

Perth, Western Australia

On November 5th 1990, delegates of T.I.C. member companies will gather at the Observation City Resort Hotel in Perth for the meeting which will include the Thirty-first General Assembly of the association on November 6th. An extensive technical programme will follow the Assembly, and social events will include a welcome reception on the evening of November 5th, and a dinner on November 6th sponsored by Greenbushes, Pancontinental Mining and Goldrim Mining.

Two plant tours have been arranged. On Wednesday November 7th the delegates will visit the tin and tantalum mine of Greenbushes, as the guests of the company. Pancontinental Mining is arranging a tour of the Wodgina tantalum mine owned by Pan West Tantalum and Goldrim Mining on Thursday, a trip which will involve a thousand-mile flight to Port Hedland.

A ladies' tour to Underwater World and Caversham Wildlife Park on Tuesday will include lunch at the Vines Resort in the Swan Valley, and on Wednesday the ladies may join the group visiting Greenbushes.

This programme contains an exceptional number of papers and tours for a T.I.C. conference and we believe it will appeal widely to those involved with tantalum and niobium.

Invitations have been sent to member company delegates and many pre-registrations have already been completed. Anyone else interested in attending the meeting should contact the T.I.C. as soon as possible, at 40 rue Washington, 1050 Brussels, telephone 32 2 649 51 58, fax 32 2 649 32 69.

Technical programme

Overview of the Tantalum Industry

by Mr Larry O'Rourke, Consultant

A Newcomer's View of the Tantalum Industry

by Mr Anthony J. Grey, Pancontinental Mining

Slag Availability in South-East Asia

by Mr Yoot Eamsa-Ard, Thailand Smelting and Refining, and Mr Rod Tolley, T.I.C. Technical Adviser

Tantalum Carbide Use in the Metal Cutting Industry

by Mr Richard C. Hendricks, Kennametal

Niobium : The Key to Commercial Superconductivity

by Mr William McDonald, Teledyne SC

Mount Weld Rare Earth Deposit

by Mr Robert Duncan, Carr Boyd Minerals

Applications of High Purity Tantalum and Market Trend of Niobium in Japan

by Mr Yoshiharu Nozawa, Vacuum Metallurgical Co Ltd

The Technology of Tantalum Carbide

by Dr Erich Schaschel, Treibacher Chemische Werke

Globalisation of the Solid Tantalum Capacitor Industry

by Mr William Millman, AVX-Kyocera Company

Pollution Control in Tantalum/Niobium Chemistry

by Dr Wolf-Wigand Albrecht, Hermann C. Starck and NRC, with Dr W. Bludbus, Dr J. Eckert, Dr W. Rockenbauer

Soviet Tantalum Industry

by Mr A. Pavlov, Raznoimport

President's letter

The collection of statistics has always been one of the most important activities of the T.I.C.

Unfortunately, issuing the statistics has been delayed since some of the member companies in the "must report" category have not promptly reported their data to the T.I.C. Therefore the shipments of tantalum products to customers for the months of January, February, March and April could be reported only on July 26th 1990.

The great value of statistics lies naturally in their timeliness. Even the best of numbers lose value exponentially with time passed.

I would like to ask all companies involved to cooperate fully and to report promptly, as requested.

Looking forward to seeing you all in Perth at the beginning of November.

George J. Korinek
President

Tantalum news items

1. Since its issue of July 2nd 1990 the London Metal Bulletin has included limits on radioactive elements in the quality definition for its tantalite quotation. It is now for the mineral with 25/40 % Ta_2O_5 , basis 30 %, c.i.f. with maximum 0.5 % ($U_3O_8 + ThO_2$).
2. In early July Hermann C. Starck announced that it had increased the 54 % holding in V Tech that it had acquired from Fansteel at the beginning of the year to 92 %. The balance is held by members of management.

Lithium tantalate

The research work on lithium tantalate which has been quite a feature of the patent and other scientific literature of the past three years is now beginning to bear fruit. Recently Fujitsu offered a complete range of Mini Li tant piezo electric single crystal filters for digital communications systems. They are housed in a sealed metal enclosure measuring only $20 \times 12.5 \times 8.5$ mm and are claimed to be adjustment- and maintenance-free.

