Introduction

Composite sandwich structures consist of two thin, stiff and strong face sheets bonded together with a relatively thick lightweight core are being widely used in wind energy, transport, aerospace and marine fields due to its high flexural rigidity, strength and low weight. As for all types of composite structures, a wide range of damages exist, caused either during manufacturing or in service. The most destructive failure is often the delamination occurring in the face/core interface as the sandwich will rapidly lose stiffness and subsequently collapse.

There are several different test methods to investigate the bond line strength between the face sheet and the core. Measuring the peel strength of the bond line give a good indication if the sandwich can perform well during its life time and its tolerance to minor manufacturing and in service damages. Different peel strength methods are available but results from the different methods can normally not be compared and even small changes in the laminate used will give big changes in the results.

Probably the most reproducible test is the climbing drum peel (CDP) test, according to the ASTM D 1781. The CDP test is relatively simple to perform but requires specific testing equipment and relatively large test specimens, see figure 1. Also the skins have to be thin if the results should be comparable to other sandwich configurations.

Figure 1 climbing drum peel (CDP), ASTM D 1781 test setup and equipment
Other methods include the cracked sandwich beam (CSB) and modified double cantilever beam (DCB) geometry. The advantages with these similar methods are less testing equipment required and smaller test specimens used. The disadvantage is that only the exact same laminate thickness and lay-up can be used if results are to be comparable.

For peel strength testing Armacell's normal procedure is similar to utilizing a DCB type specimen and mode 1 fracture measurement. However instead of calculating the fracture energy we measure the load required to pull the skin of the specimen. This is sufficient for quality testing purposes and for comparing e.g. different core materials or different resins systems.

The set up of the test is according to Figure 2 with specimen dimension: 100*25*thickness (typically 20 mm). One test batch should be of minimum 5 samples as there always is some scatter in the results.

**Figure 2 DCB Specimen preparations**

Cut through core to the opposite skin
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Bond on an angle iron 20 mm from short end and let the adhesive cure. Drill a hole, 6 mm in diameter, 10 mm from the short end. Cut trough one skin and the core, 20 mm from the same short end. Attach a ring bolt through the hole and secure on back side.

Testing and results

The test is performed using a suitable universal testing machine. A 1 kN load cell should be sufficient and the set up for a tensile test is used. The maximum load is recorded in N/25mm. An acceptable result is normally >100 N/25 mm and a good result is >150 N/ 25 mm for AC 115, 115 kg/m3 density PET foam core.

Figure 3 Set up in universal testing machine of DCB test
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Typical results for AC grade PET core (depends on resin type used etc.)

- AC 100 average result 150 N/25mm.
- AC 115 average result 190 N/25mm.
- AC 135 average result 205 N/25mm.

**Summary**

The Armacell DCB type peel strength method is presented. It can be used to check the core to laminate peel strength properties and to evaluate different parameters such as core density or core type. However, the results are dependent on not only the core material used but also on resin type, laminate thickness, fibre type etc.

Armacell AC grade PET core normally have good adhesion to the laminate with all standard laminating resin systems with increasing peel strength for increasing core material density.

**Status**

The Status of this Technical Info is **May 2011**.