BULLETIN N° 111
ISSN 1019-2026

TIC

TANTALUM-NIOBIUM INTERNATIONAL STUDY CENTER

PRESIDENT'S LETTER

The annual meeting of the T.I.C. is always an interesting occasion for those involved in the industry of tantalum and niobium. It gives us the opportunity to greet friends old and new, to compare notes and to see how the situation has changed since last we met.

As we look forward to meeting very soon for the Forty-third General Assembly in Kyoto, some parts of our industry begin to see the green shoots which signify returning growth for tantalum. For others those shoots have yet to become evident. Meanwhile the use of niobium grows as gently as the trees and bushes of the T.I.C. arboretum we planted in Araxá.

The latest statistics of the T.I.C. show strength in the production of raw materials for both tantalum and niobium. This indicates that any misgivings about a shortage of tantalum are unfounded, and that the supply is sufficient to satisfy demand. In their turn, the processors are well able to provide the materials their customers require. However, the statistics also reveal a very severe slump in tantalum consumption as it is shown in the capacitor statistics. This hopefully will be corrected in the future, as confidence in the tantalum supply grows again.

The remarkable benefits which niobium confers on steel by the addition of ferro-niobium to make high-strength low alloy steel are widely recognised. The application of this kind of steel in difficult conditions maintains the gentle rhythm of expansion.

The past year has been a time for re-assessment of our ideas. It has been a time for reflection and also for careful planning of investment for the future while considering the events of the recent past. We must look forward, but without losing sight of the valuable lessons of the past. The history of tantalum now stretches back two hundred years since it was discovered. Although the history of the industry using tantalum is not so long, it is approaching one hundred years and the use of capacitors is almost fifty years old. Both tantalum and niobium have a bright future ahead of them also.

I hope to see you in Kyoto, where we shall enjoy a varied and thought provoking technical programme as well as the hospitality of our Japanese member companies, and Nichicon in particular.

Axel Hoppe
President

T.I.C. GENERAL ASSEMBLY

The meeting of the Tantalum-Niobium International Study Center to be held in Kyoto from October 6th to 8th 2002 is promising to be well attended. The Forty-third General Assembly will take place on October 7th, to carry out the business of the association such as electing new members. The technical papers to be presented on October 7th are detailed below, with abstracts.

The social programme will include a welcome reception on Sunday October 6th, and a gala dinner hosted by Japanese members of the T.I.C. on Monday evening, as well as sightseeing tours of Kyoto and Nara.

On Tuesday October 8th there will be a tour of the capacitor plant of Nichicon Corporation at Adogawa, by kind permission of that company.

All delegates must pre-register with the T.I.C. by September 6th.

Temple at Nara, with sacred deer

CONTENTS

Shrine

TECHNICAL PROGRAMME

Japan's R&D strategy for nanotechnology and materials

Mr Ichizo Aoyama, Nonferrous Metals Division, Manufacturing Industries Bureau, Ministry of Economy, Trade and Industry (METI)

The Japanese Government formulated the Second Science and Technology Basic Plan (for FY 2001-2005) in March 2001. 'Nanotechnology and Materials' became one of the four major platforms, the others being 'Life Science', 'Information and Communication Technology', and 'Environmental Science and Technology'. In September 2001, the Cabinet worked out the promotional strategy for Nanotechnology and Materials. It focused on five R&D fields, that is (1) nano-devices and materials for future communications, (2) materials for ecology and energy, (3) MEMS for medical applications, and nano-biology, (4) measurements, evaluations and manufacturing technologies, and simulations, and (5) innovative materials technology. Both interdisciplinary applications and fundamentals are the key issues. The Government is spending around $700 billion on nanotechnology in the FY2002. Towards FY 2003, the Government will launch a new R&D policy for revitalizing the Japanese economy, called 'Focus 21'. On the basis of the strategies and policies on Nanotechnology and Materials, METI actively promotes the realization of innovative nano-tech products. In this talk, the governmental R&D strategies, in particular METI's Nanotechnology and Materials Programme will be presented.

Tantalum and niobium – a year in review

Mr C. Edward Mosheim, Technical Promotions Officer, T.I.C.