Tantalum demand in Japan

In our Bulletin for September 1989, we printed a summary of a report by Mr Yoichiro Takekuro on tantalum consumption in Japan in 1988, and his views on future demand. He has now updated his paper, and his five-year summary (with estimates for 1990) is given in Table 1 (weights in "kg tantalum contained" in the case of compounds and products).

The demand for tantalum powder declined 25% between 1988 and 1989 in spite of an increase of 3% in the numbers of capacitors produced (to 3.6 billion pieces). This is directly attributable to a fall in the average size of capacitors made, and the ever-increasing demand for higher CV powders. The growth rate of 3% in the production of tantalum capacitors, while no doubt welcome, has to be compared with the equivalent growths of 6%, 9% and 6% in output of aluminium, ceramic and film capacitors respectively. Mr Takekuro estimates growth in tantalum capacitor production to be 2% in 1990 over 1989, although he expects purchases by consumers of tantalum materials to rise by 9% as they restock after a major run-down in 1989.

T.I.C. statistics

TANTALUM

PRIMARY PRODUCTION

(quoted in lb Ta₂O₅ contained)

	1st quarter 1990	2nd quarter 1990
Tin slag (2 % Ta ₂ O ₅ and over)	154 031	257 158
Tantalite (all grades), other	125 173	142 574
Total	279 204	399 732

Note :

18 companies were asked to report, 17 replies were received for the first quarter, 16 for the second. The companies which reported included the following, whose reports are essential before the data may be released :

Datuk Keramat Smelting
Greenbushes
Malaysia Smelting
Mamoré Mineração e Metalurgia
Metallurg group
Tantalum Mining Corporation of Canada
Thailand Smelting and Refining

QUARTERLY PRODUCTION ESTIMATES

(quoted in lb Ta₂O₅ contained)

LMB quotation :	US \$ 30	US \$ 40	US \$ 50
3rd quarter 1990	246 500	381 500	437 500
4th quarter 1990	235 500	380 000	432 500
1st quarter 1991	235 500	380 000	432 500
2nd quarter 1991	225 500	380 000	432 500
3rd quarter 1991	225 500	380 000	432 500

Note :

The quarterly production estimates are based on information available, and do not necessarily reflect total world production.

PROCESSORS' RECEIPTS

(quoted in lb Ta contained)

Total receipts for the
1st quarter 1990 643 166

Note :

15 companies were asked to report, and all 15 replied.

PROCESSORS' SHIPMENTS

(quoted in lb Ta contained)

2nd quarter 1990

Product category	
Ta ₂ O ₅ , K ₂ TaF ₇	28 017
Alloy additive	33 598
Carbides	137 311
Powder/anodes	245 510
Mill products	83 382
Ingot, unworked metal, other, and scrap	20 303
Total	548 121

equivalent to 739 909 lb Ta₂O₅.

Notes :

1. 15 companies were asked to report, and all 15 replied. Reports by the following companies are essential before the data may be released :

Cabot Corporation, Electronic Materials
and Refractory Metals
W.C. Heraeus
Kennametal
Metallurg Group
Mitsui Mining and Smelting
NRC Inc.
Showa Cabot Supermetals
Hermann C. Starck Berlin
Treibacher Chemische Werke
Vacuum Metallurgical Company
V Tech

2. Reports were made in lb tantalum contained.

Capacitor statistics

U.S. TANTALUM CAPACITOR SALES

(thousands of units)

1st quarter 1990

Foil	200
Metal-cased	20 911
Moulded	74 556
Dipped	92 560
Chips	71 995
Wet slug	2 048
Total	262 306

(Data from EIA)

EUROPEAN TANTALUM CAPACITOR SHIPMENTS

(thousands of units)

1989 and 1st quarter 1990

	1989	1990
1st quarter	170 530	183 306
2nd quarter	173 672	
3rd quarter	160 227	
4th quarter	149 495	

(Data from ECTSP)

JAPANESE TANTALUM CAPACITOR PRODUCTION AND EXPORTS

(thousands of units)

1989 and 1st quarter 1990

	1989	1990
1st quarter	885 371	924 392
2nd quarter	916 492	
3rd quarter	889 050	
4th quarter	918 766	
of which exports	205 857	264 040
	205 039	
	242 893	
	243 857	

(Data from JEIDA)

