

# The sizzling silvery-white Indium heats up for a bull run

**Indium (In) – joined at the hip to Zinc:** For those zinc bulls amongst us (and my hand shoots up) the received gospel is that that Lead/Zinc supplies are on the wane over the next few years. This is not due to a shortage of the metals on the planet or to potential deposits not being identified but rather due to underinvestment in new mine development on deposits already long-ago identified. This is compounded by a decline in existing production with the closure of big mines such as Century (Australia), Brunswick & Perseverance (Canada) and the zinc mines of Portugal and Ireland heading into their declining years.

The relevance of this for Indium (In) is that this important specialty metal (in the absence of primary mines) is linked to the fate of the Zinc mining industry due to it being a by-product on Zn mining. Zinc mines are not the only source as indium is enriched in sulphidic lead, tin, copper, iron deposits also. Very rarely the element can be found as grains of native (free) metal, but these are not of commercial importance.

The most common extraction process is that the Indium is leached from slag and dust of zinc production. Further purification is done by electrolysis. The exact process varies with the exact composition of the slag and dust.

**Some Science:** Indium was discovered in 1863 and the metal was first isolated in the following year. Despite the popular conception that its name has something to do with India, it was in fact named for the indigo blue line in its spectrum that was the first indication of its existence in zinc ores,

as a new and unknown element.

Indium is a chemical element with symbol In and atomic number 49. Indium is 61<sup>st</sup> most abundant element in the Earth's crust making it rather rare, at approximately 49 ppb, approximately as abundant as mercury. It is very soft, malleable and easily fusible with other heavy metals and is chemically similar to gallium and thallium. Fewer than 10 indium minerals are known and none of these occurs in significant deposits.

**Applications:** The first large-scale application for indium was as a coating for bearings in high-performance aircraft engines during World War II. Afterward, production gradually increased as new uses were found in fusible alloys, solders, and electronics. In the 1950s, tiny beads of Indium were used for the emitters and collectors of PNP alloy junction transistors. In the middle and late 1980s, the development of indium phosphide semiconductors and indium tin oxide thin films for liquid crystal displays (LCD) and touchscreens resulted in a demand surge that, by 1992, resulted in the thin-film application having become the largest end use.

It is widely used in thin-films to form lubricated layers. It is also used for making particularly low melting point alloys, and is a component in some lead-free solders. The chart below from Nyrstar shows the demand by application (net of recycling).



The amount of indium consumed is largely a function of worldwide LCD production. Worldwide production in 2007 was 475 tonnes per year from mining and a further 650 tonnes per year from recycling. Demand has risen rapidly in recent years with the popularity of LCD computer monitors and television sets, which now account for 50% of indium consumption. Increased manufacturing efficiency and recycling (especially in Japan) maintain a balance between demand and supply. Since only 0.5%

to 1% of the production costs of these units is related to the indium content, there is no real incentive to switch away from the metal. The leading producers in Japan suggest that there will be no substitute available within the next five years.

**Pricing:** Indium demand has increased in line its consumption in LCDs and flatscreen televisions. Meanwhile supply decreased when a number of Chinese miners stopped extracting indium from their zinc tailings. In 2002, the price was US\$94 per kilogram. The recent changes in demand and supply have resulted in high and fluctuating prices of indium, which from 2006 to 2009 ranged from US\$382 per kg to US\$918 per kg. Currently prices are around \$750 per kg.

**Production:** Some use a rule of thumb that, based on the average content of indium in zinc ore stocks, there is a worldwide reserve of approximately 6,000 tonnes of economically viable indium. It has been estimated that there are fewer than 14 years left of indium supplies, based on current rates of extraction, demonstrating the need for additional recycling (if possible).



However, the US company, Indium Corporation, the largest processor of indium, claims that, on the basis of increasing recovery yields during extraction, recovery from a wider range of base metals (including tin, copper and other polymetallic deposits) and new mining investments, the long-term supply of indium is sustainable, reliable and sufficient to meet increasing future demands. This seems somewhat fanciful and wishful thinking.