Mining and shipment statistics for niobium and tantalum minerals concentrates, tin slags and all the various tantalum and niobium products have been collected from the membership of the Tantalum-Niobium International Study Center for the recent six-monthly periods of July 1st through December 31st 2001 and January 1st through June 30th 2002. Graphs of the most recent data for both elements will be presented along with commentary describing the observed trends. The graphs will cover the period from 1991 (tantalum) or 1993 (niobium) through June 30th 2002. Those raw material and product charts where new categories of data collection have been started will also be provided, beginning with the January 1st 2001 collection period.

Topics on anti-oxidation coating technology of niobium-based superalloys

Professor Toshio Narita, Hokkaido University

To improve high temperature oxidation resistance of niobium based superalloys, a novel coating was developed, consisting of a duplex layer structure: an inner, σ(Re-Cr-Ni) alloy layer and an outer, β(NiAl) layer. The inner σ(Re-Cr-Ni) acts as a diffusion barrier between the Nb-based alloy substrate and the β(NiAl) layer, which can form a protective α-Al_2O_3 scale. The coated Nb-5Mo-15W alloy was oxidized in air up to 1473K, which showed very good oxidation resistance.

Status of niobium-based superalloys development

Dr Akio Kasama, JUTEM – Japan Ultra-High Temperature Materials Research Center

The national research project for the development of novel superalloys as an advance on conventional nickel-based ones, supported financially by the New Energy and Industrial Technology Development Organization (NEDO) in Japan, was started six years ago and has just finished this year. An object in this project is that the advanced niobium-based superalloys able to be used without cooling at high temperatures over 1500°C are developed on the viewpoints of fossil fuel and global environmental protections. During the grant period, it has been apparent that the mechanical properties of pure niobium can be improved by means of both solid-solution strengthening and formation of Nb_5Si_3 in-situ composites in matrix and the niobium-based alloys surpass conventional nickel-based superalloys in high temperature properties.

Alternative reduced tantalum powders

Karlheinz Reichert, Udo Merker, Elisabeth Droste and Alexander Michaelis
to be presented by Dr Karlheinz Reichert, H.C. Starck GmbH

The introduction of tantalum capacitors with very high capacitance values into the market is hindered by a potential thermal runaway of the device in case of failure. Therefore the usage of sodium reduced tantalum powders with a specific charge of more than 50 000 CV/g is still at a very low level.

Lanterns (Photos by JW)

To partially overcome this problem we have studied the mechanism of thermal runaway and developed magnesium reduced tantalum powders which show a higher ignition threshold.

Thermal runaway in tantalum capacitors is due to a low thermal conductivity of the anode body. We have used the laser flash method to study the thermal conductivity and the ignition threshold of different high CV tantalum powders. We will show in our paper that inter-agglomerate bonding within the anode is the bottleneck of thermal conductivity and that it is possible to increase the strength of this bonding without losing the specific surface area of the anode.

The effect of metallurgical properties of tantalum target on sputtering performance

Mr Ichiroh Sawamura, Innovative Materials Development Center, Nikko Materials Co., Ltd.

The influence of metallurgical properties such as microstructure, crystal orientation and others in tantalum targets on sputtering performance was investigated. Targets with various metallurgical properties were fabricated by thermo-mechanical treatment and sputtered. Some film properties were investigated, and the influence of metallurgical factors on film properties such as sheet resistance, uniformity and others was studied.

The development of solid organic polymer niobium electrolytic capacitors

Mr Koichi Mitsui, Director of Engineering, Nichicon Corporation

Niobium has received attention as an alternative material to tantalum, because of its stability of price and supply, and some capacitor manufacturers have carried forward their development of the niobium capacitor as though it were the next generation of tantalum capacitor.

Nichicon has been developing niobium capacitors with manganese dioxide and also conductive polymer (PEDT) as cathode material. We have completed commercial products of the primary stage, and started supplying samples.

At the meeting our presentation will the review the essential nature of the niobium capacitor and compare it with the tantalum capacitor.

1.The characteristics of niobium dielectric oxide film
2.The characteristics of niobium capacitors
3.With regard to properties and reliability
4.Future prospects for the niobium capacitor

Tantalum supply chain: improving its management

Mr David Paull, General Manager-Business Development, Sons of Gwalia

In this paper, the tantalum supply chain is described and discussed, particularly as it relates to the electronics industry.

Its recent performance is examined and various recommendations are put forward to improve performance.

Finally, an attempt is made to assess an improvement in the forecasting ability of the supply chain.

