The Titanium Industry in Japan - The present and the future

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ABSTRACT

The current situation in the titanium industry in Japan, covering both titanium mill products and sponges is described. Looking to the future, the Japan Titanium Society has been working to create a long-term vision for the industry, analyzing technical and marketing aspects for emerging applications of titanium. Other major subjects are also discussed, including key factors for international collaborations which need to be addressed for the healthy growth of titanium industries worldwide.

Key words : mill, sponge, aerospace, civil, architecture, marine, medical, cooperation, LCCA

1. THE CURRENT CONDITION OF THE JAPANESE TITANIUM INDUSTRY

1.1 TITANIUM MILL PRODUCTS

It is just 50 years since research to produce titanium sponges started in Japan. During this period, titanium industry in Japan, including mill product and sponge producers, have enjoyed steady growth despite experiencing difficult situations from time to time. As shown in Figure 1, mill product shipments in Japan exceeded the long anticipated milestone of 10,000 tons in fiscal 1996 for the first time, and attained a record high of 13,597 tons in fiscal 1997. Although total shipments in fiscal 1998 suffered unavoidable adverse effects from sluggish economic conditions in Japan and other Asian countries, they maintained a high level of 12,500 tons. Average annual growth of titanium mill products in Japan has been nearly 8% since commercial production began in 1951, which is significantly higher than for conventional materials.

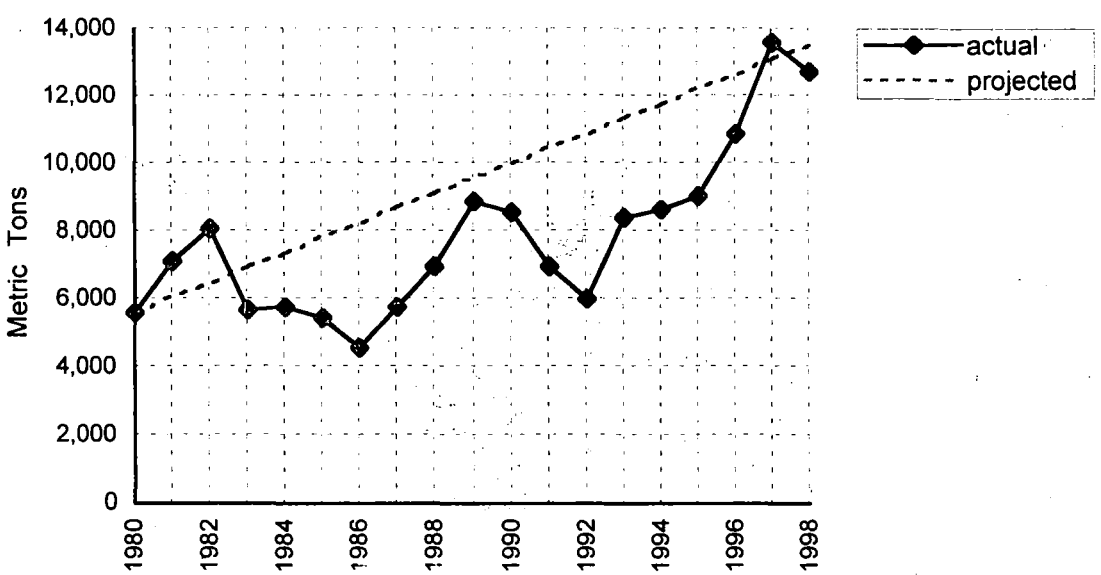

Fig. 1 Shipments of titanium mill products
[Source: The Japan Titanium Society (JTS)]

The three major characteristics of wrought titanium industries in Japan are the following:

