Scandium – The Technology Metals Race Where All are Winners

Australians are such aficionados of gambling that there is an old adage that they will bet upon two flies crawling up a wall. There are two Scandium (Sc) stories of note in Australia and both are in New South Wales and both are separated by a mere 90 miles. The first is Scandium International Mining Corp. (TSX: SCY) (which we have covered before and has had a stellar run this year) and the other is Clean TeQ Holdings Limited (ASX: CLQ |OTCQX: CTEQF) which, despite its name, is a Scandium developer as a by-product from a Nickel-Cobalt project. With Cobalt as the word on everyone's lips and Scandium the word on ours, it scores a very respectable two out of three.

Getting Informed

At the start of the Rare Earth boom, many misinformed observers referred to Scandium as a Rare Earth, this was despite it not being in the Lanthanide series at all and rarely even appearing with other REEs in mineralsiations. This was just blatant false news. Indeed Scandium is twice as prevalent in the Earth's crust as Lead. Rarity should be made of sterner stuff.

The thing that is rare is Scandium production. What production there is (and it amounts to between 10-25 tonnes per annum and even that is a shaky statistic) comes as a by-product of refining of mainly base metals. Indeed Scandium metal is very difficult to reduce to its pure elemental state. In fact, it was not isolated in pure form until 1937 and the first pound of pure elemental scandium metal was not produced until 1960.

The potential of Scandium as an alloying element in aluminium

(Al) alloys has been a long-simmering desire of many informed observers over the last two decades. Hundreds of scientific papers have been published describing various improvements in properties that can be achieved, and one text book and a string of reviews or other overview articles are written on this subject.

The use of Scandium as an alloying element in aluminium alloys was first investigated by scientists of the former Soviet Union, who developed several Sc-containing Al-alloys during the 1980’s and 1990’s.

Aeronautics

Much of the alloy development that took place in the USSR appears to have been intended for aerospace applications. One alloy, 1421, is used for fuselage stringers of large cargo aircrafts, and some parts of the MiG 29 military aircrafts are also made of Sc-containing Al-Li based alloys. It is also claimed that some parts of the international space station (ISS) are made from alloys with Sc.

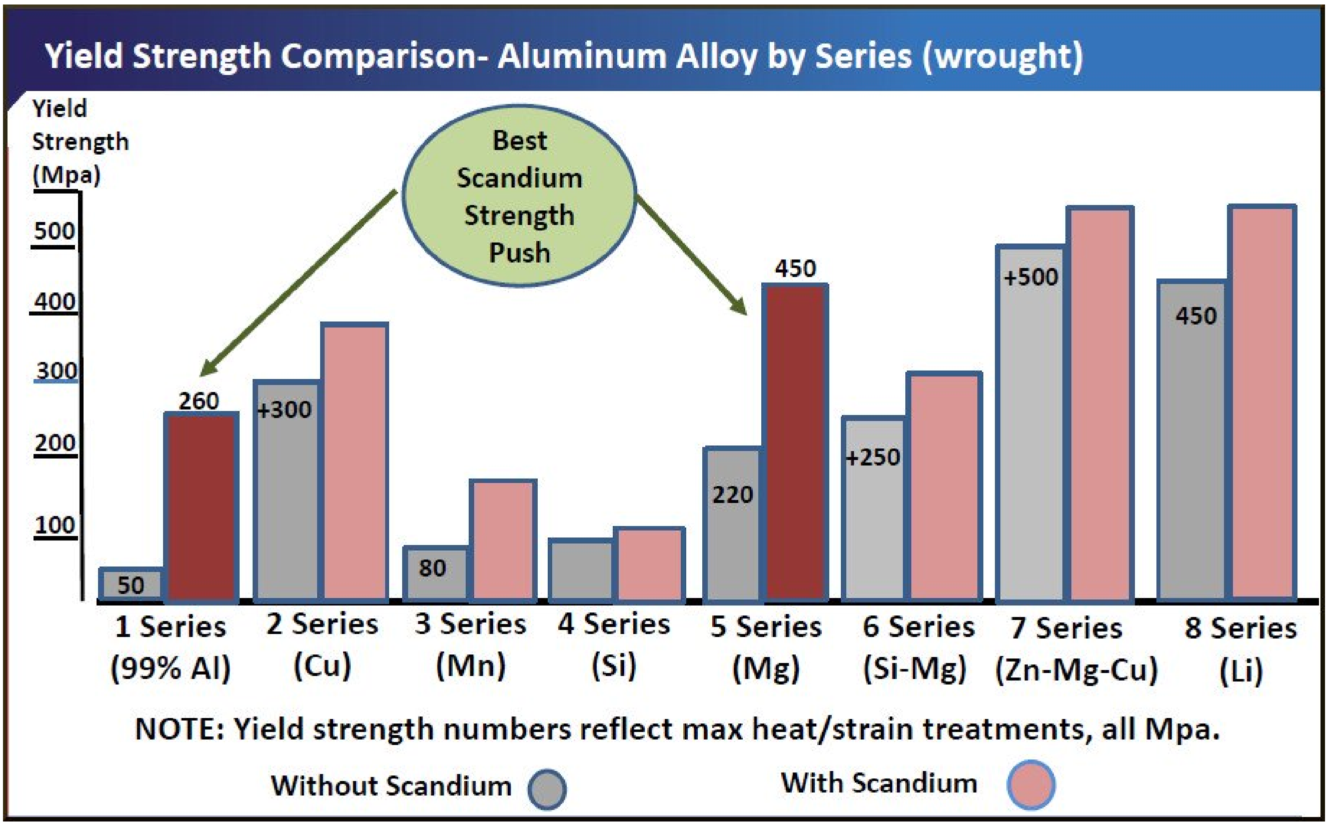
Aircraft manufacturers have been particularly interested in scandium alloyed aluminum materials. Aircraft designers believe use of Al-Sc alloys can reduce aircraft weights by 15%-20%. In addition, the ability to employ weldable structures promises similar cost reduction potential.

