

Lowering the Cost and Improving the Performance of Separators for Lithium-ion Batteries

Development and installation of advanced manufacturing processes and research into new material formulations have paid off with improved separator quality and lower cost.

ENTEK Membranes LLC

In 2009, ARRA provided \$2.4 billion in stimulus funding to support the establishment of Li-ion battery manufacturing facilities in the United States. One goal of this investment was to reduce the cost of the battery for electric vehicle applications. It was recognized that an important step for the electrification of the nation's light duty transportation sector is the development of more cost-effective, long lasting, and abuse-tolerant plug-in electric vehicle (PEV) batteries.

The separator is a critical component of the battery that impacts both performance and safety. The thin (≤ 25 microns), microporous membrane provides a non-conductive barrier between the positive and negative electrodes and also a network of pores that can be filled with electrolyte and allow ionic flow between those electrodes. In addition to preventing contact between the electrodes, it enhances safety by collapsing its pores and shutting down ion flow when the battery temperature rises to a hazardous level.

The cost of the separator membrane has been a significant fraction of the material cost of the Li-ion battery, particularly in designs for high rate charge and discharge such as for HEV and PHEV applications. Depending on the battery design, the separator may be 12-30% of the materials cost of a battery cell. Thus a reduction in separator cost is necessary to help meet the battery cost goal of \$125/kwh by 2022.

ENTEK's separator is made by what is known as a wet process, where a polymer film containing a plasticizer is extruded with transverse and machine direction stretching followed by extraction to remove the plasticizer and drying to create the needed porosity.

With the assistance of ARRA funding, ENTEK has made improvements to one its existing production line and constructed an entirely new line with advanced process capabilities and higher throughput. The ENTEK production facility has state-of-the-art online characterization equipment and a clean room for slitting master rolls. These improvements have contributed greatly toward meeting the aggressive cost targets of less than \$1/m² for high volume purchases.



Figure 1: Nishimura slitter installed in ENTEK's new separator production facility as a result of ARRA funding.

ENTEK has also received funding through the United States Advanced Battery Consortium (USABC) for the development of an inorganic-filled separator. The material produced from this work has a new formulation that has demonstrated improved oxidation resistance, improved power capability and improved thermal stability compared to standard microporous polyethylene separators. The higher power capability can contribute to lower battery costs by reducing the size of batteries needed to meet low temperature performance requirements.