1.1.1. *Concentration on civil industrial markets*

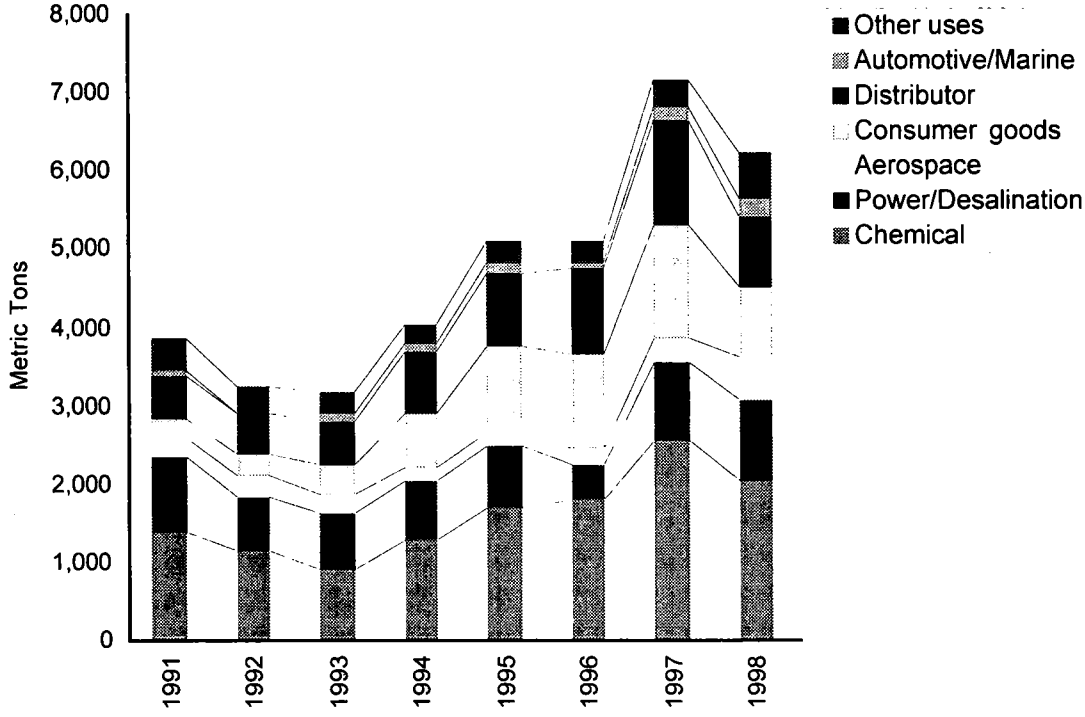

Fig. 2 Domestic shipments of mill products (1991-98)
[Source: JTS]

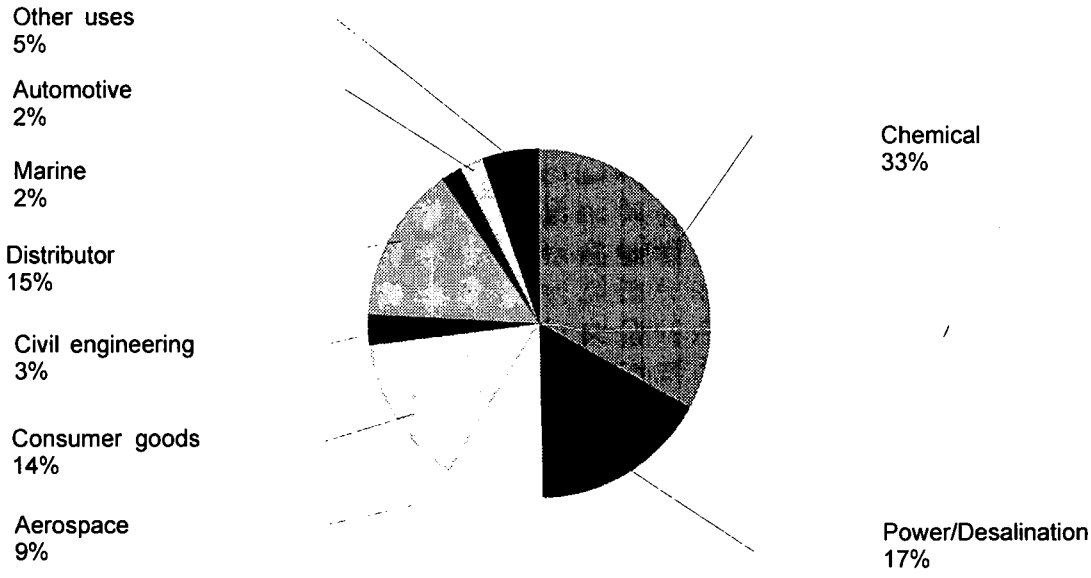

Fig. 3 Domestic shipments of mill products in 1998
[Source: JTS]

Only 9% of total domestic shipments of titanium mill products are to the aerospace industries, while nearly 40% of worldwide shipments are to either the military or aviation sectors. Instead, wrought titanium producers in Japan have concentrated their efforts on the development of various civil industrial applications for the chemical, fossil fuel power and nuclear power industries. Vibrant new markets for titanium mill products emerged one after the other -- chemical industries such as oil, textiles and fertilizers in the 1960's, soda electrolysis in the 1970's, and condensers for power plants and desalination in the 1980's. Figures 2 and 3 give a breakdown of mill product shipments by application.

