



Keep the Hydrogen in Your Tank

Novel Type IV Liner Compound for Increased Safety & Reduced Losses

Hydrogen tank liner materials need to provide a combination of functionalities under extreme conditions. Low hydrogen permeation, reduced micro cracking and blistering, and ductility at low and ultra-low temperatures represent some of the most important considerations.

The Best of Both Worlds

Fluoropolymers have a proven performance in low and ultra-low temperature use. Furthermore, they are well known to maintain permeation resistance under harsh conditions. Fluon+™ fluoropolymers are of the highest purity since they do not contain any plasticisers, flame retardants or other additives.

Fluoropolymers are inherently capable at very low temperatures, but their resistance to hydrogen permeation is a potential weakness. PVA copolymers, on the other hand, have excellent permeation resistance to hydrogen, but mechanical performance at low temperatures is fairly poor and they show high brittleness.

This novel type IV liner compound is a blend of Fluon+™ ADHESIVE ETFE and a PVA copolymer. The combination of these materials provides excellent hydrogen permeation and diffusion resistance with improved mechanical resistance at low temperature. It shows minimal blistering and micro cracking after high-pressure hydrogen exposure as well as improved ductility at low temperatures. Owing to its adhesive properties, blends of Fluon+™ ADHESIVE ETFE also benefit from superior bonding to the outer mechanical structure of the tank.

Material	Hydrogen Resistance (*1)	Hydrogen Permeation (*2)	Low Temp. Properties
PFA	Poor	26700	Excellent
ETFE	Poor	13000	Excellent
PA6	Fair	745	Poor
PVA / Fluon+™ blend	Excellent	431	Good
PVA	Fair	287	Poor

(*1) Blister after 24hrs exposed under 90 MPa

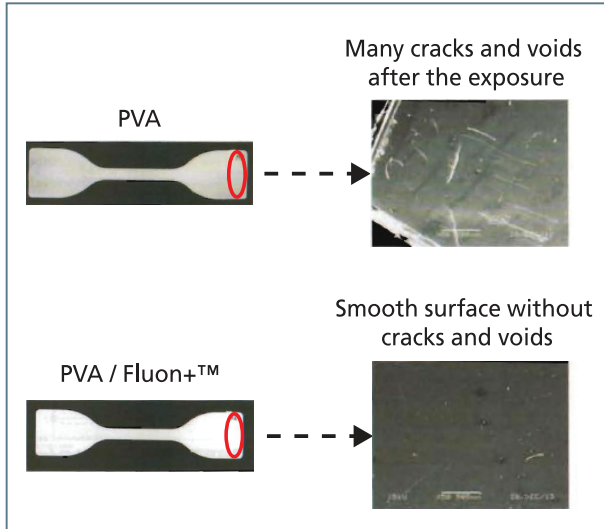
(*2) Typical value (cc 20mm/m² day atm at 40°C)

Development Status

Various material combinations have been tested by AGC. The technology is in the pre-commercialisation stage and samples can be provided upon request.

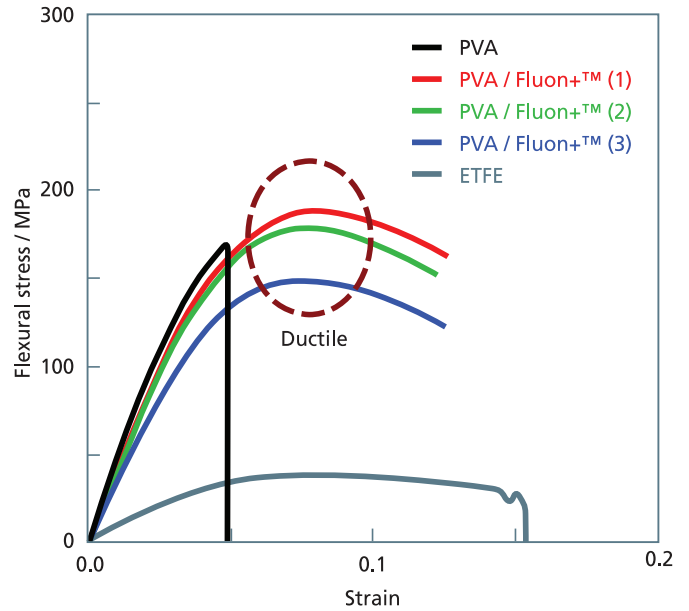
Hydrogen Resistance of Fluon+™ Polymer Blend

After Hydrogen-Gas Exposure (90MPa)



Adding Fluon+™ improves the hydrogen resistance of PVA

3-Point Bending Test at -40°C



Adding Fluon+™ increases the toughness of the base polymer to change the fracture behavior from brittle to ductile.

About AGC Chemicals Europe

AGC Chemicals is a leading fluoropolymer manufacturer and the world's no. 1 in ETFE production. The European subsidiary, AGC Chemicals Europe, produces Fluon® PTFE and ETFE and markets other fluorinated products, including Fluon® PFA and AFLAS® Fluoroelastomers. The product range offers excellent resistance against heat, chemicals and corrosion, and has a broad base of applications in industrial, automotive, aerospace, oil and gas, and other markets where long-lasting high performance is necessary.

AGC

AGC Chemicals Europe, Ltd.

Hillhouse International, Fleetwood Road North
Thornton-Cleveleys, FY5 4QD, UK