Tantalum capacitors – applications review

Mr John Prymak, Kemet
to be presented by Dr Philip Lessner

This paper will review tantalum capacitor applications showing where tantalum capacitors have lost market share to other capacitors, and why. It will also discuss applications where tantalum is the capacitor of choice, and why. Information will be presented on applications for tantalum capacitors for the future. This will include modifications for tantalum capacitors to enhance performance characteristics such as ESR, ESL, non-ignition potential, surge robustness, and reliability.

The paper on 'The global tantalum market – what the future holds' offered by Dr Andrew Cole, Metal Bulletin Research, has been withdrawn.

TANTALUM – THOSE EARLY YEARS

Continuing the history of tantalum

The use of tantalum in the incandescent bulb industry ended in 1911 and applications for the metal were sparse. The development of ductile tungsten wire brought about the replacement of tantalum and essentially that same basic technology is in use today.

Between 1911 and the early 1920s, applications for tantalum were investigated but none achieved large-scale commercial success that resulted in sustained growth in the use of this unusual element. The properties of the metal were investigated and documented during this period with minor use in specialized applications, most of which took advantage of its 'rustlessness', hardness, and ductility. Tantalum did find use in dental and surgical instruments, pen points, needles, laboratory weights, clock springs, gramophone needles, etc [1, 2]. It was used as a cathode in electrolytic analysis, and for the electrodeposition of gold, silver, and zinc in the laboratory. It was during this same period that chemists and metallurgists began to study the corrosion properties of tantalum and simple tantalum alloys with the finding that the metal was essentially resistant to most chemicals.

Numerous investigators learned that the behavior of tantalum was influenced by the purity of the metal and experimentation established that ductility performance was improved by the reduction of metallic impurities. The preparation of 'pure' metal was the key to commercial success.

The most notable success was achieved by Dr Clarence W. Balke (1880-1948) in the laboratory of the Pfanstiehl Company, Inc.[2] He joined this company in June 1916 from the University of Illinois and became the research director. The war years limited research to improvements in the tungsten technology for contact points and the development of cerium and a cerium iron alloy for use in miners' lamps and in munitions. Large tungsten disks were produced for use in naval munitions. A small effort was directed at the development of

Figure1:Clarence W. Balke

ductile tantalum, a metal for which there were essentially no significant applications at the time.

In 1918, the name of the company was changed to the Fansteel Products Company, Inc.[2] New uses were developed for tungsten-containing products, such as the 'Fansteel Tungsten Distributor' for Ford automobiles. During the early 1920s, the company was dependent on the automobile industry through the sale of tungsten contacts, tungsten sheet and rod, steel valves, and spark coils. New products were needed to reduce its exposure to this one market application, namely automobiles.

In a report to stockholders in 1922, there was an announcement indicating that an alternative product had been discovered. The laboratory 'had completed the greater part of the development work and tantalum was placed on a productive basis'. In retrospect, all of the fundamental steps necessary to develop a full scale production process for making ductile tantalum bars were in place in 1917. Wartime requirements prevented implementation. In February 1922, the first sintered tantalum bar was ready to be rolled into sheet. It dimensions were only 1/8 inch square and 2 inches long. The metal was quite pure and ductile.

In a paper presented to the Richmond meeting of the American Society of Chemical Engineers, December 6th-9th, 1922 [3], Dr Clarence Balke implied that the production of ductile tantalum was based on the reduction of the double fluoride salt of either sodium or potassium and that other reduction routes would not meet the objectives for ductility. His description of the process follows:

'Metallic tantalum can be produced by the reduction of the double fluoride (salt of tantalum) with metallic sodium or potassium. It is impossible by this process to produce a powder characterized by high purity. For best results by this method, the reaction should be carried out in a vacuum, the boats or crucibles containing the mixture of double fluoride and metallic sodium or potassium being placed in a tube or furnace which can be evacuated before the mixture is raised to the reaction temperature.'

'The product from this reaction can be treated with water and mineral acids in order to free the metal powder as completely as possible from adhering salt and other impurities. This powder is then compressed into bars and subjected to heat treatment and finally fusion in a vacuum furnace, the high temperature of fusion eliminating the impurities which may be present. If this process has been completely successful, the fused metal will be found to be ductile and susceptible to mechanical working.'

Fansteel patented the process in 1922. The quality of the metal via the described process was 99.8% pure.