1.1.2. *Oriented towards commercially pure titanium*

Commercially pure titanium accounts for more than 90% of domestic mill product shipments. This is because most titanium applications in Japan require corrosion resistance and lightness, whereas in Western countries, the military and aerospace industries need high-strength titanium alloys.

1.1.3. *Interactions between sponge producers, wrought titanium producers, fabricators and customers*

Interactive studies to develop new applications have been carried out for each phase of processing. In the development process for golf clubs, for instance, many alliances consisting of mill product producers, fabricators, designers and even customers were formed, and competed with each other on quality, cost and design. Exchanges of ideas in these three areas contributed a great deal to the huge growth in the market for golf clubs. Academic societies, together with the Japan Titanium Society, have supported and coordinated such interaction.

I am convinced that the wrought titanium business in Japan is entering a new era in which truly epochal growth for the industry is possible based on the experience accumulated from the development of new durable consumer goods applications. Titanium eyeglass frames, watchcases, earrings and accessories, bicycle parts, fishing equipment and cooking appliances have become more popular than ever in our daily life. In fact, shipments of titanium mill products for consumer goods, sports and leisure goods, and civil engineering uses, and to distributors and retailers accounted for more than 40% of domestic shipments in fiscal 1997.

There is an old saying that 'Rome was not built in a day.' The phenomenal expansion of titanium demand for industrial uses and consumer goods in Japan is the culmination of the diligent efforts of all participants, including producers, processors and customers. For example, we producers have improved product quality, making shapes more precise and designs more flexible. We have helped train fabricators by instructing them in welding techniques. We have also collaborated with designers, constructors and fabricators to launch new building materials. Recently the US and European titanium industries have been actively studying new non-aviation applications in order to secure steady growth for the industry. It seems to me that the development of the titanium industry in each country is now linked to that in other countries, and international cooperation in research and development has been enhanced. I am convinced that the role of the titanium industry in Japan can be increased by participating in joint research projects with overseas partners using the global information network.

1.2. TITANIUM SPONGES

Titanium sponge production in Japan has been affected by the titanium business cycle in the 1990's.

After reaching a peak of 25,086 tons in 1990 thanks to the boom in demand from commercial aircraft industries, the shipment of sponges suffered greatly in the worldwide recession from 1991 through 1995. Titanium sponge producers in many countries ceased operations amid a global reorganization of titanium businesses. One of the three Japanese sponge producers ceased operation in 1994.

World sponge shipments enjoyed a significant recovery in 1996 mainly due to renewed growth in commercial aerospace industries. An increase not only in the number of aircraft planned for manufacture, but also in the unit consumption of titanium per aircraft contributed to the latest upward surge in sponge shipments. Sponge shipments in Japan bounced back to the 20,000 ton mark in 1996 and remained high through 1997 and 1998, at 24,578 tons and 23,819 tons, respectively. Figure 4 shows titanium sponge shipments in Japan for the period 1980-98.

