

# The Disruptive Discoveries Journal

**Analysis of how disruption in commodities, geopolitics, and macroeconomics converge to create opportunities**

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## **Another Way to Play Lithium – The Separator Business**

We've just returned from PDAC and lithium is all the rage. The specialty chemical's parabolic price spike has altered the landscape and [as I predicted late last year](#), a crop of juniors has flocked to the space. While this is dangerous and may serve to confuse investors, it doesn't negate the fact that the lithium demand story is real.

Given the supply tightness, elevated prices for lithium concentrate, lithium carbonate, and lithium hydroxide are going to remain a fact of life for perhaps the next 18 months. The recent binding off-take agreement Galaxy Resources (GXY:ASX) signed for 60,000 tonnes of lithium concentrate at US \$600/t (FOB) with 50% of the total order value paid *up front in cash* (\$18 million) is only the latest exciting example of a lithium market taking shape.

All of this brings us back, however, to a question we've discussed publicly: as the lithium mining space continues to evolve, how do you play lithium outside of investing in the miners? The difficulty arises from the fact that beyond Orocobre (ORE:ASX, ORL:TSX) there are essentially no lithium pure plays in production. Albemarle (ALB:NYSE), FMC (FMC:NYSE), and SQM (SQM:NYSE) produce a majority of the world's lithium, but it only accounts for around 10% of their revenues. Purchasing shares in these companies and expecting a significant lift based on higher lithium prices is debatable, to say the least (though this could be argued with respect to SQM).

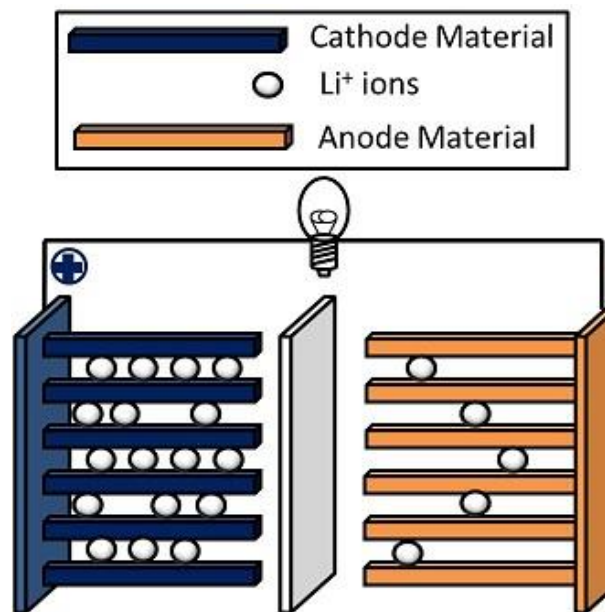
In recent years we have been advocates of examining entire supply chains as the sustainability of most mining assets appears set to remain questionable. We think that as deleveraging in the global economy continues and excess supplies of labor, capital, and raw materials are "soaked up", opportunities for above average returns in the mining space will be scarce. A solution is to take a more holistic view and examine entire supply chains for later cycle opportunities where growth is supported by strong demand and margins.

One such opportunity we're reviewing in the lithium ion battery sector is the separator business. The remainder of this note is a primer on this unique and critical piece of the lithium ion supply chain.

