Transport regulation of NORM – A threat to the industry?

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The Tantalum-Niobium International Study Center, T.I.C., is glad to take this opportunity to speak at PATRAM 2004 and to explain the situation of the tantalum industry, and the impact which recent changes in the IAEA regulations is having on this industry (Fig. 1).

The T.I.C. represents the tantalum industry from miners through processors to capacitor manufacturers. We are here because the main raw material (Fig. 2) used by the industry we represent, minerals of the columbite-tantalite series, is a naturally occurring radioactive material, or NORM, with very small amounts of uranium and thorium in the crystal lattice. But the raw materials are processed to obtain tantalum and niobium, and not uranium or thorium.

In this modern, technological world of ours, tantalum is all around us. Tantalum capacitors are highly reliable and widely used in electronics (Fig. 3). If you need a heart pacemaker, tantalum capacitors keep it working for years (Fig. 4). They open the air bag in your car in a split second if there is an impact. They are in mobile phones (Fig. 5), not only in the hand set in your pocket but in the equipment which relays the signals; they are in laptop computers, digital cameras (Fig. 6). This conference will be particularly interested to know that equipment used for measuring radiation is dependent on tantalum capacitors in order for it to work (Fig. 7).

Tantalum has uses other than in electronics as capacitors. Tantalum can reconstruct joints and tissue in the human body (Fig. 8), remaining there safely, as it is inert to body fluids. It makes tanks, pipes and components which are valued in the chemical industry for their resistance to corrosion (Fig. 9). It is in alloys in the hottest part of jet engines (Fig. 10), so they are more efficient and cause less pollution.

So the world does need tantalum.

The source of the metal is in tantalum raw materials which have, on the whole, only a very low level of radioactivity, due to uranium and thorium in the crystal lattice of the minerals. They should not be confused with processed materials such as yellow cake, for example: they are insoluble, they resist heat, they are inert, they are not fragile, and they do not pose a danger of radiation to the people near them. They are used only for the extraction of the tantalum and niobium content, and not for the uranium or thorium content. They have no record of being dangerous to transport.

Transport is necessary in this industry because the mines are in Australia (the largest source), South America, Canada and Africa, whereas the processing and refining facilities are mainly in the United States, Germany, Japan and China (Fig. 11). Only physical concentration, to enhance the tantalum content, is carried out at or near the mine sites, so the uranium and thorium are still locked into the minerals when these are transported to the refiners.

The largest mines in the world are in Australia, such as the Wodgina mine operated by Sons of Gwalia (Fig. 12). The mineral extracted is of the columbite-tantalite series (Fig. 2). The processing of the raw materials takes place in plants like this one, in Germany (Fig. 13). Only a limited number of companies in the world undertake the refining process.

Tantalum and niobium are refractory metals, that is to say they are difficult to attack, and it is necessary to use hydrofluoric acid to dissolve the tantalum and niobium from the minerals, and then to neutralise the resulting solution with calcium carbonate in order to separate the tantalum and niobium oxides. The weight of tantalum and niobium obtained is so small in relation to the discarded rock and sand, and the neutralised chemical reagents, that the ratio of the tantalite raw materials to the waste is 1:10. Due to processing requirements, there is ten times the weight of waste material compared to the weight of the raw material input, and since the uranium and thorium are in the waste at this point they have been diluted ten times.

To process the raw materials at the mine site is impractical. It would involve bringing chemical reagents such as hydrofluoric acid, which is not only corrosive but also toxic, to remote places in the desert, or – for Central Africa –

in the forest. Without the kind of environmental care and responsible handling which is normal practice for this sophisticated technology in Germany, the United States or Japan, this would not be a step forward.

Recent changes to the IAEA regulations have led to an increasing number of cases of refusal to ship tantalite because of its radioactivity, which is in fact at a very low level. The consequence of denial of shipment is a disruption of the supply chain which is already being felt by the tantalum industry.

The reasons given include refusal of ports to admit ships carrying dangerous goods, and refusal to mix general cargo with Class 7, but we have heard that the reason most frequently given is ‘company policy is not to carry Class 7’ and since the person on the telephone or sending the letter or e-mail is not responsible for company policy there is no progress beyond this point. The T.I.C. has also heard that there is often no reason given, just a refusal which ends the correspondence. This is a direct effect of the change of regulations which brought down the level of radioactivity to 10Bq/g for material to be regulated.

The amount of tantalum raw materials usually transported would be one or two sea-land containers, with about 20 tonnes of product in each container. Inside the container, the mineral concentrates are packed in metal drums or sometimes sealed in bags. So the containers need to be carried along with other cargo, the amount would not justify the chartering of a ship. Although the amount would be more than a medical source, it would be small compared with shipments of bulk ores of iron or copper, or of zircon sands or titanium concentrates. Since the tantalite is valuable, it is well protected and sealed inside its packaging.