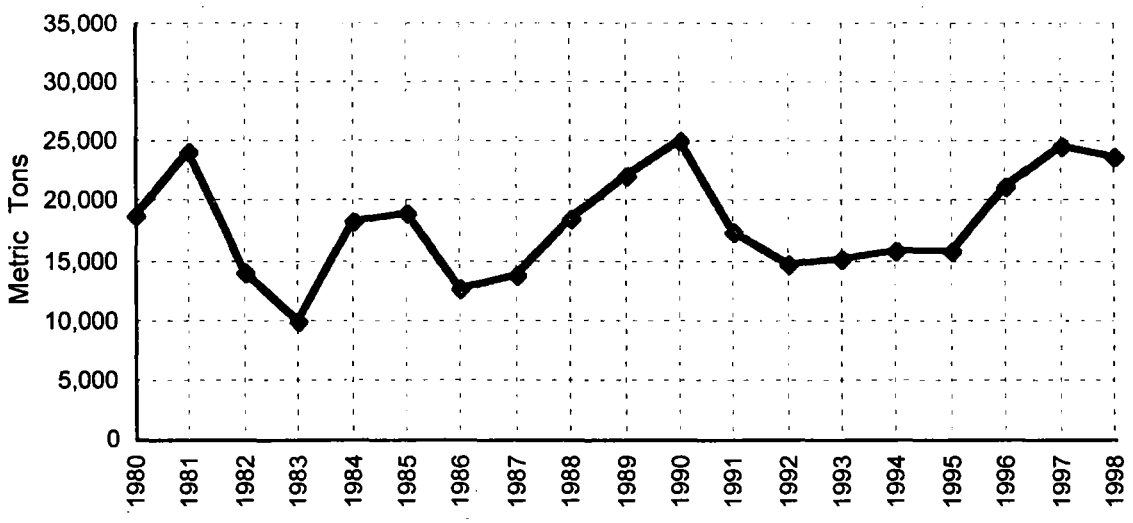

Fig. 4 Total shipments of titanium sponges (1980-98)
[Source: JTS]

Current titanium sponge production capacity in Japan is estimated to be 25,800 tons per annum, or nearly 23% of world capacity, the second largest after the former CIS countries. It is noteworthy that, at full-capacity operation, the output of Japanese sponge producers accounts for more than 30% of world production. The fact that the actual production share of Japanese sponge producers exceeds their share of capacity proves the high quality of their products.

According to statistics for sponge shipments in Japan in the 1990's, domestic shipments remained fairly flat, whereas exports have sharply increased since 1996, mainly because of a surge in demand for high quality sponges for aerospace applications. Exports in 1997 reached 12,500 tons, which was nearly 3.5 times as much as in 1992. Meanwhile, demand for sponges in Japan increased, most additional requirements being covered by imports from the former CIS countries. Figure 5 gives a breakdown of titanium sponge shipments for the period 1991-98.

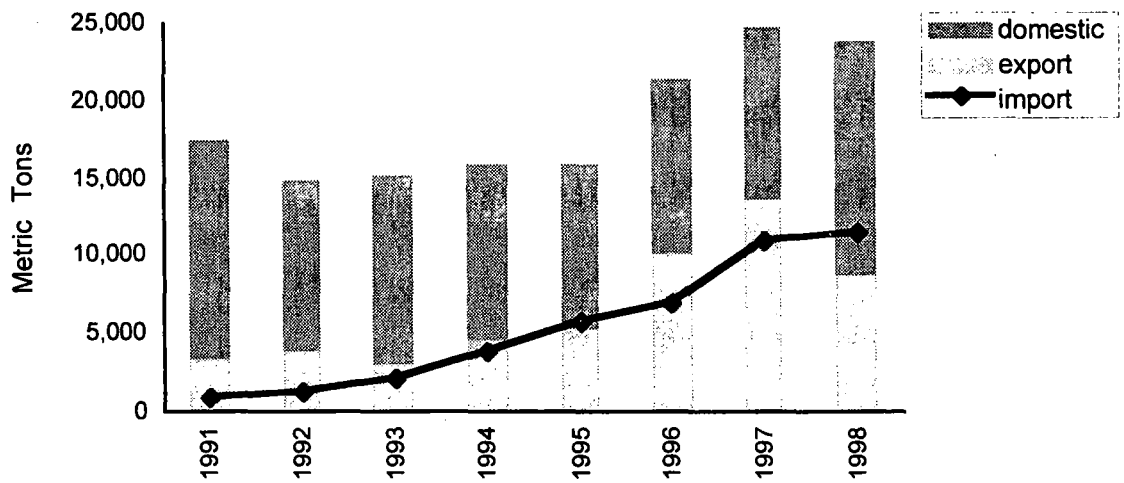

Fig. 5 Titanium sponge shipments (domestic, export) and import
[Source: JTS]

Inventory adjustment seems to be currently under way for various titanium components for aerospace industries. Once excess stocks held by fabricators are reduced, however, exports of sponges produced in Japan will increase again. The contribution of Japanese producers to sustaining world aerospace industries is not limited to the quantity of their output. Recently, customers in the aircraft engine sector have been demanding higher quality sponges. I firmly believe that Japanese sponge producers can fully respond to such challenging requirements while at the same time bringing down production costs as higher grade markets are steadily growing.