	1986	1987	1988	1989	1990
Tantalum powder	85 120	109 125	158 652	119 660	130 000
(of which imports)	(19 150)	(22 448)	(35 438)	(27 877)	(23 000)
Tantalum compounds	50 320	48 320	55 340	59 320	59 000
(of which imports)	(14 300)	(14 500)	(17 000)	(24 300)	(24 000)
Tantalum processed products (imports)	34 554	42 034	78 732	47 702	49 920
	(14 748)	(20 890)	(46 007)	(24 495)	(23 030)
Total demand	169 954	199 478	292 724	226 682	238 920
of which imports	(46 198)	(57 838)	(98 445)	(76 672)	(70 030)
Import share %	27	29	34	34	29

Table 1. Japanese tantalum demand 1986-90

The percentages by weight of the various uses of this demand are given in Table 2 (figures are percent of total annual demand).

	1986	1987	1988	1989	1990 est
Electronics industry	66	70	68	69	69
Cemented carbide alloys	22	17	13	19	18
Ceramic industry	8	7	6	7	6
Others	4	6	13	5	7

Table 2. Percentage consumption of tantalum by use 1986-90

Mr Takekuro is concerned on strategic grounds that imports of tantalum powder, compounds and finished items expressed as a proportion of total demand have stayed high: he expects however that both the market share and weight of imports, at least of tantalum powder, will decline in 1990. He attributes this to the continuing expansion by the major capacitor manufacturers of their offshore production, and to a change in the distribution route of imports in the latter half of 1989.

that in the Kuala Lumpur tinfields, except for some isolated occurrence, it is virtually absent. In the present samples, the only struverite collected from the Kuala Lumpur area comes from Yew Hing Mine, located on the road to Ulu Langat.

Struverite is fairly magnetic and is mainly found in the magnetic fraction together with monazite and tourmaline. The magnetic property of this mineral is governed by its iron content.

Niobium-tantalum minerals in peninsular Malaysia

Much of the niobium and tantalum co-produced with tin in Malaysia reports in the tin smelters' slags, but there is some recovery of mineral columbite-tantalite, and also of struverite (which is fairly low in tantalum, and so tends to be recovered more at times of high prices for the metal).

The following relevant excerpts from a recent paper (Bull. Geol. Soc. Malaysia Oct. 89, pp. 1-12) by Dr Wan Fuad Wan Hassan of the National University Malaysia are reproduced with his permission.

Two types of associations are recognised from the Malaysian tin pegmatites, namely the Semiling-Bakri association and the Chenderiang association (see map). The Semiling-Bakri type contains abundant columbite-tantalite in addition to cassiterite. Also identified in small amounts were wodginite, fersmite, tapiolite, euxenite, and gahnite together with the normal rutile, monazite, xenotime, tourmaline, etc. Indeed, columbite-tantalite is a major by-product of the tin mining operations in Semiling and Bakri.

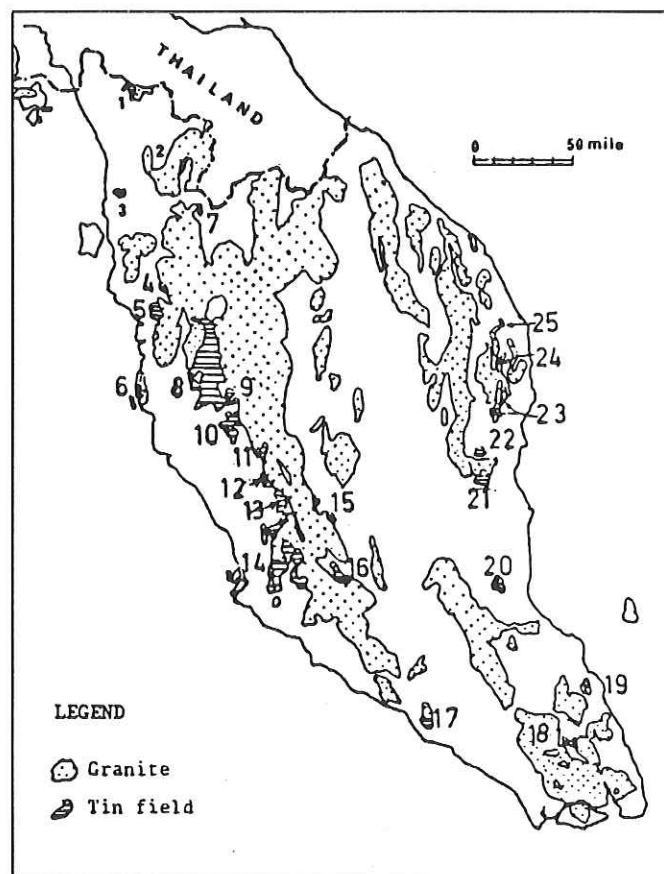
Between the Semiling and the Bakri pegmatites themselves, some mineralogical differences are noted. The Semiling samples are relatively rich in gahnite, while the Bakri samples contain more varieties of the niobium-tantalum minerals such as wodginite, fersmite, and tapiolite.

