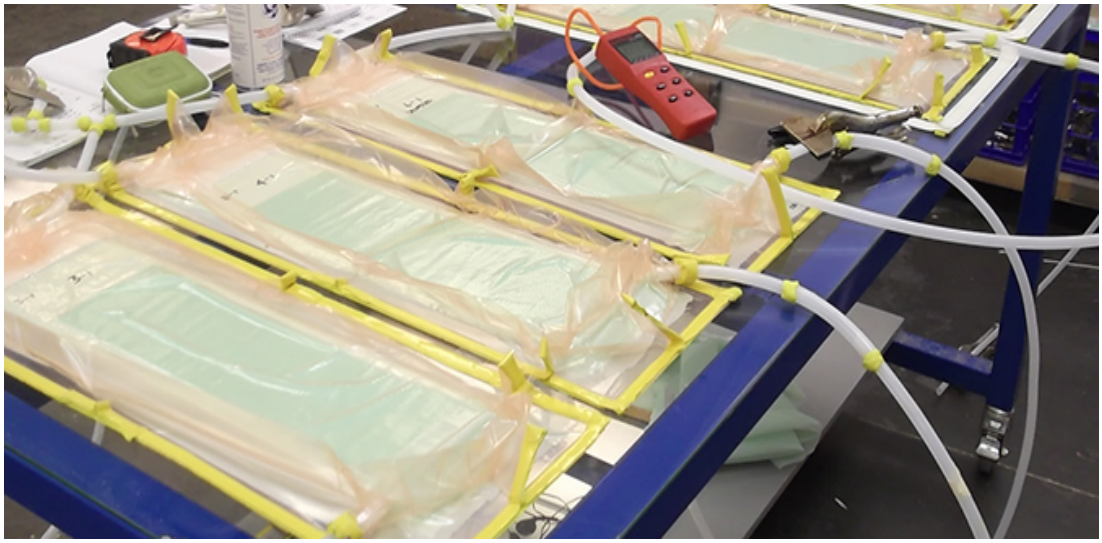

# Does Double Bag Infusion Really Work

The double-bag infusion concept has been debated in the industry for some time. After having received several questions as to the effects of double-bagging, Composites Consulting Group (CCG) decided to compare it with the traditional, single-bag infusion procedure. Dean Callander, Process Specialist for CCG, presented his team's findings at the American Composites Manufacturers Association Convention in Orlando, Florida, at the end of January 2013.

The double-bag infusion concept utilizes two vacuum bags. The actual *infusion* takes place in the first bag, where air, moisture and solvent are extracted. Sealed to the mold and enveloping the first bag, the second bag provides extra pressure on the infused part. The vacuum pressure in the first bag is reduced as the resin fills the part, so it no longer exerts full pressure on the laminate. The theory is that the second bag compensates for this, applying continued full vacuum pressure to the part, hence allowing for further resin removal, increased fiber content and an improved thickness consistency together with a lower void content.

In the first round of testing, the *CCG* test team used ten samples of a nominal 1221 g/m2 (36 oz/yd2) 0-90 biaxial stitched E-glass fabric from Vectorply. The test team kept the materials in the same conditions before and during the test. Different combinations of process variables were used to test the specific theories: resin feed inlet not clamped after fill, resin feed inlet clamped after fill, etc. After the *infusion*, the team measured and weighed the

panels. Void fractions and fiber fractions were established through standard test methods ASTM D 2584 and ASTM D 2734. The National Institute of Aviation Research (NIAR, Wichita, Kansas) verified the baseline results.

The results showed no real improvement in the panels that had been double-bagged. All weights fell within 0.6 kg/m2 (0.12 lb/ft2), and thickness varied less than 0.3 mm (0.01 inch). In a second test round, *CCG* repeated the infusion with the panels that had showed the best results in the first round. Again, there was no significant difference between the single and double-bagged *infusions*.

Callander says that they were able to test the pressure theory by placing scales under a double bag setup, providing a “visual” reference. Vacuum pressure of 5”Hg was applied to the first bag, representing what the pressure reduces to after a part has filled. The scales used in the test registered approximately 160lbs of force at this vacuum pressure. The edges were isolated by placing a frame of timber around the set of scales. (Extra force is applied to the edges of a part due the stretching of the bag over this edge if it is not pleated, or any sort of material bridging of the bag is allowed to happen.) A breather material is placed between the bags to allow for adequate vacuum flow. Full vacuum pressure (28”Hg+) was then applied to the second vacuum bag. Once the vacuum had been applied and the part had “settled”, the scales registered no extra force.

However, *CCG* did detect some minor advantages. It seems that double-bagging smooths out any wrinkles in the first bag, making the whole set-up slightly tighter. The second bag creates full vacuum pressure *between* the two bags, not *on* the first bag. Any improvement from the second bag on the first is from a mechanical smoothing of the first bag, helping with thickness consistency, but to the tune of less than 1/3 of a millimeter in this instance. A second bag will also make up for any leakage in the first bag; however, with proper bagging technique the first bag should be airtight, making a second bag unnecessary.

Callander points out that the concept was developed by the aerospace industry, to deal with other process parameters not specifically addressed with this method. The small improvements in the reduction of thickness may be worth the extra cost for an aerospace project, but are of limited advantage to even a high-performance marine project where demands on cost and performance efficiency are of vital importance.

Instead of looking into alternative types of infusion procedures, Callander says it is more important to make sure the process itself is under strict control. Attention to detail, including a list of instructions for the procedure carried out in the same way every time, is vital. Once a process is established, it will be possible to try new solutions and evaluate them accordingly.

*Composites Consulting Group*