The T.I.C. has carried out a survey of its members to find out the levels of radioactivity in their shipments of tantalum raw materials, and this has indicated that some 80% of shipments exhibit levels of 40Bq/g or less. But this shows that many shipments fall between the old level of 70Bq/g and the new level of 10Bq/g in IAEA regulations when considering parent nuclides only, hence they come into Class 7 as ‘hazardous goods’.

The effective dosage of radiation received by people, either workers or the general public, in the vicinity of a container during transport would not pose any risk to health. We would like to propose that instead of a limit in terms of level of radioactivity, a limit in terms of radiation dosage could be used in the transport regulations. An upper limit of 5 μSv per hour at the surface of the container would not pose any danger, and would allow the transport of tantalum raw materials to continue.

There is no doubt that tantalum raw materials with radioactivity levels at the high end of the range should be labelled and documented, and all the regulations should be respected. The T.I.C. expects its members to comply with regulations.

But for the majority of these materials the classification as ‘hazardous goods’ is not appropriate and it is disproportionately restrictive. The majority of tantalum raw materials could safely be transported as general cargo. We do not believe that these goods pose a danger to workers or to the public.

The regulations which are currently being applied to the transport of tantalum raw materials are disrupting the supply chain unnecessarily, as these minerals do not pose a danger to workers or the public during transport.

T.I.C.

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Columbite tantalite series
$(Fe, Mn)(Nb, Ta)_2O_6$

Density:
5,3 - 8,1 g/cm^3

Melting points:
Nb: 2470° C
Ta: 2996° C

Fig. 2: The mineral Tantalite is the principal source for the production of Tantalum and Tantalum products

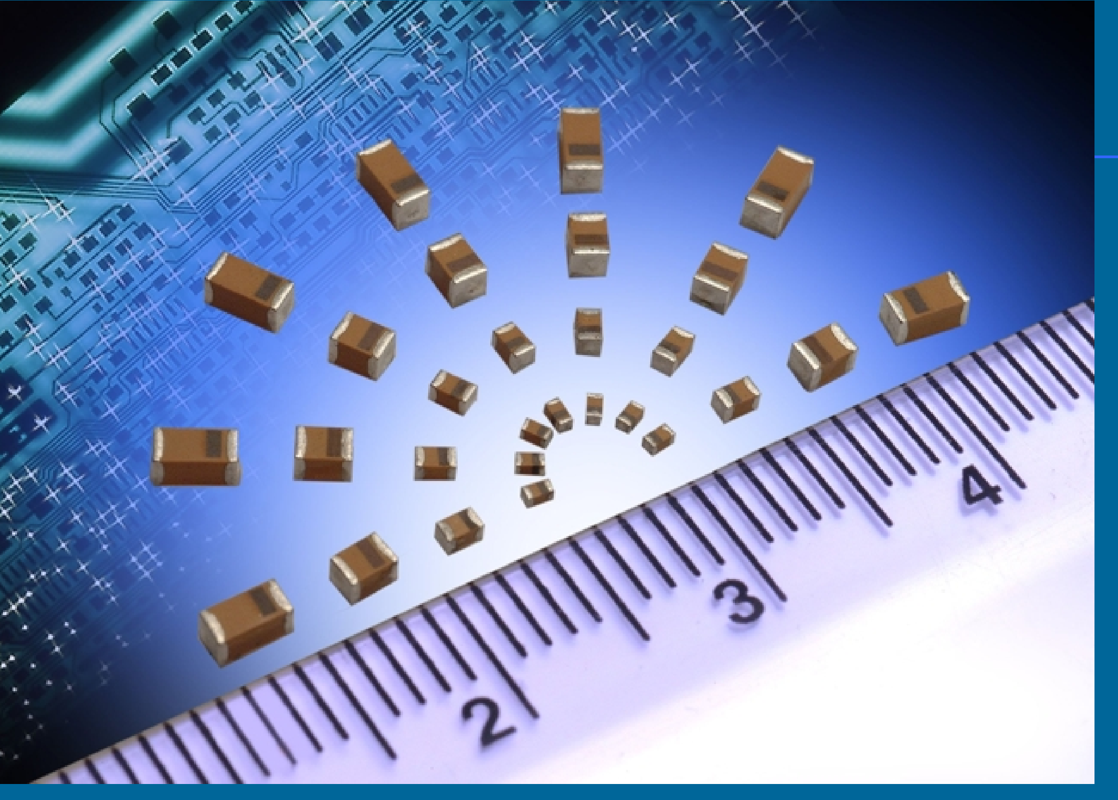


Fig. 3: A series of Ta-capacitors as used in many electronic devices

Fig. 4: Heart pacemakers require reliable capacitors, made from Tantalum metal

Fig. 5: Mobile Phones wouldn‘t work without Tantalum

Fig. 6: Digital Cameras require Ta-capacitors in its electronics and Tantalum/Niobium Oxide for optical systems of highest quality