Chenderiang tin deposit was described as pegmatitic by Ingham and Bradford (1960). During the writer's visit to the area, the pegmatite outcrops are no longer available. Examination of the coarse amangs from the mines shows the presence of coarse pebbles of tourmaline, struverite, cassiterite, topaz and quartz, which convinced the writer of their pegmatitic origin. A single quartz crystal observed has a diameter of about 10 cm.

Cassiterite is the dominant economic mineral. Columbite-tantalite, which is abundant in Semiling and Bakri, is notably rare in Chenderiang. Lepidolite, a lithium mica, is reported to occur in the pegmatite. The rarity of columbite-tantalite and the presence of topaz and lepidolite differentiate the Chenderiang pegmatite from the Semiling-Bakri type.

STRUVERITE

Struverite or niobium-tantalum rutile is rather limited in distribution; it is mainly found in the Western Tin belt of the peninsula, and is rather rare in the east coast. It is particularly common in Kinta Valley, especially at Tanjung Tualang, Kampong Gajah, and Chenderiang. The struverite occurrence dies away towards the south of Kinta Valley so



- | | | |
|------------------|-----------------------|----------------------|
| 1 Sintok | 11 Selim | 21 Gambang |
| 2 Baling | 12 Kelian-Kalumpang | 22 Sungei Lembing |
| 3 Semiling | 13 Serendah - Ulu Yam | 23 Bandi |
| 4 Selama | 14 Kuala Lumpur | 24 Bukit Tulis, Paka |
| 5 Taiping | 15 Bentong - Karak | 25 Bukit Besi |
| 6 Segari | 16 Titi | |
| 7 Klian Intan | 17 Bakri | |
| 8 Kinta Valley | 18 Pelepah Kanan | |
| 9 Chenderiang | 19 Jemaluang | |
| 10 Tapah - Bidor | 20 Bukit Payong | |

The Toongi Project in Australia

(The following article is reprinted, with permission, from the 1989 Annual Report of Alkane Exploration NL, the owners of the project.)

The Toongi Project is located 20 kilometres south of the large regional town of Dubbo in central New South Wales, approximately 410 kilometres north-west of Sydney.

The potential of the deposit was recognised in 1988 and a pre-feasibility study completed in mid-1989 indicated the possibility of a two-stage development, initially producing high purity zirconia (ZrO_2), yttria-rare earth concentrate ($Y_2O_3 + REO$) and tantalum/niobium pentoxide (Ta_2O_5/Nb_2O_5).

Dependent upon market demand and development of a suitable process, further downstream separation and refining are possible to produce zirconia, yttria, hafnia, tantalum pentoxide, niobium pentoxide and selected individual rare earth oxides.

GEOLOGY AND RESOURCES

The deposit consists of a small discrete intrusive stock of hydrothermally altered trachyte (alkaline volcanic rock) which contains highly elevated levels of rare metal and rare earth elements. The stock is roughly elliptical with dimensions of 600 x 400 metres and a surface area of approximately 185 000 square metres. Toongi forms one of a number of trachytic intrusive bodies of varying size within the Dubbo E.L., but few show the elevated levels considered necessary for economic development.

Weathering is limited to generally less than 1 metre but oxidation is apparent down to approximately 10 metres. The oxidation has little or no effect on the host rock or on the mineralisation.

Limited percussion and diamond drilling combined with surface sampling defined the following:

INDICATED RESOURCE :	10 million tonnes grading
0-30 metres :	2.1 % ZrO_2 ,
	0.05 % HfO_2 ,
	0.14 % Y_2O_3 ,
	0.56 % Nb_2O_5 ,
	0.036 % Ta_2O_5
	0.75 % REO
INFERRED RESOURCE :	40 million tonnes at similar
30-100 metres :	grades
TOTAL :	50 million tonnes

An initial mining assessment indicates that the deposit could be mined by conventional open cut techniques to at least 100 metres vertical depth with the waste to ore ratio being less than 1:1.

