Battery Separators for Electric Vehicles

CASE STUDY

PIABEVBA5EN

Background

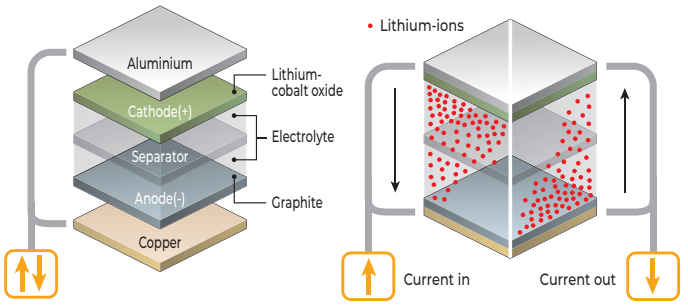
Lithium-ion rechargeable batteries have experienced a rapid growth in electric vehicle utilizations, due to their high energy and power density. The continuous market demand for more autonomy and flexibility of the EV batteries encourage manufacturers to keep developing new designs and innovative materials.
Separators are thin permeable polymeric membranes that sit between the anode and cathode of a lithium-ion battery to prevent them from coming into contact – a potential fire hazard.

In recent years separators have benefitted from a number of innovations that improve their structures and properties, directly impacting battery performance in areas such as energy and power densities, cycle life, and safety.

Separators are also becoming thinner, making production processes and QA controls more and more challenging for chemical companies. In addition, polymeric films must not contain any microscopic metal particles because contact with other parts of the battery cell could cause electrical short circuits.

High performance filtration solutions are now required at the different fabrication stages to ensure separators meet technical specifications in terms of cleanliness, quality and uniformity of the polymeric material.

Functional Principle of a Lithium Battery (example)

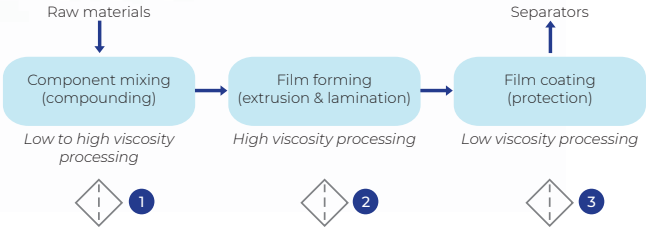


Electrical current reaches the cell by conductive surfaces at both ends of the stack.

During charging
Positively charged lithium-ions pass from the cathode, through the separator and into the anode where it is stored. When no more ions flow to the anode the battery is fully charged.

During discharge
Negatively charged lithium-ions travel back through the separator and into the cathode. When no more ions flow to the cathode the battery is fully discharged.

Typical Separator Fabrication Process



Fine filtration required at each fabrication stage to meet the QA specification

Problem

Two major chemical companies wanted to upgrade the filtration solutions installed on their processing lines to increase the quality of the polymeric separators they were producing and selling to EV battery manufacturers.

Existing installations were very different from each other in terms of design, production capacity and performance. Therefore, a plant survey was performed to identify the weakest links in the fabrication process in terms of contamination, and identify where a filtration upgrade would best help meet the cleanliness specification.

The survey revealed that the two plants had different areas of weakness as shown in the table below:

Fabrication stage	Products	Plant A	Plant B
1	Process water		X
	Paraffin liquid	X	
	Plasticizer	X	
2	Polymers	X	
3	Protection liquid		X

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Pall Solution

Laboratory dynamic tests were performed to identify the best, cost-effective filtration solution for each fabrication stage. Below is a summary of the upgrade implemented in each plant:

Plant A

Liquid Paraffin: Pall Profile® A/S 1401 style depth filters constructed of Polyphenylene Sulfide (PPS) Medium were installed to protect a UF cross-flow system

Plasticizer: The same Pall series filters as above were installed to provide wide chemical compatibility and exhibit great ability to remove soft deformable contaminants

Polymer film: Pall Dynalloy® 25µm candles were installed in CPF systems

Plant B

Process Water: 2 stages of filtration have been installed:

1- Pall Profile II filter cartridges used as prefilter (ß1000 >10µm or 90µm depending on the water quality)

2- Pall Profile Filter Cartridges with Ultipleat® construction increased the effective filtration surface area by 30%. The crescent-shaped pleat construction combined with Profile 4.5 µm depth filter medium provides a very low clean pressure drop and an unsurpassed service life

Coating: Pall Poly-Fine® filter cartridges were installed for consistent and cost-effective particle removal in low viscosity fluid applications

CPF System® Polymer Filter Candle System

Pall Profile® A/S Filters

Pall Poly-Fine® Filters

Conclusion

In the two plants, Pall conducted a plant survey and identified the fabrication stages that were significantly impacting the overall quality of the finished products. The filtration upgrades installed on the different processing lines has enabled the chemical companies to supply their customers with separators fully complying with the technical specifications.

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