, and so on. The remaining applications are: others in the chemical industry; approximately 15 000 lbs in the medical industry in the form of clips, screws and similar items; and about another 10 000 lbs are used for melting and sintering of rare earth and plutonium.

With regard to military applications, the main use is in the United States. Because of severe budgetary constraints, the production of a large number of different components is unlikely. This means that some relatively large consumption figures which were discussed some time ago will be stretched out and realized at a much more modest level.

The wire application should increase with the increase of capacitor units.

USE OF TANTALUM IN SUPERALLOYS

A relatively new and welcome application for tantalum is its use in the superalloys used in the production of turbine blades for the jet engine industry. It is difficult to obtain accurate statistics for this use, however, since T.I.C. figures merge the shipments of superalloys in a miscellaneous sector with scrap and ingots. The use of tantalum, both virgin and scrap material, for this application was in good years approximately 200 000 lbs. In 1993, however, the usage was, at best, only half of this amount. The superalloy industry was going through very difficult times, and this was reflected in the substantial problems the airlines were encountering worldwide, and in the decrease in expenditures in the military aircraft industry. Nevertheless, there was a marked improvement of demand for tantalum in this sector in the spring of 1994.

NIOBIUM

Figure 8 shows the demand for niobium over the last five years. The graph indicates the demand for compounds and alloy additives, i.e. oxide, vacuum grade FeNb and NiNb, pure Nb and its alloys, such as NbZr, NbTi, NbCu, standard grade FeNb and total.

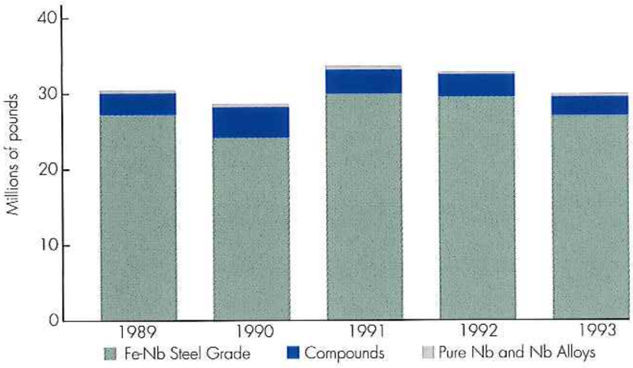

Figure 8 : Niobium consumption, 1989-1993 (million lbs per year)

Demand for niobium is still very much dependent on the development of the steel industry and accordingly its HSLA grades and stainless steel. This application still uses around 90% of all niobium used. The two main applications for HSLA steel are automotives and pipelines.

The HSLA steel accounts for over 75% of FeNb use, stainless steel for about 15% and the rest is for miscellaneous use. Whereas the HSLA steels contain 200-700 ppm Nb, the ferrite stainless steel (without Ni) contains 0.4-0.5% Nb. Over an extended period of time, the standard steel production should grow only minimally with the economy, the stainless steel compounded growth of over 4% per year should continue until the next century. The automotive industry offers new potential for stainless steel in its exhaust systems and other parts which are exposed to corrosion.

Engineers are learning to think in terms of life cycle costs, rather than immediate price. We should force this concept for tantalum. It is disappointing to see the decline of compounds and alloy additives. The main consumer is the aircraft industry, and as we know this industry went through some difficult times - 1993 was one of the worst years in a long time. There is improvement expected for 1994, over 10% based on the first 6 months and 1995.

The "niche business" of pure Nb and its alloys, such as NbZr and NbTi, is also rather stagnant. The reasons are: decrease in the government sponsored aerospace activities, the problems in the nuclear energy industry, and the cancellation of the SSC project in the US. This project would have used about 3 million lbs of niobium in the form of NbTi and would have provided a large increase for this sector. The only major remaining high energy physics project is the LHC (Large Hadron Collider) of CERN in Geneva, but its niobium requirements will be less than one quarter of that of the SSC. The final approval of this project should be imminent.

Several government sponsored projects on energy storage using superconducting materials have been delayed or cancelled. One positive sign has been the announcement of the German railroad system to plan a very fast train between Hamburg and Berlin, based on magnetic levitation (Maglev). Unfortunately this project is not based on superconductivity, but on regular magnets, but it is hoped that it will generate interest in Maglev based on superconductivity.

The use of MRI continues at a steady pace and is at present the backbone of the superconduction business: it uses about 100 000 lbs of niobium annually.

Based on the first 6 months of 1994, the niobium consumption increased over 22% from about 15 million lbs in 1993 to nearly

19 million lbs in 1994. Practically all the increase was in the steel grade FeNb. It seems that this increase is not real, at least to the extent that higher inventory policies introduced by CBMM are at least partially responsible for this growth and an actual increase of about 12% is more realistic.

A significant change in the industry was announced recently: the Canadian niobium producer Niobec (a joint venture between Cambior and Teck Corporation) started a ferro-niobium production in the middle of October in Quebec.

The mine produced about 2000 tons of Nb in concentrate. The concentrate has been exported mainly to Europe and Japan.

Niobec invested about Can $ 7 million for a reactor vessel which uses aluminothermic technology to convert concentrate into FeNb. By the end of 1994 all the concentrate exports will cease, and all concentrate will be converted into FeNb. Converters had financial and environmental problems. Waste from the production of FeNb can be slightly radioactive as the concentrate contains small amounts of uranium and thorium. This waste can be dumped into a mineshaft at Niobec.

Niobec's FeNb production will be the first in Canada since the 1970's.

In summary, the niobium business is still very much dependent on the use of FeNb in HSLA and stainless steel. The development of the "boutique" applications for aerospace and superconductivity is as usual taking longer than expected and is under 10% of the total use.

Group touring SCSM plant

Gala dinner : drummers

CABOT PERFORMANCE MATERIALS

T.I.C. member Cabot Performance Materials recently announced the completion and start-up of a second 1200 kW electron beam furnace at its plant in Boyertown, PA. The furnaces are both capable of producing 12 inch diameter ingots of tantalum and 14 inch diameter niobium ingots.

The company has also registered its quality system to the ISO 9002 standard, applying to a variety of materials including tantalum and niobium products, to indicate its commitment to quality and continuous improvement.

MEMBERSHIP

Elected to membership by the Thirty-fifth General Assembly:

A&M Minerals and Metals Ltd.

140-142 St John Street,
London EC1M 4AB, England.

Tan Ceramics Ltd.

77 Frishman St., P.O. Box 11807,
Tel Aviv 61116, Israel.

Trademet S.A.

31 Drève des Anglais,
B-1390 Grez-Doiceau, Belgium.

Intermet Resources has resigned from membership, and the membership of Ginatta and Philips Components has been terminated.

Associate member:
Mr Christian Polak,
37 rue René Cassin,
74240 Gaillard, France.

Tantalum-Niobium International Study Center,
40 rue Washington,
1050 Brussels, Belgium
Tel.: (02) 649.51.58
Telex: 65080
Fax: (02) 646.05.25

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