The three principle effects that can be obtained by adding scandium to aluminium alloys are

- grain refinement during casting or welding
- precipitation hardening from Al3Sc particles
- grain structure control from Al3Sc dispersoids

Addition of scandium in combination with zirconium is particularly effective (which gives us a chance to mention Alkane, which is in close proximity to both the projects in NSW).

The table below shows graphically the eight major series of Aluminium alloys. As can be noted all of them provide aluminium with a strength push when combined with Scandium in an alloy. The two that show the greatest benefits are with pire aluminium and in alloys with Aluminium and Magnesium.



Source: Scandium International

A little goes a long way with Scandium in alloys. Small additions of the metal to an alloy can produce a quantum benefit in strength for a relatively low cost (in many cases the Sc added to the alloy master mixes is a fraction of a percent of the total metal). The effect though is massive in lowering the weight of the plane and thus the fuel costs of operating the plane. The stronger the aluminium the less than needs to be used.

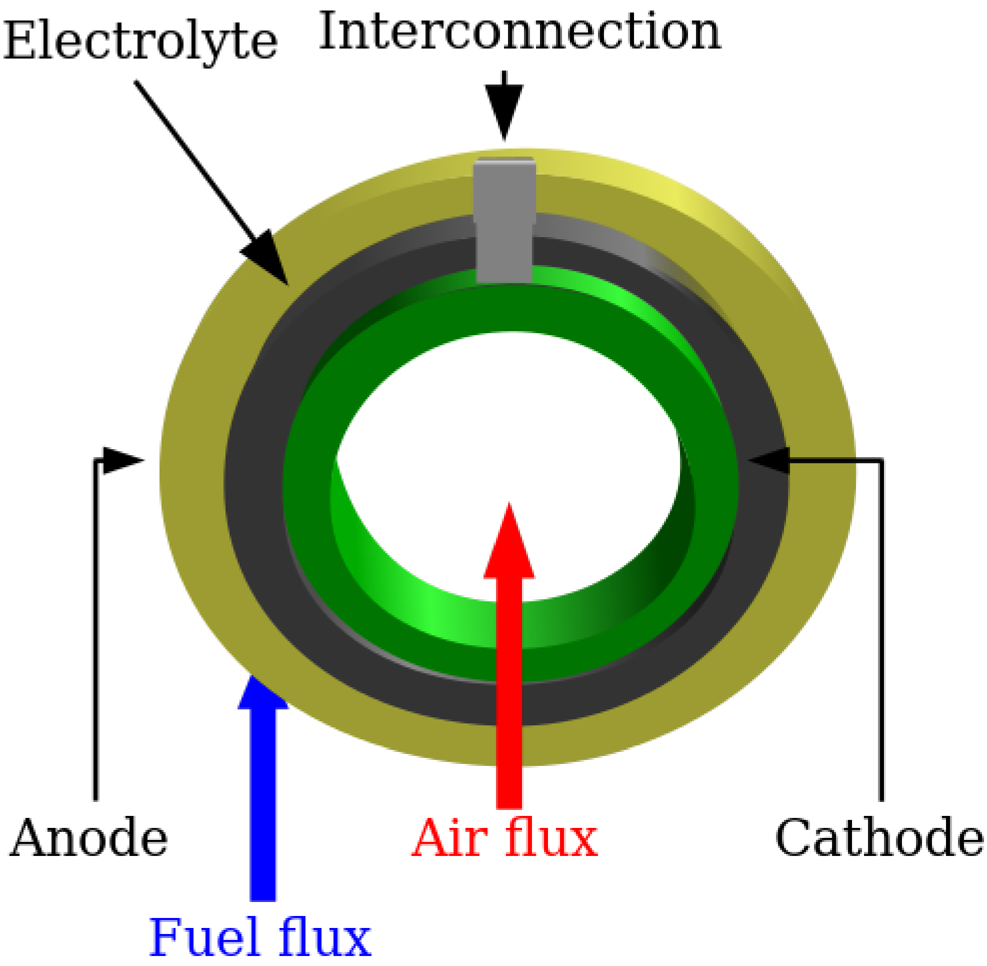
The problem the aircraft manufacturers face in adoption of Scandium alloys *en masse* is not one of price or desirability it is of supply. With no primary mines and no sizeable supply there could at some point be an absolute absence of Scandium supply for either competition reasons or geopolitical considerations. Boeing going to the storage division and finding no Scandium for that day's production would effectively shut down operations. Only with a largish, stable supply from a politically friendly jurisdiction can a wholesale adoption of Scandium in aeronautical applications be considered. For the first time since 1960, this possibility can be realistically contemplated.