### What is a separator?

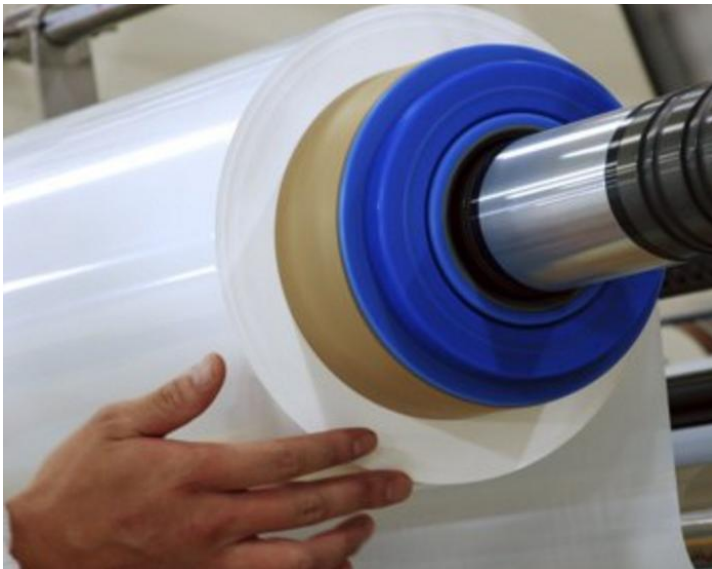
A separator is essentially a piece of plastic, but that understates its crucial role in the functioning of a battery. The separator is a porous piece of material (typically either polyethylene or polypropylene) that allows for lithium ions to flow between the anode and cathode of the battery as well as preventing the short circuiting of the electrochemical process (separators are also used in lead acid batteries). The thickness of a separator is measured in microns. One micron is one millionth of a meter or .00004 inches. A human hair is roughly 75 microns across and the typical separator is 25 microns and below depending upon a host of factors.

Given that batteries can generate a great deal of heat during usage and charge cycles, the separator effectively "shuts down" the battery when the temperature reaches 130° C (266° F) by melting and closing the microscopic pores, blocking ion transfer in the electrolyte. Battery chemistry hinges on safety more than any other issue and so preventing the excessive heat, also known as thermal runaway is imperative.



Source: Wikipedia

Shown below is a separator “sheet”.

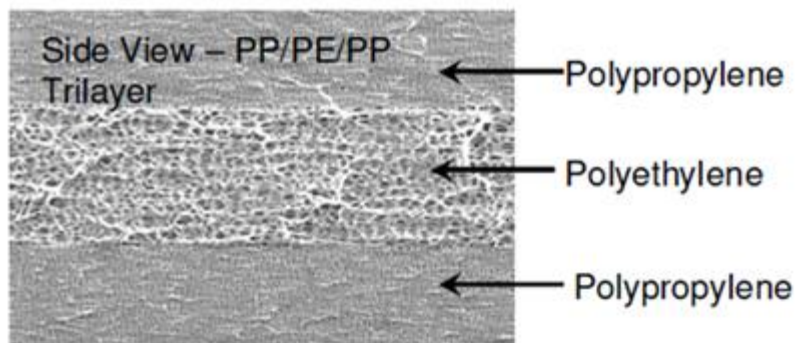


Source: EVworld.com

The separator is also a high cost battery component, accounting for 15 to 20% of the cell cost despite being less than 5% of the cell content (when added with the electrolyte). This is in contrast to lithium chemicals only accounting for 2 to 3% of the overall battery cost, so you can see why understanding the separator business is crucial – lowering the overall separator cost can have a beneficial effect on the overall cost of the battery.

### **What are the two types of separators?**

Separators are broken down into two types – wet and dry. A dry separator is manufactured by melting a polymer and stretching it in a single direction. This process is simpler and cheaper than that of a wet separator though dry separators are thicker due to a multi-layer structure done for safety purposes. A magnified view of a dry separator is shown below. While a cheaper solution, dry separators lack flexibility in design, limiting their use.