METALLURGY

Early metallurgical tests aimed at producing a mineral concentrate were not encouraging but a bench scale programme carried out in 1989 using a selective acid leach technique gave very positive results. This work was based upon three samples from the diamond drill hole TOD 1 and gave recoveries of 57-98 % zirconium, 85-97 % yttrium, 67-79 % niobium and 89-98 % selected rare earth elements.

No attempt was made with this programme to optimise operating parameters and it is believed that significant improvements can be achieved with further test work.

FEASIBILITY STUDY

In order to generate an understanding of the potential of the project, Dema Pty Ltd, Perth-based project development consultants with specialist knowledge in the processing and marketing of rare metals and rare earths, was engaged to undertake a pre-feasibility study. This study examined the status of the technical data and recommended a work programme and possible development strategy based on the initial financial evaluation.

This concept involved a two stage development: the first would produce zirconia (99.6 %), yttria-rare earth concentrate (92-95 %), and a tantalum-niobium concentrate (95 %), all of which are believed to be readily marketable; a possible second stage would develop further separation and refining facilities to produce a suite of high purity metal oxide products.

POSSIBLE PRODUCTION SCENARIO

Based upon an ore treatment rate of 200 000 tonnes per annum the first stage development would produce:

$ZrO_2 + HfO_2$ (99.6 %)	3500 tonnes
$Y_2O_3 + REO$ (92-95 %)	1600 tonnes
Equivalent Y_2O_3	250 tonnes
$Ta_2O_5 + Nb_2O_5$ (95 %)	875 tonnes
Equivalent Ta_2O_5	25 tonnes

The results have encouraged the company to proceed to a preliminary feasibility study which will involve further drilling to more accurately

