Separator Fabrication

Filtration Solution in Separator fabrication process

APPLICATION PAPER

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Introduction

The Electric Vehicle (EV) market is undergoing a revolution, transforming the transportation landscape with the use of Lithium-Ion battery (LiB) technology.

The demand for electric vehicles is projected to reach 44% of global passenger vehicle sales by 2030 and 75% by 2040. To meet this challenge, the quality of LiB construction materials including cathode active material, anode active materials, electrolyte, separator and others, must adhere to established specifications.

Separator

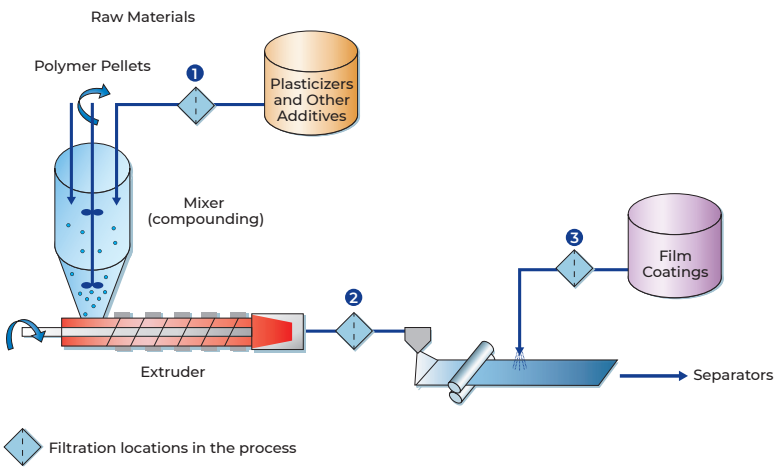
Separators play a crucial role in batteries by preventing short circuits while ensuring safe operation. Lithium-ion batteries have the highest demand globally due to their high charging capacity and extended battery life requirements. Separators are porous polymeric membranes that separate the cathode and anode electrodes, allowing the flow of lithium ions during charging. For optimal functionality, the polymeric materials used in separators must be filtered prior to their formation.

As separators become thinner, production processes and quality control become increasingly challenging for chemical companies. Additionally, polymeric films must not contain any microscopic metal particles, as contact with other parts of the battery cell could cause electrical short circuits.

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

Separator fabrication

The typical separator fabrication process, illustrated in Figure 1, involves three main steps: raw material mixing, film forming, and protection layer coating.



Fabrication stage	Materials to be Filtered	Recommended Filtration
1	Process water	Polypropylene (PP) depth/ pleated filter
	Paraffin liquid	Polyphenylene sulfide (PPS) Depth Filter
	Plasticizer	PPS-Depth Filter
2	Polymers	Metal Filter (Disk, Candle)
3	Protection liquid	PP-Pleated Filter

Figure 1: Typical Separator Fabrication Process

Raw Material Mixing (Compounding)

In this initial stage, additives such as paraffin (used as a lubricant or slip additive), plasticizers, and other essential components must be meticulously filtered before mixing to remove any impurities. The primary polymer for separator fabrication is typically a polyolefin, such as polyethylene or polypropylene. These polymers provide the necessary structural integrity and performance characteristics required for high-quality separators. Filtration at this stage ensures that the raw materials are free from contaminants, which could otherwise compromise the quality and effectiveness of the final product.

Film Forming

In the film forming step, the purified polymer is melted and extruded through a die, such as a T-die or manifold die, to form a continuous polymer film. Before the extrusion process, the melted polymer is subjected to filtration using a metal filter designed to withstand high operating temperatures. This critical filtration step ensures that any remaining impurities are removed, resulting in a uniform and defect-free polymer film. Pall's proven polymer melt filter technology is instrumental in this process, enabling chemical companies to produce high-quality polymeric separators that meet the stringent demands of EV battery manufacturers.

Protection Layer Coating

The final step in the separator fabrication process involves applying a protection coating to the polymer film. The coating agent, or protection liquid, is meticulously filtered before being sprayed onto the film to ensure the highest quality and performance. This protective layer enhances the durability and functionality of the separator, providing an additional barrier against potential contaminants and mechanical damage.

Conclusion

By ensuring thorough filtration at each stage of the separator fabrication process—raw material mixing, film forming, and protection layer coating—manufacturers can produce high-quality separators that meet the stringent requirements of EV battery applications. This meticulous attention to detail in filtration not only enhances the performance and reliability of the separators but also contributes to the overall efficiency and safety of lithium-ion batteries used in electric vehicles.

