

# Manganese to the Rescue?

Manganese scarcely gets a mention in the North American markets for several reasons. The main one is that the trade is so dominated by the bulk metal trade that juniors are just not players (or have not been in recent memory) while a secondary factor is that Canada and the US and peculiarly poorly resourced in this metal so if juniors or majors have dabbled it has tended to be those in Australia that have done so.

In this piece we shall look at Electrolytic Manganese, the component in various batteries types, both new and not-so-new, which has been largely overlooked due to the focus on other battery metals like Lithium and Cobalt of late. The key factors to consider here are that while EMD is a lot cheaper input than some of the scarce battery metals, the supply of EMD (though not global manganese production) is dominated by China and thus there is a need for North America, in particular, to re-establish a non-Chinese supply chain in EMD to ensure resource independence and freedom from the gyrations in Beijing's political moods.

## **Electrolytic Manganese**

EMD is a black powder (or plate or chip that will be ground into powder) that has a gamma crystalline structure and is used almost exclusively in the cathode of dry-cell batteries. There are three grades of EMD:

- alkaline
- lithium
- zinc-chloride

All types and grades of EMD are produced by the same general process. Almost all EMD produced and consumed in the United States is of the alkaline grade. Within each grade of EMD, the quality of EMD may vary, with the higher quality EMD used in AA/AAA type batteries, and the lower quality grade used in C/D

batteries. All new suppliers of EMD must be qualified by the battery manufacturer before their EMD can be used in a specific battery. Almost all EMD is sold directly or indirectly through an importer or producers' sales representatives to end users (battery manufacturers).

This has relevance to the North American economy with the USA being the largest consumer of EMD globally at 41%. Currently there is no production of electrolytic manganese in North America. For a long while American Manganese was the great white hope for this mineral in North America but never seemed to get escape velocity.

The US International Trade Commission in 2014 conducted a survey to which respondents attributed the decline in U.S. EMD demand to the movement of battery production outside the United States and the increased importation of tools, toys, and electrical equipment imported from China with batteries pre-installed. The domestic interested parties attribute the decline in U.S. EMD demand primarily to technological changes in portable lighting and a shift to smaller battery cell sizes, which require less EMD. A slight majority of responding domestic producers, importers, purchasers, and foreign producers reported that they expected U.S. EMD demand to decline in the near future, while all other respondents reported that they expect demand to fluctuate.

According to the consulting firm, Grandview, the global EMD market demand was 202,700 tons in 2014 and is expected to grow at a CAGR of 4.9% from 2015 to 2022. Global EMD consumption in alkaline batteries alone exceeded 140,000 tons in 2014.