The applications for this ductile metal were determined by the results of the research of Dr Edgar W. Engle [3], a member of Dr Balke's staff. He discovered that tantalum formed a film that blocked the current from going in one direction and only permitted it to go in the opposite direction, in an electrolyte such as sulfuric acid. The first time this was observed was during an experiment to use tantalum metal as the electrodes in chlorine cells. The anode direct current would not pass. This observation provided the idea for a rectifier and the Fansteel Balkite Rectifier was born.

The Balkite Rectifier became a household word. These were the days of DC radios and you needed to have an 'A' battery (automobile battery) to heat the filaments in the tubes. You also needed a big dry cell pack or even several of them for the plate circuit. Every week or two you had to recharge the battery. The battery had to be carried to the local filling station, using a car for transportation or a wagon if you didn't have one. The Fansteel invention was a rectifier using a lead cathode and tantalum strip anode in sulfuric acid. This device allowed the individual to charge the battery in his home.

In a few years, Fansteel produced a 'battery eliminator' that was a high voltage rectifier with a filter circuit so that it smoothed out the pulses from the AC current (see Figure2). This eliminated the need to replace a set of 'B' batteries every two or three months since it required only the addition of a little water. The rectifier sold for about $10. It and the Balkite Charger were shipped in railroad-car quantities. Production began in 1923 and was measured in millions of units. Nationwide distribution outlets were established and this obscure little business grew to sales of $4,940,161 in 1926. The Balkite Trickle Charger was offered later.

As often happens in business, another invention was about to destroy Fansteel's market. In 1927, an alternating current tube was developed that eliminated the rectifier and battery charger. This invention permitted the radio to be plugged directly into the wall outlet and use AC current. Once again, Fansteel had an intriguing and unique metal without any application.

The loss of this consumer business pushed Fansteel into industrial applications utilizing tantalum, the first being the manufacture of redesigned rectifiers containing tantalum for railroad signal systems [1]. Thousands were used in 105 different rail companies all over the world. Before this discovery, batteries had to be loaded on flatcars and hauled to the nearest town for recharging. Modifications were produced for use in telegraph service, telephone switchboards, and fire and burglar alarm systems.

Fansteel attempted to re-enter the consumer electronics business with the entrance of the Balkite Radio in 1928 (3). It was a complete failure.

During the 1920s, research was conducted to investigate and

Figure 2: Advertisement from Radio News, February 1926 [3]

understand the properties of tantalum metal [1]. By 1929, its unique resistance to corrosion, behavior towards gases when heated in air and vacuum, mechanical properties as a pure metal and as a function of 'gas content', and control of ductility and brittleness were well understood. A Fansteel publication summarized those properties as follows:

1. 'Tantalum is unaffected by practically all forms of corrosion.'

2. 'Commercial Tantalum is of about the same hardness as cold rolled steel.'

3. Commercial Tantalum is extremely ductile when worked cold, and may be hammered, rolled, machined and drawn. When annealed it will withstand a surprising amount of working.'

4. 'Tantalum welds readily to itself and to other metals by the roller or electric spot welding methods.'

5. 'Tantalum may be finished in a number of iridescent colors.'

6. 'Tantalum has a very high melting point, exceeded only by that of tungsten.'

7. 'Tantalum may easily be hardened to hold an edge or wearing surface.'

8. 'Tantalum cannot be worked hot, and it must not be heated in air to more than a dull red heat.'

9. 'At moderately high temperatures, Tantalum freely absorbs the common gases, such as hydrogen, oxygen, and nitrogen. These gases may be subsequently driven out by heating the metal in a vacuum to temperatures near its melting point.'

10. 'Tantalum used as an electrode in electrolytic solutions, acts as an electrolytic valve, passing current in one direction only, thus automatically rectifying an alternate current.'

11. 'Commercial Tantalum costs about one-fourth as much as gold and one-fifteenth as much as platinum.'

These properties were presented to prospective customers for consideration of using tantalum where other materials being used were unsatisfactory or no materials had been found which solved a specific need for a specific application.

The early depression years, 1929-1931, dealt another financial blow to Fansteel, but inventiveness carried the day. Research established that almost any gas would combine with tantalum at temperatures above dull red heat, including those released by other metals. This provided the impetus for using tantalum in vacuum tube applications where high vacuums were required for superior performance. A small quantity of tantalum performed as the 'getter' for any gases in the tube atmosphere.

Fansteel was already involved with the production of molybdenum wire for use as grid windings in radio tubes and was able to construct several hundred sample tantalum tubes. These were submitted to manufacturers in the United States and Europe for evaluation. The first success was achieved in marine radio equipment. This was followed by success in short-wave and ultra-high frequency tubes which would become extremely important in World War II radar equipment. Tantalum was now being used as a material for plates, grids, and support members in these tubes.