EV Battery Value Chain

The various stages in the electric vehicle (EV) battery value chain, shown in Figure 2, highlight the crucial roles of filtration and separation in achieving yield, purity, and reliability goals. This includes lithium refining, battery cell manufacturing, recycling, and the production of battery active materials. Active materials require the treatment of chemicals and polymers to create essential components like the separator, electrolyte, and anode/cathode.

Pall Corporation, with over 400 experienced engineers and scientists, is your partner for filtration and separation needs throughout the EV battery value chain. Services include prototype testing, on-site pilot testing, best practice training, process optimization, audits, contaminant analysis, application troubleshooting, validation services, and presentations at scientific forums.

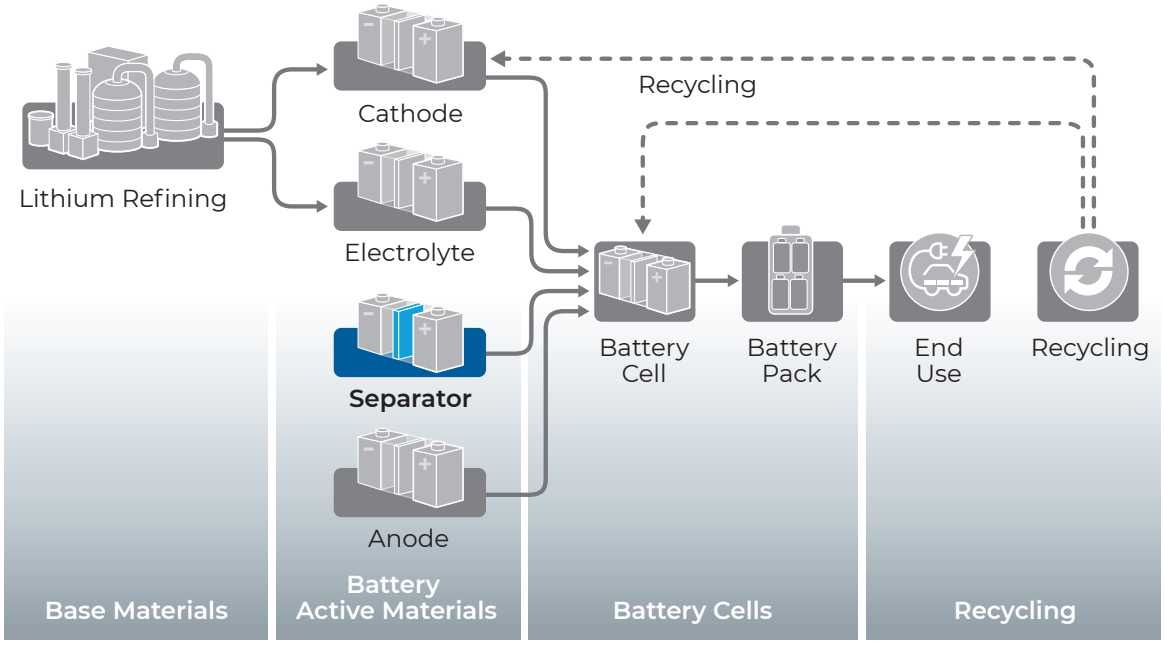


Figure 2: Applications in the EV Battery Value Chain

Takemi Namba is an Application Specialist at Pall Corporation, bringing over 20 years of expertise in filtration and separation technologies. For further information, he can be contacted via email at ***takemi_namba@ap.pall.com.***

Anoop Suvarna is the Global Battery Materials Manager at Pall Corporation, with more than 20 years of experience in the energy and industrial sectors. He can be contacted via email at ***anoop_suvarna@ap.pall.com.***

References

1. *Bloomberg New Energy Finance, "Electric Vehicle Outlook 2023", Bloomberg NEF, New York, 2023 https://about.bnef.com https://about.bnef.com/electric-vehicles-outlook/*

PALL CORPORATION

Corporate Headquarters
Port Washington, NY, USA
+1-800-717-7255 toll free (USA)
+1-516-484-5400 phone

European Headquarters
Fribourg, Switzerland
+41 (0)26 350 53 00 phone

Asia-Pacific Headquarters
Singapore
+65 6389 6500 phone

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