China is a leading producer of indium (390 tonnes in 2012), followed by Canada, Japan and South Korea with 70 tonnes each. Teck's Trail refinery in British Columbia is a large single-source indium producer, with an output of 32.5 tonnes in 2005. We cannot find specific numbers for Trail that are more recent

but one can presume that the largest part of the 70 tonnes of Canadian production reported by the USGS in 2013 would have been from Teck's facility. Nyrstar, as Europe's largest zinc refiner, saw its indium production increase by 154% in 2013, to 33 tonnes, from 13 tonnes in 2012. The company increased capacity at its Auby smelter in France to 45 tonnes per year during 2013.

**Potential Production:** Adex Mining (TSXV: ADE) has the Mount Pleasant Mine in New Brunswick, which holds a sizeable indium resource. This deposit had previously been mined by Billiton and Lac Minerals. At times the deposit was exploited for Tin and at other times for Tungsten. The main deposit is the Fire Tower Zone where the NI 43-101 resource estimate includes an indicated resource of 13,489,000 tonnes at 0.33%  $WO_3$  and 0.21%  $MoS_2$ , as well as an inferred resource of 841,700 tonnes at 0.26%  $WO_3$  and 0.20%  $MoS_2$ .

The North Zone contains an updated NI 43-101 resource estimate including 12,400,000 indicated tonnes averaging 0.38% Sn, 0.86% Zn, and 64 ppm In, as well as an inferred resource of 2,800,000 tonnes averaging 0.30% Sn, 1.13% Zn, and 70 ppm In. This mine is the most plug-and-play project we have seen with a whole suite of existing infrastructure that was installed by previous owners and consists of a large complex of buildings for administration, management and security; ore processing (crusher-concentrator) and ore storage; warehousing and maintenance. There is a 430-metre-deep mine with thousands of metres of underground development, including a service decline and conveyor decline. It also has a fully functioning tailings pond that is regularly maintained and monitored. The company is at the stage where it has contracted with several consulting and engineering companies to complete a pre-feasibility study and environmental permitting approval in relation to the Fire Tower Zone.

With Tin, Tungsten and Indium all well-priced at the moment,

it would appear Adex has hit the trifecta of specialty minerals with its Mount Pleasant venture. Now to fund it...

Portex Minerals (CSE: PAX) is a Toronto-based mineral exploration which currently has a 100% ownership interest in the Toral (with a NI 43-101 resource estimate) and Lagoa concessions in North West Spain; an 85% interest in the Lagoa Salgada concession in the North West end of the Iberian Pyrite Belt in Portugal; and 24 base and precious metal exploration licenses in Ireland and Northern Ireland. The Irish properties seem too prolific in number for our liking but the real gem is the Lagoa Salgada deposit which is in the general vicinity of the well-known Adjustrel and Neves Corvo mines. While the Iberian Pyrite belt is known for its strong Indium component, Lagoa Salgada is particularly rich in this by-product. This deposit's NI 43-101 resource estimate did not split out the Indium, showing that management were not aware of what they were sitting on here. The deposit consists of a partially defined massive sulphide deposit upon which Tetra Tech Wardrop, in January 2012, prepared a NI43-101 resource estimate including indicated resources of 2.9 mt at 7.2% zinc equivalent and inferred resources of 1.6 mt at 5.5% zinc equivalent. Academic papers on the deposit show readings of Indium as high as 90 ppm (or 90g/t).

With gold, silver and tin in the mix too, Lagoa Salgada has no shortage of "added extras" to justify moving the property towards production in the shorter term.

In a nifty move, Lithic Resources changed its name to InZinc Mining (TSXV: IZN). We suspect most viewers of the change would not get that the "In" is actually Indium. The company completed a preliminary economic assessment for its West Desert (which it has owned since 2005) zinc-copper-indium project in Utah just now in April 2014. The assessment concluded that the deposit would be developed as an underground mine with an onsite mill that would produce zinc-indium and copper-gold-silver concentrates. The newest PEA

foresees a low-cost, long-life zinc mine at West Desert. An underground mine with conventional mining and milling methods is projected to produce an annual average of 107.9 million pounds of zinc, 1 million tonnes of iron concentrate (magnetite) and 9.9 million pounds of copper over a 14.8 year mine life. As of November 2009, indicated resources at West Desert totaled 283 tonnes of indium, but the latest PEA using a Gross Metals Values cutoff value of \$50/tonne counts on an indicated resource of 433 tonnes and an inferred resource of 1,102 tonnes. The problem is the hefty capex at this time which comes in at US247mn.