Tantalum has also been used successfully in neon sign tubes as the electrode material. Its function extends the life of the tube by protecting the atmosphere inside the fixture from undesirable gases.

Tantalum metal also found application in laboratory equipment where it replaced glass, porcelain, and platinum for certain procedures. Tantalum dishes, spatulas, stirring rods, filter cones, and analytical weights came into common use. The U.S. Bureau of Standards accepted tantalum weights for analytical weight sets up to 50 grams.
Tantalum found extensive use in the manufacture of synthetic silk due to the acid resistant qualities of the metal. Cellulose in a liquid state is forced through the tiny holes of spinnerets. These tiny fibers harden when they contact acid. The structure of the fiber is determined by the size and shape of those tiny holes and this makes it essential that the metal used for the spinneret be highly corrosion resistant. Prior to the use of tantalum, only platinum or a platinum-gold alloy were used.

Tantalum was suggested for use in small tools, made entirely of the metal or at least 'tipped'. They would be rust proof and non-magnetic, and could be hardened to the level of steel. Jeweler's tools was one of the proposed uses.

Tantalum was proposed for any application where corrosion by salt air was a troublesome problem. Its use in writing pen tips was an established fact based on the observation that the metal has the 'smoothness' of gold points at a fraction of the cost. A tantalum pen-point can be hardened by heating for a moment in air whereas gold points require that a point of iridium be welded to the gold to provide sufficient hardness.

Tantalum's iridescent colors decorated watch straps and cases. The late 1920s also saw the development of tantalum carbide applications. Dr Balke noted that tantalum carbide either alone or in conjunction with tungsten carbide, reduced the coefficient of friction at the edge of cutting tools. He also discovered that both titanium and niobium carbides provided that same property, but to a lesser degree. This discovery doubled the usefulness and value of cemented carbide tools that were only used to cut cast iron or other materials that produce broken or pulverized chips. The first Fansteel carbide tools and dies were marketed under the trade name Ramet in 1930.

The work of Dr Balke and his staff at the Fansteel Products Company, Inc. resulted in over 30 patents during these early years. This company was probably the greatest contributor to the development of the technology and applications for this rare metal during these early years of the industry based on documentation found to date.

TANTALUM MINERAL CONCENTRATES

The only documented source of tantalum-bearing mineral concentrates used by Fansteel during the years prior to 1930 is 'Fansteel's Tantalum Mine in Western Australia' [1]. A map of Australia locates the mine in an area known as the Pilbara District and is described as a 'desolate desert about 450 miles from the nearest railway. Water is scarce and the temperature hovers around 120 degrees in the shade'.

The 1945 publication from the Department of Mines, Western Australia [4], provides a map of Western Australia and details the mining operations in the Pilbara region in the northwestern district and others. This area was first mined in 1904 when manganotantalite was found in some tin concentrates. The area has yielded variable quantities of rare metals, such as yttrium, cerium, lithium, beryllium, tin, antimony, tungsten, bismuth, iron and manganese among others in addition to tantalum and columbium.

The primary named areas of mining are Wodgina, which includes the West Wodgina and Stannum groups of workings about 3 miles west and 8 miles south-west of Wodgina respectively. Wodgina is located about 70 miles due south of Port Hedland. The tin and tantalum ores occur in many of the pegmatite dikes and in the soil and alluvium. Veins are reported up to 500 feet in width. The primary tantalite lode is located about 0.5 miles northeast of the old Wodgina townsite. It extends for some 2000 feet in a northerly direction. The southern end of the lode disappears below the surface alluvium of a tributary of the Turner River, known as McCarthy's Creek. Analysis of some concentrates from the area in 1927 contained tantalite at 77% Ta_2O_5. Prior to 1929, most of the tantalite was obtained from this area from the alluvial soil by 'dryblowing', with individual pieces weighing up to 35 pounds.

The Main Tantalite Lode is composed of albite, quartz, microcline, lepidolite, and occasional mica. Manganotantalite is distributed through the feldspar zones. It occurs in irregular fragments of all sizes, ranging from one to five pounds in weight with one large piece, found in 1905, weighing 500 pounds. The average composition of the concentrates was 68% Ta_2O_5. Shallow surface workings consisted of open cuts, trenches, and pot holes extending along the lode for about 1500 feet. Underground workings cover a length of 480 feet.