### **Battery Usage – Covering the Gamut**

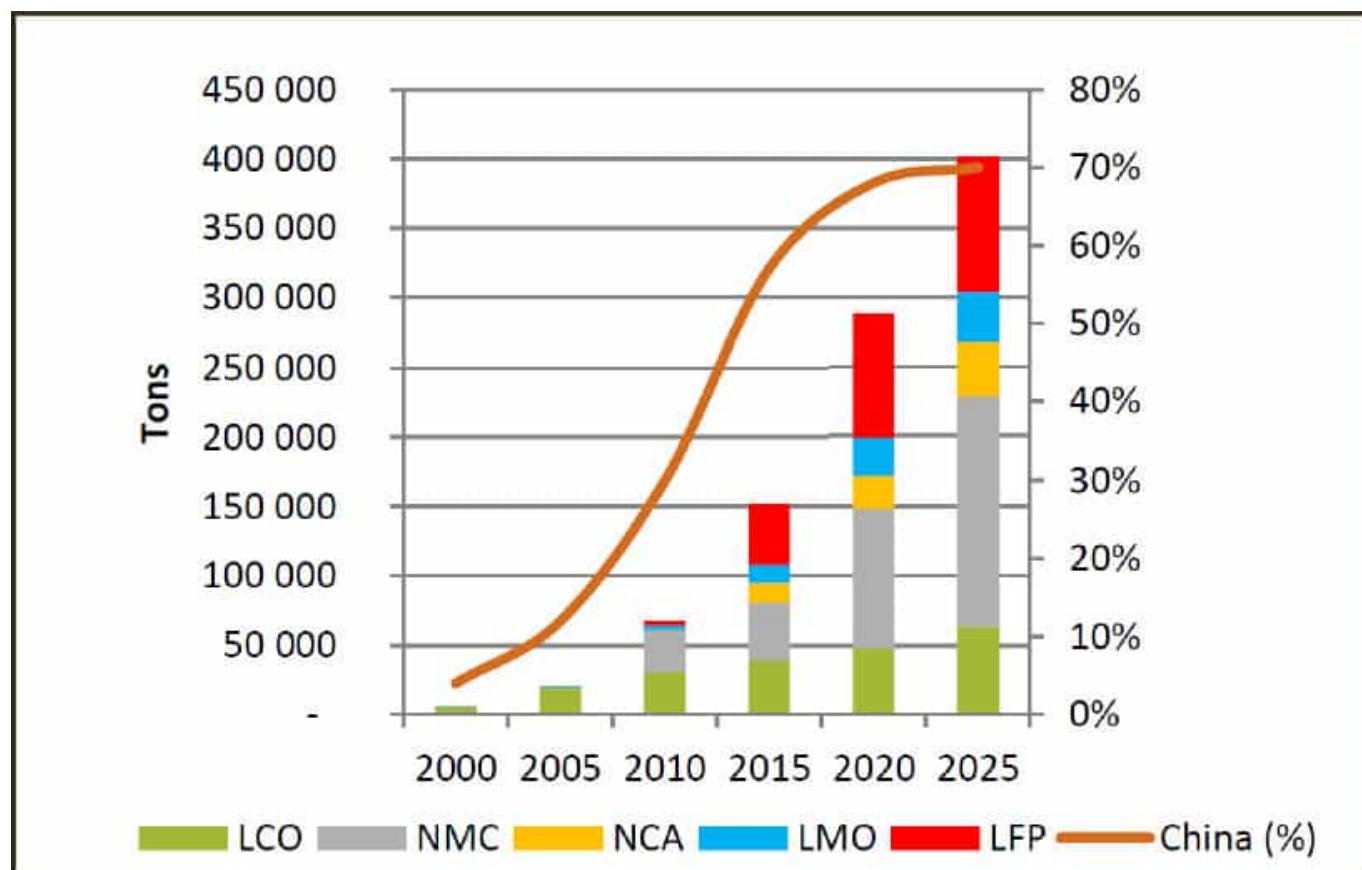
As mentioned already manganese is currently employed in that most prosaic of battery formats, the alkaline battery (think AA or AAA). There is nothing new in that but it does provide a constant demand for manganese and has done for over half a

century. It is also one in which little effort goes into the recycling of the manganese metal. The consulting firm, Technavio, estimated the global market for alkaline batteries to reach close to US\$7.46 billion by 2019. The prospects for growth in this market are heavily dependent on the cost, quality, environmental norms, and technological efficiency of these batteries. Increasing demand for such batteries from emerging economies and physical remote controls is expected to bolster market growth during the forecast period. However they also noted that the Americas are expected to witness a decrease in the overall revenue due to its limited application areas, advances in technology, and competition from other battery chemistries. By 2019, Technavio estimated that the Americas would retain its market dominance and account for more than 50% of the total market share owing to the primary battery segment's shift from zinc-carbon to alkaline batteries.