2. THE FUTURE OF THE TITANIUM INDUSTRY IN JAPAN

The titanium industry in Japan, which has maintained a high level of production and shipments for the past few years, is set to pass through a period of reorganization in 1999 and 2000 mainly because of a downward revision in commercial aircraft production plans and the cancellation of big industrial projects in both the private and government sector in South East Asian countries.

Even under such difficult conditions, we must redouble our efforts to broaden the potential for new applications as well as to reduce titanium production costs. The diversification of lifestyles, interest in an improved quality of life, increased environmental consciousness and the emergence of the aging society, are all trends that give titanium a good opportunity to transcend its current position as a very high performance metal for special purposes, and to become a popular and familiar metal used in every aspect of our daily lives.

In 1992, the Japan Titanium Society drew up the first long term vision for the titanium industry in Japan, which included demand projections, shipment targets and research subjects up until the beginning of the 21st century. Shipments of mill products exceeded 13,000 tons in 1997, four years earlier than the target year set out in the vision.

At present, the Japan Titanium Society is revising and extending its long term vision to cover the ten years to 2009. Figure 6 shows the previous and revised forecasts for titanium mill products. In the new version, projected demand for mill products in 2009 is 30,000 tons, 2.4 times as much as in 1998, and technical and marketing issues to be tackled in the coming ten years are listed by market segment, both for existing and emerging segments. Potential cost reduction measures to enable titanium to compete with conventional materials will also be technically analyzed.

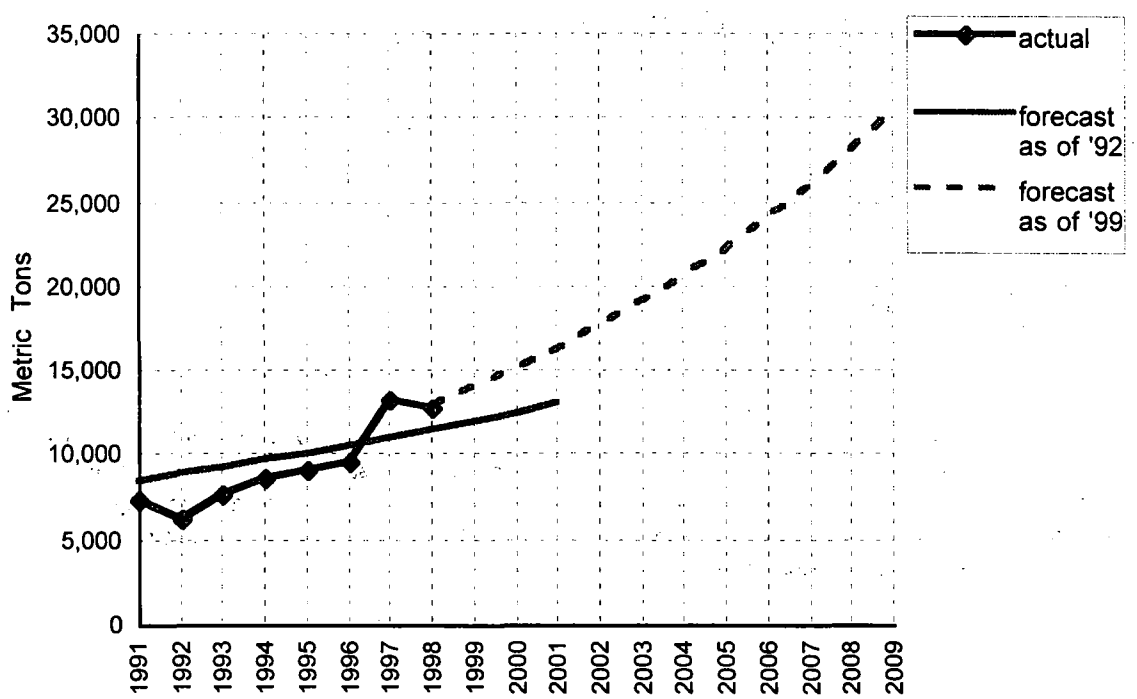

Fig. 6 Projection of titanium mill product shipments up to 2009 [Source: JTS]

