Adhesive bonding of GMT components

Introduction

PP is a non-polar polymer with poor intrinsic bonding capability. It can however be surface treated to achieve a more polar surface by the creation of polar groups, current methods include plasma treatment, fluorination and flame treatment of which the latter is the most common for GMT components.

It is imperative to use a GMT grade suitable for bonding treatments. Some grades are not suitable because of the content of particular additives detrimental to bonding properties. Quadrant Plastic Composites can offer suitable grades in various fiber contents and in combination with a high number of fabrics and mats.

The bonding of GMT with PP matrix is particularly sensitive to the following parameters:

- Purity of the material and processing equipment.
- Preheating and molding process parameters.
- Component geometry and blank lay out.
- The surface treatment chosen and the processing equipment.
- The primer and adhesive used.

Purity

Special care should be taken in transport, storage and handling to avoid all contacts with grease, oil and other types of surface contamination which can result in a degradation of the bonding properties. In particular pneumatic and mechanical equipment used to handle blanks and the molding press can contain lubricants detrimental to the bonding properties of the material.

Preheating and molding conditions

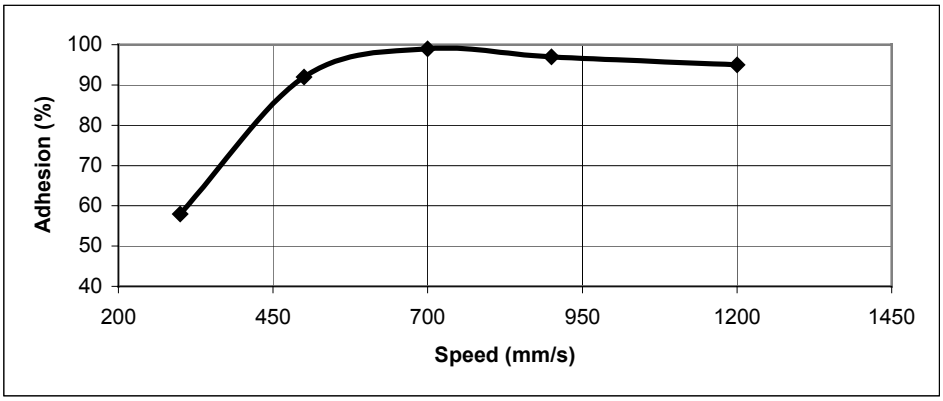
Any presence of degraded PP will result in PP molecules of very low molecular weight which forms a wax like surface layer on the component. This wax layer can disturb the adhesion by forming a film between the component and the primer film. Therefore, the material must not degrade in the oven, if smoke emerges from the blank in the oven it is an indication that a strong decomposition of PP is taking place locally and this may result in a poor adhesion.

Component geometry and blank lay out

In molded GMT parts one can distinguish between the inlay zone (where the preheated blank is placed) and the flow zone. The surface roughness on a microscopic scale in the inlay zone is usually significantly rougher than the flow zone, this results in better bonding properties in the inlay zone. It is advised to mold a rough surface at the flange of the component to be bonded. Long flow lengths and sharp corners have a negative influence on the ability of the material to form proper bonds, it is therefore advised to have “smooth” flow patterns and to position the blanks to avoid long flow lengths with respect to the bonded areas of the component.

Surface flame treatment

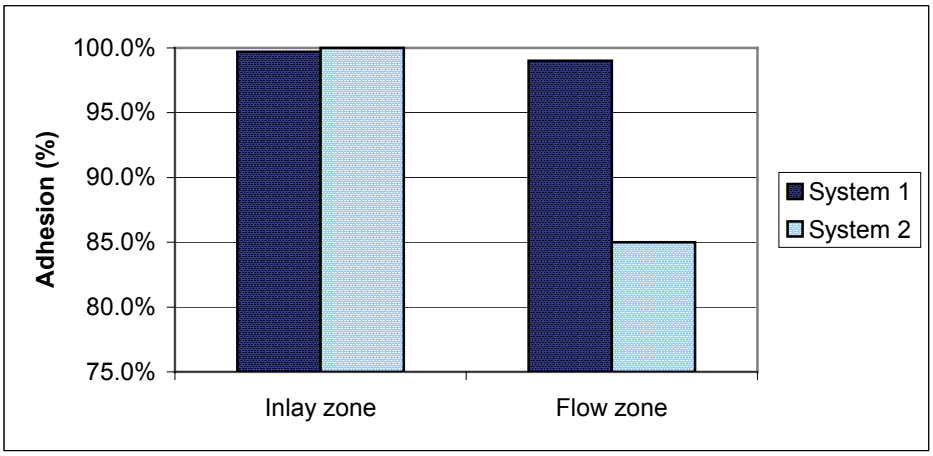
It is imperative to find the correct flame treatment suitable to the component in question, key factors are the gas type, gas to air ratio, burner type, gas flow rate, flame distance and flame passage speed (treatment time). A too excessive treatment of the surface results in degradation of the PP and therefore low adhesion and a too limited treatment does not activate enough molecules per unit area. It is often a rather delicate procedure to find the proper conditions and great care has to be taken in the experimentation. In the figure below an example of the influence of the flame passage speed on the adhesion between adhesive and GMT after cataplasma treatment. Help in optimizing the system is often given by the machine supplier.



An example of measured influence on burner speed on the adhesion of moulded GMT. Where the optimum is situated depends on the whole system.

Primer and adhesive

It is important to chose the right combination of material, process, primer and adhesive. It is therefore very difficult to give general advise to the choice of primer or adhesive. It shall however be known that very big differences has been observed between different generations and makes of both primers and adhesives. In the figure below are some measured values showing the difference between two generations of bonding system (primer and glue) applied onto the components produced and surface treated under exactly the same conditions with the same materials. The adhesion was measured after cataplasma treatment in the inlay zone and in the flow zone. The adhesion system suppliers are competent in advice of system choice.



An example of the measured difference between two bonding systems (primer and adhesive) on the adhesion on flame treated GMT.

Commercial systems

For commercial systems please contact QPC or directly the following suppliers:

- Dow Chem
- Sika
- Loctite-Henkel
- others