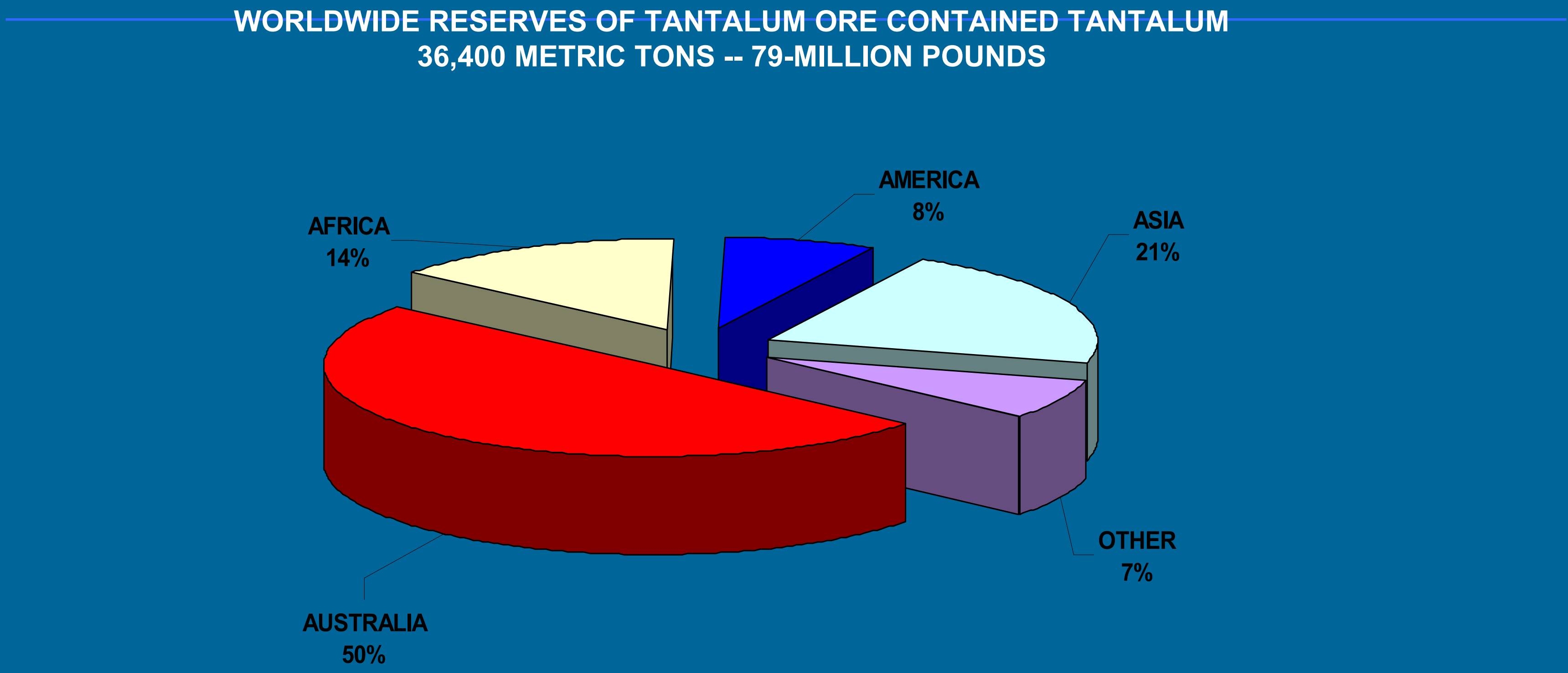
Fig. 7: Measuring radiation is dependant on Ta-capacitors

Fig. 8: Tantalum is used for the reconstruction of joints and tissues in the human body, as it is inert to body fluids

Fig. 9: Components of Tantalum Metal are very resistant to corrosion

Fig. 10: Tantalum is in alloys in the hottest part of jet engines

Fig. 11: Tantalum Raw Materials Supply



RESERVES ARE A 16-YEAR SUPPLY BASED ON YEAR 2000 PRODUCTION RATES

H. C. Starck estimates

Fig. 12: Tantalum Mine of Wodgina in West Australia

Fig. 13: The processing of Tantalum from ore requires decent chemical techniques using HF

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A threat to the industry!