The Japan Titanium Society has been explaining the excellent properties of titanium as an 'Ecological Material' to industrial bodies as well as directly to consumers. An 'Ecological Material' is defined as a material from which maximum utility can be obtained, whose production, use and recycling creates less of an environmental burden. With the growing popularity of the Life Cycle Cost Assessment (LCCA) method in evaluating potential impacts on the human body, ecosystems and the environment, the advantages of titanium over conventional metals are becoming increasingly clear, even though initial material costs and fabrication costs for titanium are higher.

Typical examples of new applications for titanium in Japan include the following fields:

A. Architecture

The cumulative amount of titanium employed in the contruction of roofs and walls in Japan since it first came to be used in architecture has now reached around 1,300 tons. Titanium's high strength to weight ratio, good resistance to corrosion by sea water, and maintenance-free characteristics make it economical in the long run and decrease the burden on the environment. These properties, together with its potential for being shaped into sophisticated designs, promise new titanium applications not only for public architecture but also individual housing. An example of titanium's use in architecture is shown in Photo 1.

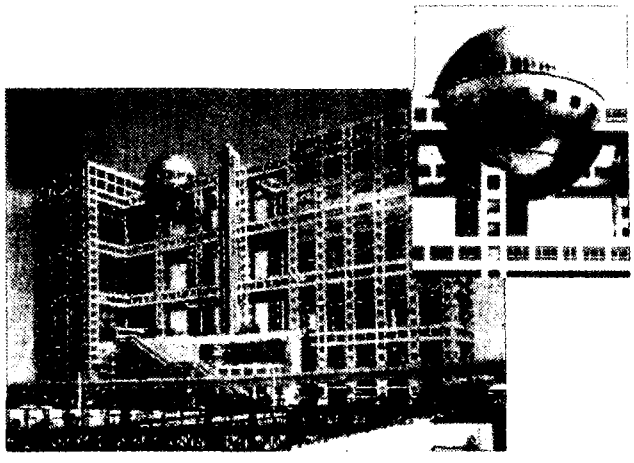

Photo 1.: Spherical Observation Room of Fuji Television Headquarters in Tokyo

[Source: NIPPON STEEL CORPORATION]

B. Offshore construction and Marine transportation

Offshore construction and marine transportation are considered huge emerging markets. A marine mega-float project in Japan has proceeded to its second phase, in which technology is being developed to allow actual use in constructing an airport. During the first phase, titanium clad steel was used in splash and tidal zones, taking advantage of titanium's potential to resist corrosion for a hundred years and its lack of adverse impact on the environment. This is shown in Photo 2. In the same way that titanium is now being increasingly used in the construction of tank trucks, it is expected that titanium will take the place of stainless steel in the construction of chemical tankers for carrying phosphoric acid.

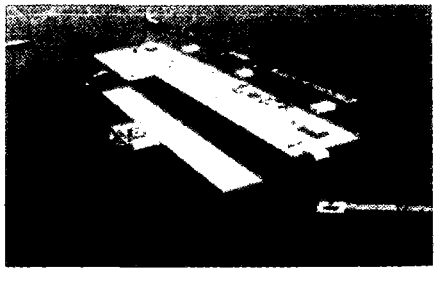

Photo 2.: Very large floating structures form part of an experiment at Yokosuka
[Source: Mega-Float Technological Research Association]

C. Medical and Welfare Facilities

Titanium's non-toxic characteristics promise potential applications for medical and welfare facilities. Its light weight, non-allergic properties and resistance to corrosion by chemicals have recently opened up a new market for titanium's use in the construction of wheelchairs. Other potential medical applications are pictured in Diagram 1.