Source: BatteryUniversity.com

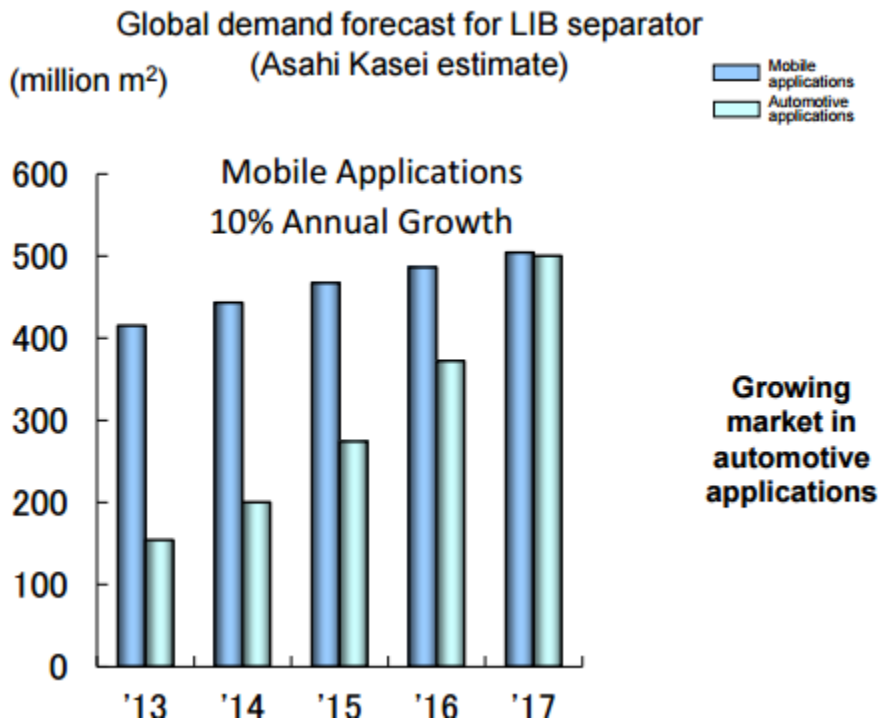
When produced, wet separators are stretched in two directions and are coated in a material which is then cooled. Wet separators are higher cost, but are stronger and thinner than dry separators. This enables higher capacities and has made it the preferred separator for lithium ion batteries. Given the

thinness of wet separators, the coating plays an important role and the main functions are heat resistance and adhesiveness between cathode and anode.

While we were unable to find a breakdown between wet versus dry separators in terms of market share, it is believed that the dry separators are the majority of the market owing to lower cost. However, wider adoption of electric vehicles and energy storage applications, coupled with safety advances in wet separators has this type gaining market share going forward. As is the case with other parts of the battery supply chain, scale coupled with technological advancement is key to market share.

### What is the size of market and who are the main players?

The largest separator manufacturer in the world is Japan-based Asahi Kasei (3407:TYO). The company was a major global provider of wet separators and then, through its \$2.2 billion purchase of Polypore in 2015 came to dominate the market for dry separators as well.



Asahi Kasei operates several business lines and the separator business is included in its “Electronics” line. In 2015, the company reported 2 Trillion Japanese yen in net sales (\$17.6 billion), 182 billion yen (\$1.6 billion) of which was generated in the Electronics business line. Various reports have the company as the dominant force in the separator business with a market share in excess of 30%. When Polypore was acquired, the company had revenues of US \$442 million in its Energy Storage Unit in 2014.

Of note here, however, is the fact that despite the strong forecast growth in separator demand (shown in the chart above), Asahi Kasei only generates gross margins in its Electronics business of around 9% based on the above numbers. This is not unlike the difficulty faced when analyzing lithium

producers who generate 10% to 12% of their revenues from lithium and the bulk from other chemical businesses – how do you gain direct exposure here?

Owing to the complexity of the battery supply chain, there are literally dozens of other separator manufacturers, both publicly listed and privately held, many of which are based in Asia catering to both the lithium ion and lead acid battery markets. Toray, Sumitomo Chemical, Entek, and SK Innovations are some of the names with significant market share and growth plans.

## Takeaways

As is the case with much of the lithium ion battery supply chain, the separator business is not well understood. However, if the markets for electric vehicles and energy storage products are going to grow well above global GDP (and we believe they will), then other parts of the battery supply chain must grow along with it. Given the vital role the separator plays in making sure a battery operates safely and for a suitably long life, a clearer understanding of the challenges, growth dynamics, and players in this market is a must.

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