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Solef® PVDF

for Flexible Battery Separators

SPECIALTY POLYMERS

Solef® PVDF is a partially fluorinated semi-crystalline polymer with excellent thermo-mechanical and chemical properties. It is widely used in many specialty applications such as oil and gas, semiconductors, membranes for water filtration, plumbing, architectural coatings and photovoltaics.

This special fluoropolymer brings many advantages to the lithium battery industry when utilized as a binder in the formulation of electrodes as well as in the design of the separator.

Solef® PVDF grades for battery separators offer all the advantages of a high purity resin with the suitable chemical and electrochemical stability critical in the aggressive environment of a lithium battery.

Different technologies may be employed for manufacturing separator membranes, either dense gelled or porous ones.

Advantages of Solef® PVDF Grades

Due to its physical-chemical properties, PVDF can be processed by different processing methods including solutions-based and melt extrusion technologies.

It offers various advantages when it is utilized in the design of separator, as main component or even just as a thin coated layer:

- Electrochemical stability from 0 to 5 V vs Li^+/Li
- Solubility for easy processing
- Fast wettability of the membrane
- Controlled leakage of electrolytes
- Durable adhesion with electrodes
- Flexibility for lamination process

Product Range

According to the specific design of the separator and to the manufacturing process, it is possible to select the most appropriate Solef® PVDF grade.

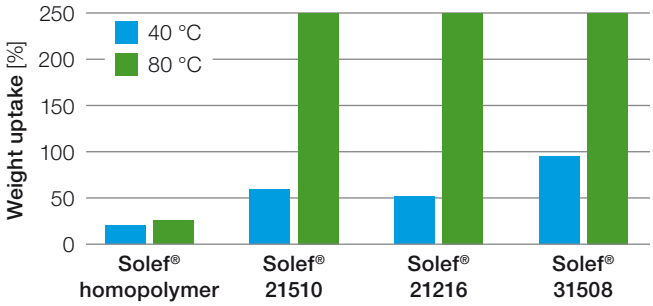
Some differences may be highlighted between PVDF homo and copolymers. Homopolymers are soluble in a limited number of solvents such as NMP, DMAc, DMF, TEP and DMSO and they show low swelling ability in electrolytes. Their melting temperature and crystallinity are high, determining superior mechanical properties and high thermal resistance.

Copolymers are soluble in a wider range of solvents including, for instance, acetone, MEK and THF for easier processing. They have high swelling ability which allows the design of gel polymer membranes or coating adhesive layers.

Swelling Properties

The high compatibility of PVDF with electrolytes guarantees fast wettability and suitable ionic conductivity. Due to the different crystallinity, PVDF homopolymers can uptake lower amounts of electrolytes and maintain the original shape, while copolymers can reach high swelling levels especially at high temperatures.

For a comparison among various Solef® homopolymer and copolymer grades, swelling experiments have been performed on molded test samples, which have been immersed in a standard mixture of electrolyte (EC/DMC/DEC 2:2:1) and $LiPF_6$ 1 M for 30 days. Maximum swelling values give an indication of the compatibility of the polymer with a specific electrolyte.



Grade	Type of Polymer	Application	Molecular Weight [kDa]	Melting Temp. [°C]
Solef® 1015	PVDF standard homopolymer	Porous separator for high ionic conductivity	570 – 600	170 – 175
Solef® 6020			670 – 700	170 – 175
Solef® 21216	PVDF-HFP copolymer acetone soluble	GEL polymer technology for safety and flexibility or coating of polyolefin separator	570 – 600	130 – 136
Solef® 21510			290 – 310	130 – 136
Solef® 31508	PVDF-CTFE copolymers acetone soluble	Coating of polyolefin separator	270 – 290	167 – 171

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