

# Enhancing polymer adhesion through surface activation using an in-line atmospheric pressure plasma

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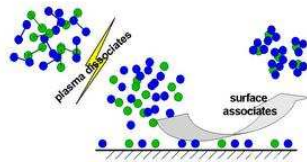
*This project was carried out with the support of PREMI and Holfeld Plastics*

## Project Summary

Plasma and corona treatments have been widely used to enhance the surface energy of polymers prior to adhesive bonding. In this study a reel-to-reel atmospheric pressure plasma treatment system known as Labline™, was used to activate the surface of polypropylene (PP) and polyethylene terephthalate (PET). An epoxy adhesive was used to bond the activated polymers and the bond strength was assessed using the tensile lap shear test method. The effect of adding nitrogen and oxygen into the helium plasma was examined, both with respect to the bond strength of the epoxy and polymer surface energy. The change in surface energy with time after treatment was monitored using the contact angle technique. A correlation was made between the contact angle change as the polymer relaxed and the adhesive bond strength.

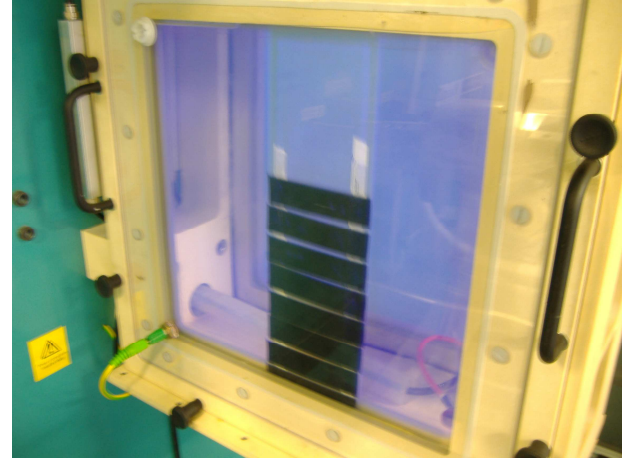
## Influence of plasma on polymers:

- Crosslinking  
Chain Scissioning
- Etching  
Removal of surface contaminants
- Functionalisation  
Increase surface energy



## Effect of plasma gas composition on adhesion

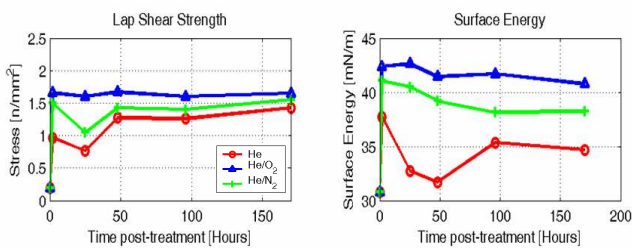
The addition of a small amount (1.25%) of oxygen (O<sub>2</sub>) or nitrogen (N<sub>2</sub>) to the helium plasma has the effect of enhancing the adhesion for PP. Addition of O<sub>2</sub> or N<sub>2</sub> had limited effect for adhesion of PET. The O<sub>2</sub> or N<sub>2</sub> containing helium plasma more effectively polarises PP. The effect is also observed through surface energy measurements



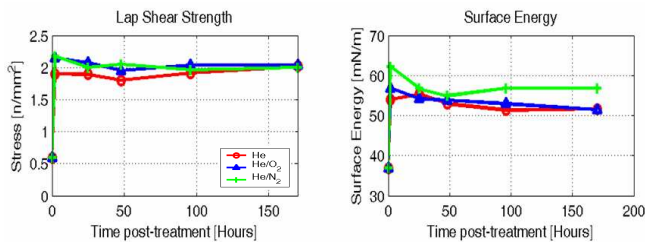
**Figure 1:** Samples being treated in an atmospheric pressure plasma



**Figure 2:** Effect of plasma treatment on water contact angle



**Figure 4:** Effect of plasma gas composition on lap shear strength and surface energy for PP



**Figure 5:** Effect of plasma gas composition on lap shear strength and surface energy for PET



**Figure 3:** Adhesion test (Lap Shear Strength) machine and schematic