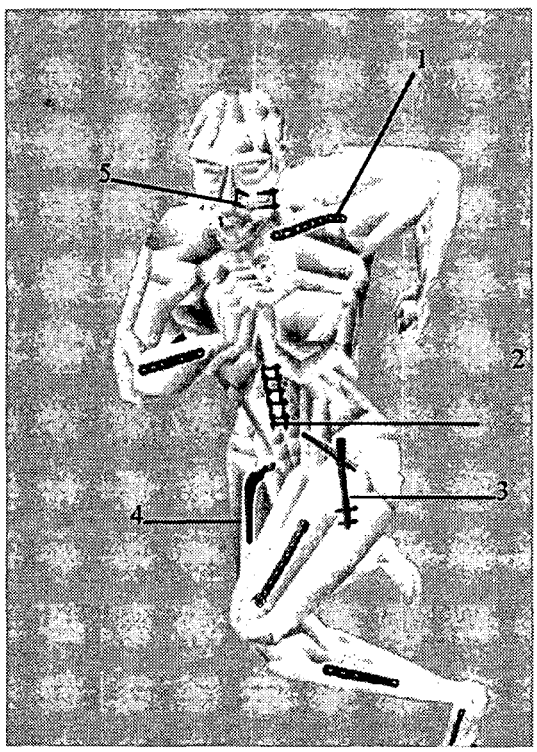

Diagram 1:

Medical applications

1.Diaphysis plates 2. Perdicle screw 3. Intramedullary nail

4. Hip joint prosthesis stem 5. Dental devices

[Source: DAIDO STEEL Co., Ltd.]

3. PROPOSALS ON INTERNATIONAL COOPERATION

No one company, nor any one country, can explore the frontiers for applications and usage of titanium alone. It is essential that the fruits of research and development and market development activities be expanded around the world in a timely fashion, through the exchange of information internationally.

At the 8th World Conference on Titanium held in Birmingham, the former chairman of the Japan Titanium Society made imaginative proposals on the promotion of concrete international cooperation. Although recognizing the progress made in the intervening four years, I would like to renew his message here, and repeat the following three subjects as initial steps for strengthening such collaboration in the changing environments surrounding titanium industries around the world.

3.1. COLLECTION AND PUBLICATION OF TITANIUM STATISTICS FROM ALL TITANIUM PRODUCING COUNTRIES

Firstly, I would like each titanium producing country to establish a formal system of collecting and publishing detailed annual statistics on its titanium industries. The exchange of information through the collection and

publication of statistics by country is the first step toward international cooperation. In order to enhance the stable and steady growth of titanium industries worldwide, accurate data about demand/supply, output/consumption, import/export and nominal/actual production capacity by country is indispensable. Before entering the next century, I look forward to exchanging ideas about the future of world titanium businesses with all people involved in different countries, based on a common understanding supported by such kinds of objective numerical data.

3.2. PROMOTING GLOBAL UNIFICATION OF INDUSTRIAL STANDARDS FOR TITANIUM

Secondly, I would like to stress the necessity of promoting the global unification of industrial standards for titanium. At present, each country employs its own industrial standards for various titanium products. In order to develop new applications for titanium and promote global marketing activities, it is necessary to unify different standards in different countries into worldwide standards. Such unification might cause conflict with the business strategy of an individual company. I firmly believe, however, that such standardization would broaden the foundation of titanium markets in the long run, thus compensating for the painful efforts and patience of each participant.

3.3. ESTABLISHMENT OF DATA-BASES FOR TECHNICAL INFORMATION RELATED TO TITANIUM

My third and final proposal is to promote the establishment of data-bases for various technical information released by worldwide titanium industries. The establishment of a data-base dedicated to research into Life Cycle Cost Analysis(LCCA), for instance, which can be internationally accessed through an information network, would be useful for differentiating titanium from such alternative materials as stainless steel and copper. I expect that many projects which extend beyond national boundaries will emerge in the near future, utilizing such data-bases and sharing intelligence with each other to open a new era for titanium industries.

I believe all three measures will not only promote the global penetration of titanium products, but also enable all titanium producers to efficiently match their resources to the existing and emerging needs of world titanium markets.

4. CONCLUSION

More than 50 years have passed since the start of commercial production of titanium, once called a "dream metal." During that time, titanium industries around the world have grown significantly and titanium has been recognized as a valuable metal for aerospace use. Now, we are standing on the threshold of the 21st century. Let us work together to enable titanium to play an active part as a material for use on land and in marine applications, and as a material that balances the needs of people and the environment.

In conclusion, I wish to express my sincere gratitude to all those who have worked so hard in organizing this significant 9th World Conference on Titanium.