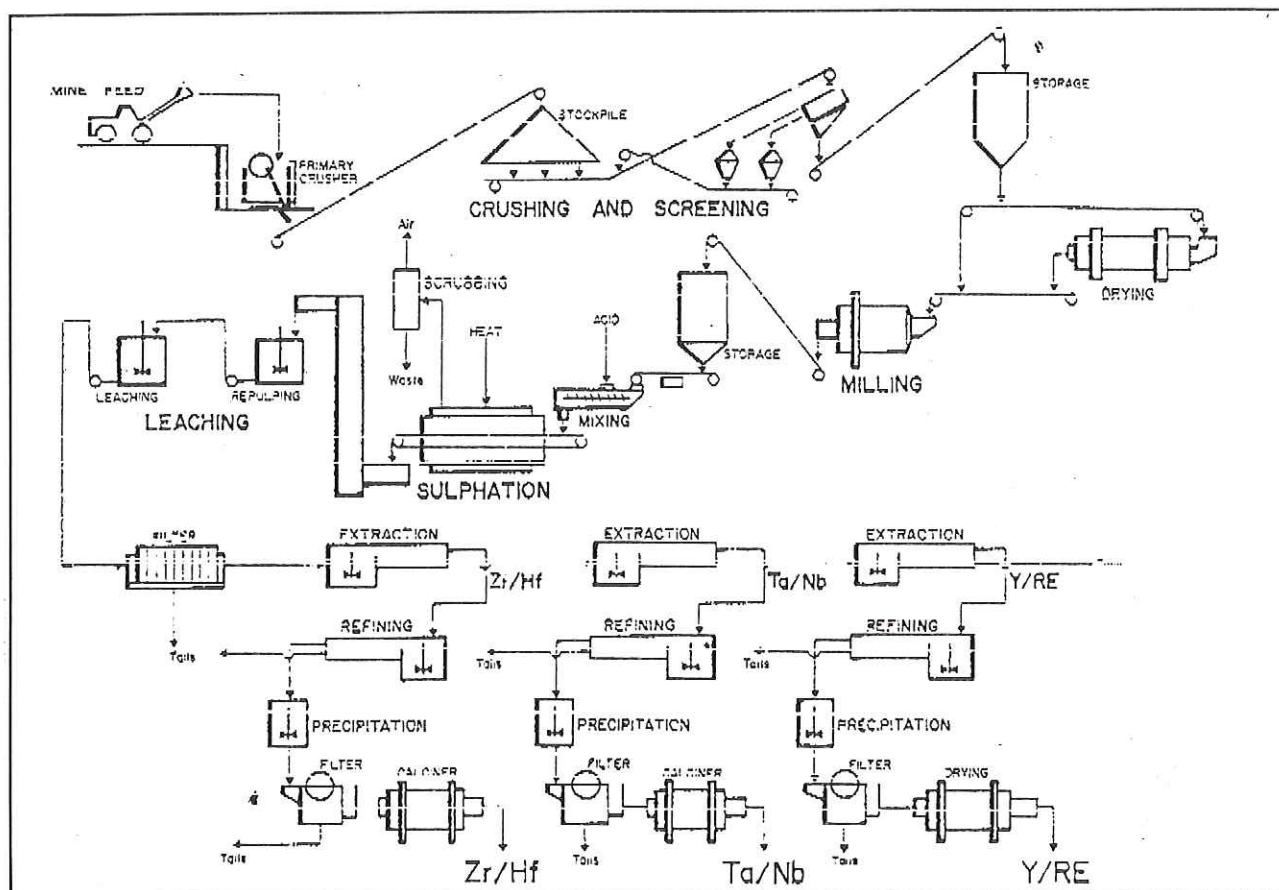


Figure 1:
Toongi Project - Conceptual flow sheet

define the ore resources, examine possible grade variations within the body and eliminate any analytical uncertainties. The drilling will also provide additional sample material for optimisation of the metallurgical processes.

Although it is not a mineral sands deposit, the company considers it has the potential to become a significant world class resource of zirconium, yttrium, niobium, tantalum and rare earth elements. The grades and contained metal compare more than favourably with large mineral sands deposits such as Encabba and Wim 150 for Toongi to become a potential long term supplier of yttria, zirconia and rare earth elements.

Europe in the 1990's

In May, the Non-Ferrous Metals Committee of the Belgian Engineering Society organised a conference on the effect of the single market on the metal trade in Europe after 1992. Our Secretary General, Mrs Judy Wickens (who is a member of the committee) attended, and has now received the text of the keynote speech given by a partner of Price Waterhouse. Points which may be of interest to T.I.C. members are :

- the establishment of research and development programmes under the Uniform Act of 1987. The 1987-91 budget was set at 5.4 billion ECU, and covers eight specific areas : the quality of life; telecommunication and information; modernisation of the industrial sector; biological resources; energy; science and technology at the service of development; marine resources; and European scientific and technological cooperation. One item of R & D specifically covered concerns the recycling of non-ferrous metals, and the budget for this programme for the period 1990-1992 is 45 million ECU. The Commission will put up 50 % of the cost of any R & D project covered under this heading, and involvement of small and medium-sized companies is encouraged. At present the Commission is concerned with the recovery of nickel, chromium, wolfram, aluminium and zinc.
- the development of non-nuclear energy sources (in particular solar, wind, geothermal and bio-mass) and the improvement of energy distribution within the Community. With regard to electricity, the speaker remarked that this might have a significant effect on copper usage, and on the development of other conducting materials such as new alloys.