An adit was driven into the northern side of a hill on the northern end of the lode. In 1942, the author concluded that there was not any programme to establish a continuous mining operation and development of the property. Between 1925 and 1929, the alluvial deposits were worked and shipments totaling about 70 tons were realized. From 1931, the property was controlled by a company known as Tantalite Ltd. This company produced continuously from the Main Lode until the outbreak of World War II. Intermittent contracts were typical and all of the production was limited essentially to surface mining. The author speculates that the area contained a large continuous ore body that needs to be tested below the surface when the world demand justifies this detailed examination.

Another promising area for tantalite within the Pilbara area occurred at Tabba Tabba, a small tin and tantalum deposit about 40 miles southeast of Port Hedland. The deposit lies in a northwesterly direction and varies in width from 40 to 150 feet. The tantalum-containing minerals are manganotantalite, simpsonite, and microlite with associated cassiterite. The alluvial ore was processed into a tantalum-tin concentrate by sieving. Electromagnetic separation of the tin mineral from the tantalum concentrate was required. Concentrates ranged from 36 to 72% Ta_2O_5, depending on the quantity of manganocolumbite in the mineral mixture.

The Strelley workings were about 40 miles east-south-east of Port Hedland, and 6 miles southeast of Strelley station homestead. This area was formerly known as Tabba Tabba Creek. The pegmatite extends over a length of 2400 feet with a width varying from 100 to more than 700 feet. Old workings consisted of irregular pot holes, trenches, open cuts, and shallow shafts. The tantalum-bearing minerals were manganotantalite with some tapiolite and microlite. Tin-bearing minerals were present in low concentrations in this deposit. Systematic mining was not attempted.

Other areas of tantalite occurrence in this region that have been examined were Pilgangoora (Green's Well), McPhee's Range, Moolyella, Cooglegong-Eleys-Hillside, Woodstock, Abydos; Mt. Francisco, and Split Rock.

The southwest district of Western Australia listed numerous areas of tantalite occurrence. The very first discovery of tantalite was at Greenbushes, located about 42 miles south-east of Bunbury. The primary tantalum mineral was reported to be ferrotantalite containing up to 80% Ta_2O_5 with stibiotantalite, tapiolite, and ferrocolumbite as minor constituents. Unfortunately there are no early production records in existence. Total production in 1942 was 1.5 tons, by sluicing alluvial material. Old residents of Greenbushes described the tantalite as occurring in 'patches' containing up to 20 pounds. Workings did not exceed 12 feet in depth. A lot shipped in 1943 of 2000 pounds analyzed 73.5% Ta_2O_5. Most of the tantalite occurred in pieces ranging from 0.5 inches to up to 52 pounds at the north end of the pit.

Additional occurrences of tantalum-bearing minerals have been noted at Balingup, Smithfield, Jimperding, Mt. Dale, and Ravensthorpe.

The total quantity of tantalite concentrate mined in Western Australia was 260.4 tons between 1905 and 1943, with the overwhelming bulk of the material obtained from the Pilbara District. Most was from alluvial sources. Attempts at mining pegmatites only occurred after 1935. It is believed that there were significant shipments of small parcels with about one-third coming from the Greenbushes area.

In the early 1900s, a great proportion went to England for transshipment to Germany or was shipped directly to Siemens and Halske in Berlin. Since 1932, when tantalite mining at Wodgina and other locations in the Pilbara region was taken over by Tantalite Ltd., virtually all the production was shipped under contract to Fansteel Products Co., Inc in Chicago, with small parcels sold to Electrometallurgical Co (later Union Carbide Co) in Niagara Falls, N.Y., to Murex in Great Britain (about 9 tons) and to Japan (about 12 tons).

Worldwide consumption was averaging between 15 and 19 tons per year prior to World War II and was increasing. The demand for tantalite concentrates was for a minimum Ta_2O_5 content of 60% and a maximum Nb_2O_5 content of 25%. Impurity concentrations and specifications were negotiated between buyer and producer. Actual production from the Pilbara District between 1931 and 1940 assayed 63.5% Ta_2O_5 and 12.0% Nb_2O_5.

At the outbreak of the war, shipments of tantalite from Australia ceased, the reason given as the American market having temporarily reached saturation with the production of refined metal exceeding demand. The period of 1944-1945 saw a turn-around in concentrate requirements due to new wartime uses. The demand for concentrate was urgent, with the high level of urgency even lowering the grade that the U.S. government was willing to purchase, taking the minimum Ta_2O_5 down to 30.0%.