We might also mention Geodex Minerals (TSXV: GXM) which holds the Mount Pleasant West Project. This consists of five claim blocks east and west of the aforementioned Mount Pleasant mine (owned by Adex Mining) and located south of Fredericton in southwestern New Brunswick. The property includes claims acquired by staking and through option/ joint venture agreements with other companies. The project area is in an area with excellent logistics and infrastructure. Since 2006, Geodex has conducted exploration programs on the property, including multiple diamond drilling programs but there is no resource as yet.

Finally, in the "outside the box" category there is 5Nplus (TSX: VNP). This stock is truly for the cognoscenti. It is not however a miner. The company draws its name from the purity of its products – 99,999 % pure (5 nines, or 5N) and more. It specializes in the production and purification of minor metals such as bismuth, gallium, germanium, indium, selenium and tellurium as well as inorganic chemicals based on such metals and compound semiconductor wafers. Many of these are critical to industrial applications such as solar, light-emitting diodes and eco-friendly materials. Its history goes back to 2000 when some employees of ANRAD Corporation, formerly Noranda Advanced Materials, decided to start their own company through a management buy-out of certain assets. It

currently employs nearly 700 people worldwide and operates manufacturing facilities and sales offices in several locations in Europe, the Americas and Asia.

It was actually a conversation with one of their traders, at the recent Antimony conference, about Indium which prompted us to write this piece.

### **Malku Khota – An Object (Abject?) lesson to us all**

You don't need a particularly long memory to recall the fate of South American Silver Corporation and its Malku Khota property in Bolivia. This was a large resource of Indium with an indicated resource of 1,481 tonnes and inferred resource of 935 tonnes. For the cheap seats however it was marketed as a sizeable silver play. The problem the company had was that it quite correctly decided that its Indium (and 15 tonnes of Gallium) component were also sexy and represented icing on the cake. By some estimations its Indium resource represented 25% of the global resource of the metal. However this clearly came to the attention of parties for whom silver didn't matter a damn but for whom these other two metals were strongly sought after. In particular the Chinese with total dominance of the Gallium space had NO interest in having anyone outside China with any capabilities in the metal. These are both metals that the Chinese seek to dominate so that they can control the value-added chain in the technologies that use them (gallium-arsenide chips in the case of Gallium and flat screens in the case of Indium).

Well, may we ask whether the grab of Malku Khota in August 2012 by the Bolivian government on some feeble grounds did not presage a transfer of this asset to the Chinese eventually? How long before we hear this land-grab "closes" with the Chinese walking off with the prize of 25% of global Indium reserves and some Bolivian functionary's Swiss bank account bulges just that little bit more?

**Conclusion:** Attempts to put together an ETF of physical Indium several years ago, utilizing a vehicle called SMG Indium, came to grief. The website can still be seen online and we have a yellowing copy of the prospectus on file but clearly Indium was a bridge too far at that point in time when investors were just wrapping their brains around Rare Earths (and then shortly afterwards licking their wounds). However Indium is not going away (even if the Bolivian government thinks it can take some out of circulation). The demand is strong and unless the seemingly ubiquitous LCD screen disappears in the near future, demand would seem to be set for an upward path for some time. Recycling potential from broken or redundant screens would seem to be set as a constant, as in an algebraic equation, despite whatever boosters in the trading community might like to say (seemingly hoping to talk down prices).

With the impending crunch in Zinc/Lead production and the sparse pipeline of new projects, well might Indium supplies track lower with the production of these household name base metals. It is only those deposits with outside Indium grades that will provide some solace that a zinc-induced supply crunch may yet be mitigated. Indium is clearly not the word of the moment amongst mining's chattering classes but like so many other specialty metals the years of blithely ignoring brewing supply problems could have this metal becoming an obscure object of desire faster than one might imagine.