Lifton on the recycling of lithium ion batteries

I spoke at the Mines and Money, Toronto, Conference last Monday in the Battery Materials Section, and I was struck by the fact that battery materials' recycling has a fluid definition, so I'd like to give you my answer to the question. What exactly do I mean by the "recycling of lithium ion batteries?" I mean the profitable recovery and reprocessing for re-use of the functional materials and their precursors necessary to construct the operational parts (the cathode, electrolyte, and anode) of a new lithium ion battery for the same purpose as the one that was" processed" to recover the raw materials used in its construction. So now what does all of that mean?

A lithium ion battery is a fabricated (man-made) device for the efficient economical storage of electricity and for its controlled release upon demand.

Such devices (the batteries) are manufactured with the lowest cost of construction, operation, and efficiency that is practical. They are not today designed for ease of recycling. So in order to recover the maximum value from a damaged or end-of-useful-life battery (i.e., a scrap battery) one has to devise a general purpose way of disassembling them mechanically; extracting the desired raw materials; and separating and refining them back into materials ready-for-use by manufacturers of battery cells, those modules from which the battery is itself constructed. It goes without saying that one also needs to sell the ready for use raw materials and components to a cell manufacturer who in turn can qualify his product with his end use battery manufacturer customer with your raw materials being used. To do this you need to be aware of your customer's (the cell manufacturer's) specifications before you start!

Not all of the desirable materials in the scrap are chemicals. There are the materials of construction of the case, the cathodes, the anodes, and the internal structure. There is also the internal copper or aluminum “wiring” in the battery; and there are the electronic control “chips,” the fluid control valves, and the sensors used in battery internal management.

The most efficient recycling will always be done if the feed stream is uniform. But in the real world this is unlikely to be economically feasible.

The stream of scrap batteries to be first disassembled to marshal the above desired raw materials, structures, and components will be mixed, so that although a general disassembly protocol can be developed it will be and must be designed to be flexible.

Liquid electrolytes can be simply drained but mixing the ones from different battery types destroys their recyclability. It is the same with electrolyte membranes.

It is unlikely that the profitability of lithium ion battery recycling will be dependent on the recovery for re-use of electrolyte liquids or membranes. But even if not a cost will be incurred for their safe and legal disposal.

Assuming that has been done the next step involves mechanically separating the components of the cathodes and anodes.

In modern large scale lithium ion batteries the cathode is an aluminum foil “coated” with a chemical or chemicals (such as lithium cobalt oxide-a cathode material formed by the cell maker which may contain, for example, nickel, manganese, and related metals). The anode will be a copper foil coated with a mechanically formed type of spherical graphite. The electrolyte liquid or membrane will be a mix of organic and inorganic chemicals and materials.

Probably the best way to recover the cathodes and anodes is by hand separation. It is best to separate the electrode coatings mechanically or even by freezing (as one recycler does) so as to break the bond between the coating and the support.

The metal foils upon which the coatings are put are if recovered intact and cleaned suitable for re-use perhaps not in a new battery but certainly in a refurbished one. At the very least they are pure metals, aluminum and copper, and have value in the scrap market.

The cathode coatings contain lithium and in the USA will probably contain cobalt and may contain nickel and manganese also.

These coatings can easily be put into solution in acid or base and the individual metals separated and purified by ordinary chemical processes or by newer processes that are more economical such as Molecular Recognition Technology the selectivity of which allows the desired metals to be recovered individually from mixtures without the need for elaborate traditional precipitation, filtering, and associated steps. Once the individual metals are in solution they can be easily transformed into the salts specified by the customer at the degree of purity required. In all cases the newly reformulated "salts' must be battery grade. This means, for example, for cobalt that the cobalt salt must be iron free. Today both the extraction of the lithium and of the cobalt from the mixed solutions and the purification of the cobalt to be iron free could be done in a few steps by existing Molecular Recognition Technology developed by IBCAT of Utah.

The anode presents a different problem. The graphite coating must be "cleaned," of residual metal ions and this is usually done as in the initial preparation of the graphite by an acid wash or by pyrolysis. It is the form of the graphite as well as its purity that must be maintained. Electrodes must have the greatest possible surface area so that the graphite has

been “spheronized” and often coated so that the anode will be millions of graphite spheres giving orders of magnitude more surface area than a strip or chemically or physically deposited layer of pure graphite.

Clearly the total recycling for re-use of the recoverable materials in a scrap lithium ion battery is today feasible. Many companies already disassemble such scrap and sell it or send it to various other entities in the battery materials supply chain.

Now it is time to assess the total economics of recycling the recoverable raw materials in such batteries and refining them back to customer specifications for re-use by cell and new battery manufacturers. This involves collecting the scrap preparing it, extracting the desired metal and component values, remanufacturing the chemical values to customer specifications, and marketing the products.

All of the above steps are being done individually and in some combinations.

It’s time for vertical integration.

Lifton prepares for the Mines and Money Show in Toronto

September 16, 2016 – Jack Lifton in an interview with InvestorIntel Sr. Editor Fred Cowans discusses recycling automotive components, particularly batteries. Jack will be representing InvestorIntel in the Toronto Mines and Money show and speaking at 3:20 PM Monday, September 26th on energy storage presentation.

In this interview, Jack explains that it is very important to recycle electric vehicle battery materials as we do not produce enough lithium, cobalt and spherical graphite to make even a fraction of the vehicles that Elon Musk's Tesla plans to manufacture in the year 2018 alone.

Fred Cowans: Jack Lifton is the senior editor at InvestorIntel. Jack you certainly don't need any introduction to our audience. Welcome via Skype to the InvestorIntel studios here. You're going to be in Toronto soon for the Mines and Money show.

Jack Lifton: Yes.

Fred Cowans: It's September the 28th. The exact dates are the 26th to the 28th. What are you going to be talking about?

Jack Lifton: I'm going to be talking about recycling automotive components, particularly batteries, but also anything that can be recycled containing technology metals and materials.

Fred Cowans: That's stuff you've been writing about for some time.

Jack Lifton: Yes.

Fred Cowans: Do you want to give us some themes that you're going to be talking about within that?

Jack Lifton: Yes. I'm very surprised that there's been so little talk and action in North America about recycling lithium-ion batteries for vehicle use, very large batteries, when in fact the governments of both Canada and the U.S. mandate…. to access the complete interview, click here