The price of tantalite concentrate from Australia increased from about £2 13s. in 1930 to £10 in 1935 for 60% Ta_2O_5 minimum. From 1935 up to about 1941, concentrates from the Pilbara region were sold under contract by Tantalite Ltd. to Fansteel Metallurgical Corp. at prices ranging from £A1500 to £A1800 per short ton. It has been reported that in 1937, the price exceeded £A2000 per short ton for 65% ore concentrate. During 1943, the American Board of Economic Warfare supplied a table of prices for future shipments of tantalum concentrates. The prices were proportional to the tantalum oxide content and provided pricing for a range from 30 to 80% Ta_2O_5 with a low of £A240 2s. 4d. per short ton up to £A2364 4s. 9d.

(To be continued in the December 2002 Bulletin – The Birth of the Use of Tantalum in the Capacitor and Chemical Process Industries.)

References

1. Rare Metals, The History, Properties and Uses of the Metals… Tantalum, Tungsten, Molybdenum, by the Fansteel Products Company Inc., North Chicago, Illinois, 1929

2. $2500 and a Dream, The Fansteel Story, by Jon R. Tennyson, 1982

3. The Story of the Production and Uses of Ductile Tantalum, by Clarence W. Balke, Fansteel Products Co., Inc. Paper presented at the Richmond meeting of the American Institute of Chemical Engineers, December 6-9, 1922

4. Tantalum and Niobium, Bulletin No. 3, Department of Mines, Mineral Resources of Western Australia, by Keith R. Miles, Dorothy Carroll, and H.P. Rowledge, published in Perth, Australia, 150 pages, 1945

DLA

For the offering on July 16th, the DLA made no award for tantalum/columbium (niobium) concentrates, it announced on August 8th 2002.

ITIA AND IMOA

The associations for tungsten (ITIA) and molybdenum (IMOA) have recently published calls to their respective industries to register comprehensive data about their products in order to continue trading when the EU New Chemicals Policy becomes a European Regulation. Eurometaux has already tried to raise industry's awareness of the necessity to 'prove that all substances placed on the market are safe'. At its most succinct, this is expressed as 'no data, no market'.

Information on the White paper, published on February 13th 2001, can be found at http://europa.eu.int/comm/environment/chemicals/whiepaper.htm.

MEMBER COMPANY NEWS

Angus & Ross/Cabot

Angus & Ross announced on August 16th that Cabot Corporation had invested in new shares in Angus & Ross, bringing Cabot's total investment to £1.07 million, 18.4% of the company's issued shares. The mining company continues its exploration in Greenland, its target is a resource of 15 million tonnes at 500 ppm Ta_2O_5 and 6000 ppm Nb_2O_5.

AVX

AVX Corporation reported net income of $1.3 million for the quarter ended June 2002. Sales unit volumes had increased at a higher rate than predicted, and selling price pressure slowed as production capacity utilization in the industry increased, commented CEO and President Mr Gilbertson, adding that cost savings had helped to improve profitability.

AVX/Cabot

AVX Corporation announced on August 5th 2002 that it had filed a complaint against Cabot Corporation in the US District Court of the Commonwealth of Massachusetts with respect to its existing supply agreement with Cabot for tantalum powder, ore and wire. The complaint claims 'unfair and deceptive practices by Cabot, breach of contract, and other related matters', stated AVX.

Cabot Performance Materials

Cabot Corporation, the parent company, reported a 50% drop in earnings for the quarter ended June 2002 compared with 2001, from $38 million in 2001 to $19 million in 2002. The operating profit of Cabot Performance Materials fell from $31 million in 2001 to $10 million in 2002. Mr Kennett Burnes, Chairman and CEO of Cabot Corp., said that until the electronics markets improve, among other factors, it would be very difficult to predict the results of Cabot Performance Materials' business.

Cambior

Cambior posted a net loss for the quarter ended June 30th 2002, although the loss was much smaller than that posted in 2001. Cambior's 50% share of niobium production from the Niobec mine was 392 tonnes for the quarter, an increase of 10.4% on 2001. During the quarter Niobec received certification of its environmental management system under the ISO 14001 standard, and all Cambior's operations now have this prestigious certification, announced the company.