Solid Oxide Fuel Cells

A solid oxide fuel cell (or SOFC) is an electrochemical conversion device that produces electricity directly from oxidizing a fuel. Fuel cells are characterized by their electrolyte material; the SOFC has a solid oxide or ceramic electrolyte. Advantages of this class of fuel cells include high efficiency, long-term stability, fuel flexibility, low emissions, and relatively low cost.

Scandium's usefulness for SOFCs is that it exhibits exceptional electrical conductivity and heat stabilization qualities and therefore the largest volume current use for the metal is in SOFCs.

Scandium is used as the electrolyte component in the fuel cell, most commonly as scandia stabilized zirconia (ScSZ). Below can be seen a conceptualization of how these fuel cells work, with the electrolyte (containing the Scandium) being the dark grey layer.



Incorporation of scandium in SOFCs enables a lower operating temperature resulting in longer lived equipment and less costly materials of construction. Bloom Energy in the US is the leading SOFC manufacturer and currently the single largest scandium user. The fuel cells are massed into stacks to match the energy required so the potential is enormous and once again limited only by the reliable supply of Scandium rather than any lack of potential end demand.

Conclusion

Scandium is the example, par excellence, for our thesis of "Build it and they will come". In the aeronautics industry in particular tooling up for a different mode of manufacturing or input can be a massive cost running into the hundreds of millions of dollars if not billions. It is clear that the industry wants to apply the benefits that Scandium brings but it is not going to go out on the limb and hope that the adage "Build it and they will supply us" proves to be true. As we all know that train is heading down the track fullspeed towards Tesla that has foolishly failed to secure its supply of Cobalt and Lithium for the future. The likes of Boeing and Airbus are not so naïve.

Thus when a significant supply of Scandium is guaranteed then the synergies between aeronautics and Scandium mining will come into play and the uptake of product will be potentially enormous. That in itself will trigger more realistic and workable pricing and in turn that will feed greater uptake (beyond the aeronautical industry into those with more sensitive price points, such as lighting and fuel cells). Scandium International is well positioned to do this as a primary mine and potentially Clean Teq will be able to follow with its sizeable by-product credit of Scandium from a Nickel/Cobalt production facility.

It also seems that Australia and most specifically New South Wales will be the epicentre of Scandium activity for the short term and maybe even farther into the future. This in some dusty pub in the Australian pub in the outback will find that betting on either, or both, of those flies will pay off.

Note from the assistant publisher: George Putnam, President and CEO of Scandium International will be presenting at InvestorIntel's 6th annual Cleantech and Technology Metals Summit, and is scheduled to speak on Monday 15th from 1:50 – 2:05 PM (EST).