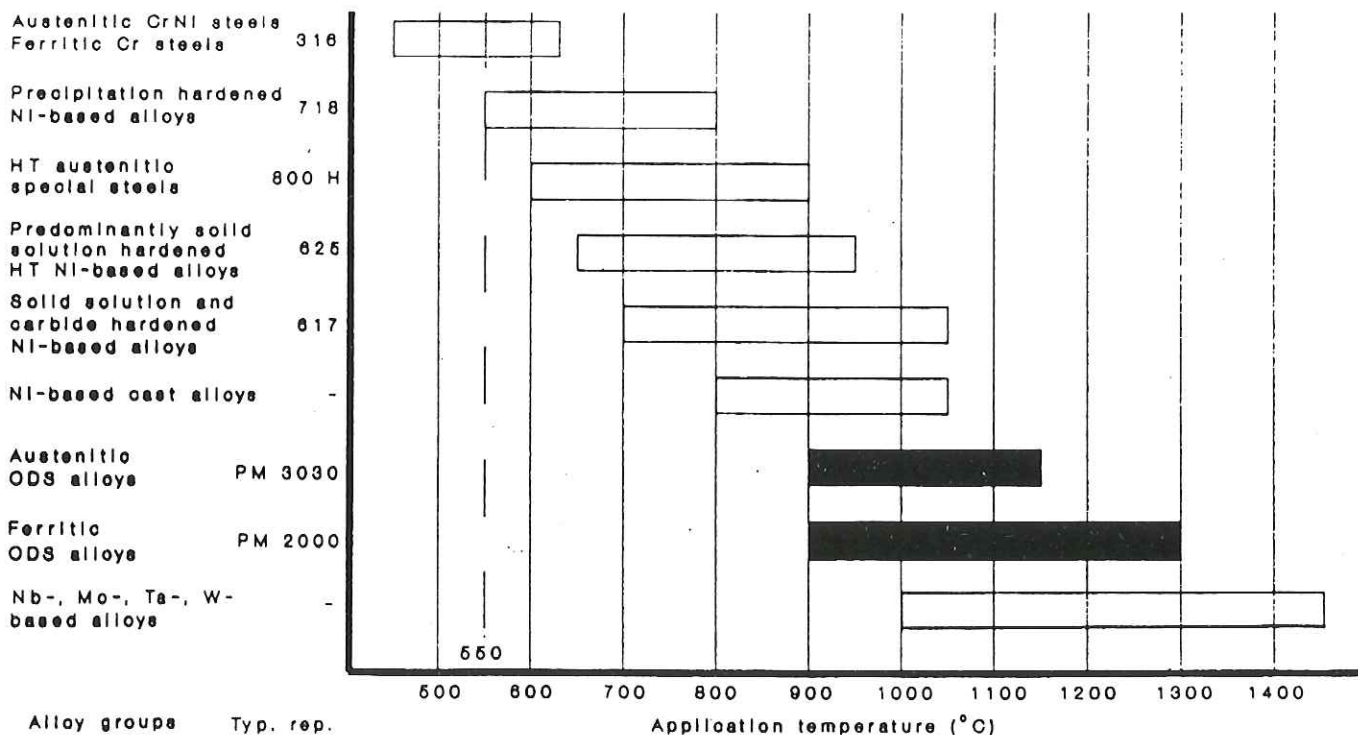
- the encouragement of competition and the removal of unfair practices. The latter particularly concerned "dumping" and examples were quoted of Japanese titanium and Chinese tungsten. The speaker remarked that the EEC in the past had been accused of acting far too slowly on such matters : he hoped for an improvement in this, and other of the Commission's services.
- the encouragement of transnational cooperation between companies, especially smaller firms, established in member countries, and the resulting need for consistent company legislation and protection of intellectual property (invention and trademarks).
- the mobility of labour of all grades, with a supporting social charter of working conditions (not yet agreed to by the United Kingdom), and mutual recognition of diplomas of higher education (for courses of not less than three-years' duration after secondary studies).

The non-ferrous metal sector in Europe is faced with great challenges, but also opportunities : mergers and trade associations will be formed to take advantage of the new political structure in a decade of great change.

Powder metallurgy 90

The above exhibition in conjunction with a conference of the same name was held from 2-6 July this year and attracted 200 exhibitors from 20 countries. Much of it was concerned with equipment for pressing and sintering, and with the applications of the enormous diversity of powder mixes now used for fabrication of special shapes and inserts. Metallic hard materials based on tungsten and titanium carbides were represented by our T.I.C. member Hermann C. Starck (with its great range of tantalum and niobium compounds), by GTE and by Metallwerk Plansee who were showing their austenitic ODS (oxide dispersal strengthened) alloy PM 3030 nickel based, containing yttrium oxide and tantalum (see performance diagram below) as well as the proceedings of their recent seminars on their ODS alloys, refractory metals and superconductors.

Kinetic energy armour-piercing materials on offer and shown by Royal Ordnance Specialty Metals use WIMET high density materials, all tungsten or tungsten carbide based : tantalum usage was restricted to nose cones.



High Temperature Materials-Range of Application Temperature

SYMPOSIUM PROCEEDINGS

Some copies of the Proceedings of the International Symposium on Tantalum and Niobium held in Orlando, Florida, in 1988 are still available, \$ US 80 including post and packing. Apply to the T.I.C. with your order.