Epcos

Reporting on its third quarter of 2002 (April 1st to June 30th), on July 31st 2002, Epcos said that expectations of sustained growth raised by double-digit growth rates for new orders during the previous three quarters had not materialised. 'New projects were postponed by customers, price erosion abated less sharply than expected, and the overall business climate in Epcos' European home market deteriorated', the report continued. In the quarter ended June 30th new orders fell 5% and sales fell 3%. On a regional basis, it was noted that in Europe there was a decline in business, and that this was 'most pronounced in Germany where new orders fell 26%', whereas business in North America remained stable and Asia posted growth of 12% in new orders. The decline in new orders from the European automotive electronics and telecommunications industries was 'huge', and the mobile phone business declined, said Epcos.

Net income for the quarter was 'minus 9 million euro', compared with plus 1 million euro for the previous quarter. Although new orders for capacitors were more or less constant compared with the preceding quarter, 'tantalum capacitors and inductors in particular were hit by the slump in telecommunications'. New orders for SAW components, used to filter frequencies in TV sets and mobile phones, dropped away after the World Cup ended. Epcos expects a revival in 'a significant growth industry' as next-generation mobile phones are introduced, but for the moment Epcos assumes that business will 'continue to stagnate'. Restructuring will involve 'write-downs for production machinery' and 'personnel adjustment' affecting some 300 employees in Europe (the company employs 13 000 people worldwide). This will tailor the cost structure of Epcos 'to deliver positive results even against a background of sustained economic difficulties', said Mr Gerhard Pegam.

Sons of Gwalia

As the reporting year of Sons of Gwalia closed in June, the company reported record tantalum production for the quarter ended June 2002 of 716 494 lbs Ta_2O_5 contained, and record production for the year of 2 138 841 lbs Ta_2O_5. Sales for the quarter and for the year were also at record levels. 'Demand for tantalum in the all important electronic sector is slowly improving' commented this company.

Haddington

Haddington International Resources announced on July 12th that it had completed the improvements to its Bald Hill tantalite facility, which would reduce costs. This upgrading had taken daily through-put from 30 tonnes to 45 tonnes, production would therefore be increased 50% over the originally designed level of 145 000 lbs Ta_2O_5 per annum. Record output in one week had been achieved in the week June 18th-25th, at 4573 lb Ta_2O_5.

Kemet

From March 2001 to March 2002 shipments in the capacitor industry were considerably below capacitor consumption, observed Mr Maguire, as customers used up the extraordinarily high levels of inventory they had accumulated. He believed that the capacitor industry was nearing the end of the inventory correction. In 2002, some electronics end markets, such as notebook computers, servers and automotive applications, were growing, but the communications sector had weakened. Innovative products this year included new organic tantalum capacitors. Net earnings in the June quarter 2002 were $3.4 million, compared with $13.1 million in that quarter of the preceding year. One facility in Greenwood, SC, and two in Matamoros, Mexico, were to be closed, to cut costs.

Metallurg

Metallurg announced a loss of $108.8 million for the quarter ended June 2002, compared to net income of $128.7 million for the equivalent quarter of 2001. Mr Alan Ewart said that there were signs of improvement in certain of Metallurg's markets, and the company was currently completing investments in new facilities in the US, the UK and Braazil. Cost reduction programmes had been initiated and would continue throughout 2002.

Ningxia

Ningxia Orient Tantalum Industry, an associate company of Ningxia Non-ferrous Metals, intends to keep its tantalum powder production at around a quarter of its total capacity for the remainder of 2002, reported Metal Pages on August 15th. The company posted a first half net profit of US$1.1 million, a fall of 93.9% from the equivalent period a year ago. The unusually strong markets of 2000 and in the first half of 2001 were given as the reasons for the drop in profits, continued Metal Pages.

Tertiary Minerals

Tertiary Minerals described as 'particularly encouraging' a new discovery of economically significant tantalum grades in a large pegmatite dyke 1.8km to the east of the company's Rosendal deposit in Finland. This would add to the resource base, noted Mr Patrick Cheetham.

Wah Chang

Parent company Allegheny Technologies reported a second quarter net loss of $7.5 million, compared with a net income of $6.2 million a year earlier. Weak demand for commercial aerospace and power generation markets had an impact on the high performance metals segment, and these conditions were expected to prevail for the rest of 2002, said the President and CEO. Subsequently, in an attempt to cut costs, the corporation announced a workforce reduction of 2.6%, mainly in the flat rolled division.