More interesting for the future perspective though is the application known as the Lithiated Manganese Dioxide (LMD) Battery. The standard mix of LMD used in batteries contains 4% Lithium, 61% manganese and 35% oxygen by atomic weight. The attractions of this format are that LMD has high power output, thermal stability and enhanced safety when compared to other lithium ion battery types. For these reasons LMD batteries are currently being used in the Chevy Volt and Nissan Leaf. Research at the University of Illinois has achieved an advanced prototype battery, using Lithiated Manganese that can be recharged in as little as two minutes (equivalent to filling a gas tank).

The growth projections for various battery types are worth looking at. Avicoenne Energy produced, in 2017, its projections for growth in various types of batteries and these were presented at the Argus Battery Metals conference which I recently attended.

The different categories shown include LMO batteries ( $\text{LiMn}_2\text{O}_4$ ) which are notably being used in vehicles made by Nissan and BMW. One would note that Nickel Manganese Cobalt (NMC) battery formulations (the grey shaded sections) are the largest section of the market by 2025 according to Avicoenne.



While the blue section for Lithium Manganese Oxide batteries appears to be one of the lesser categories on the chart (and it is) it might also be noted that it is also the “type” that grows the most in percentage terms (with something like a quadrupling in usage).

### Cobalt Focuses Minds

The current Cobalt “crisis” is focusing minds, including ours, as we have written about recently here. As we noted here recently there is no direct “switch” out of Cobalt into other metals there are patents out there for other technologies, both currently employed and theoretical, that employ other metals and minerals such as Manganese, Titanium (Lithium

Titanate batteries) and Antimony/Magnesium (Molten Salt batteries), Vanadium (Vanadium Redox Flow batteries) and in other metals. Conventional wisdom has it that battery manufacturers, particularly in the HEV/EV sphere, are committed to Lithium Ion batteries and will pay through the nose rather than retool or adapt. However, if there is a Cobalt shortage in absolute terms or supply becomes highly irregular then they may not have any choice but to consider the unthinkable, particularly when it impacts the economics of vehicle costs.

Solutions that involved Electrolytic Manganese open up the interesting possibility that EMD, the production of which is currently dominated by China, might be tempting as an alternative within China in light of that country's lack of guaranteed Cobalt supplies.

### **Names to Conjure With**

As we have noted here recently the prime prospect for Electrolytic Manganese at the current time is Manganese X Energy Corp. (TSXV: MN). The other long term player is American Manganese a stock that we have watched closely over the years which has the Artillery Peak deposit in Arizona. This company is run by the people that were formerly involved with Adanac Moly. However with a very low grade at their deposit they have now been talking about moving into the recycling of Lithium Ion batteries instead, which ironically have minimal Manganese content.

Also in the past here we have written here about Star Minerals which claimed to have pretensions in the Manganese battery space but then changed its name to Navis Resources and retreated to the curious combination of diamonds and Rare Earths.

Then prowling in the ASX all one can find is Mesa Minerals, which came to grief and is now in administration. There

problem seemed to be that they were ahead of their time.

## **Conclusion**

The battery technology world is becoming an alphabet soup that exceeds even the complexity of the Lanthanide series when Rare Earths first burst on the scene. While Manganese has traditionally been seen at a component in steel alloys it is the battery applications of Electrolytic Manganese Dioxide (EMD) has been predicted to be fastest growing segment of manganese production. As we have noted the Alkaline batteries that have been top dog in many electronic devices for many decades are in a slow decline in North America, but still in a growth mode in developing economies.

As we have noted though the Cobalt crisis has driven, pardon the pun, some auto manufacturers to conjure with, and implement, solutions that linked to Manganese-based batteries. The more intense the Cobalt crisis becomes (if it plays out as many fear) then the greater the impetus to consider Manganese as an alternative to Cobalt.

Beyond that there is also an imperative to create a value chain for EMD production outside China. There is no reason for this not to happen and a number of junior listed players have considered, or are actively considering, driving this process. The initial fears of a Trump showdown with China have retreated but to deliver on promises of US independence from Chinese domination having a North American Value-added chain converting of Manganese into EMD is a fairly indispensable requirement.