German Advanced Composites

Fast Forward with Innovation

MTI® Process

The MTI® (**M**embrane **T**ube **I**nfusion) process, based on a microporous membrane hose, is a cutting edge composite production method. It is in some decisive factors different from the standard Vacuum Infusion Process (see animation film on GAC`s website "MTI How it Works"). It was developed to make the resin infusion process easier and more reliable enabling the user to achieve high-end results on a par with autoclave systems but with much less investment and expenses in equipment, labor and material. The following recommendations shall provide useful information in terms of the technology, the physics behind and a proper set-up.

Vacuum level – A high vacuum level is an important factor with the infusion of high quality parts. We recommend an initial vacuum level in the system of 10mbar/0.145psi (**absolute pressure, NOT relative pressure)** and below. Relative pressure is most often indicated by an analog gauge mounted on the vacuum pump. It monitors the pressure difference between atmospheric pressure and absolute pressure in the system. Since the atmospheric pressure is most often unknown (it depends on different parameters like the elevation of the location and the weather) this value doesn`t tell much about the absolute pressure in the system which is the only reliable indicator for the remaining amount of air in the vacuum system, thus for the quality of the produced part. The more air in the vacuum system the more voids are possible. With an average atmospheric pressure of 1000mbar/14.50psi a system pressure of 10mbar/0,145psi (**absolute pressure)** leaves 1% air in the system.

The use of a digital absolute pressure gauge helps monitoring the vacuum pressure (connected to the feed-line during the set up and leak check of the system).

Vacuum integrity – A high vacuum integrity is also very important for the production of void-free laminates. Make sure the vacuum system is airtight with a drop test. Our interpretation of a "drop test" is, after you`ve sealed everything to the best of your ability clamp all lines and shut off the vacuum pump. If you lose more than 3mbar/0,435psi within 15 minutes you have a leak that needs to be found and fixed prior to infusion. An airtight system keeps the vacuum easily without pressure drop even without the support of the vacuum pump. In case of leaking tools or splitted moulds you can use - in addition to the vac-film sealed on the mould perimeter - an envelope bag which is also evacuated by using a T-connector and a standard vac-line.

We recommend to produce also the moulds with the vacuum infusion process to ensure the highest possible vacuum integrity. The MTI® membrane shuts off the way to the vacuum pump when it is once completely covered with resin. This effect protects the laminate from bleeding out which would result in pinholes on the surface. Furhermore it leads to an easily adjustable lower hydrostatic system pressure (controllable by the height difference mould/resin source) which in turn leads to a collapse of possibly entrapped air bubbles (unlike the standard VIP where entrapped air bubbles expand to maximum size in the vacuum atmosphere).

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After the evacuation line is shut off the vacuum pump can no longer compensate any leakages in front of the membrane. **Important:** The vacuum integrity of an infusion set-up is one of the main factors for the quality of the laminate!

Self-regulating MTI® process – As already said, an MTI® setup is a closed hydraulic system which means that only air and gas can escape but not resin. Resin will stop when it hits the membrane and continue to flow through the rest of the dry fabric, eliminating the need for complex calculations of resin injection points (keeping only in mind the overall flow distance that the resin can attain in your particular infusion setup). Such a self-regulating system provides the perfect environment to create void free laminates. The final system pressure is adjustable very easily through the height difference between the mould cavity and the resin source which provides some further important advantages. One can produce laminates with a particular high fiber to volume ratio between 57 and 60% by placing the resin source 5ft below the mould cavity short before the infusion process is completed. This procedure leads to app. 150mbar/2.1755psi remaining system pressure which corresponds to the fiber opening forces. More resin can be drawn into the laminate and a higher/deeper visual quality of the part is achievable by reducing the height difference up to 1ft because the setup is then less compacted.

There is little that can be done wrong and with few tests you are able to find the optimum for your particular application.

Degassing the resin – We highly recommend to degas the resin for at least 15 min. under full vacuum (less than 20mbar/0.29psi) before it is applied in the infusion process. This removes embedded air out of the matrix material (coming in through the mixing process) which could cause voids in the laminate. Embedded air bubbles expand to maximum size within the vacuum athmosphere which is present along the resin flow front. We recommend an epoxy infusion resin with a proper pot-life (1 hour or more, the longer the better) and a sufficient viscosity of 300 mPas or lower. The lower the viscosity the better the resin flow through the laminate. Heat lowers the viscosity but also reduces pot-life. We also recommend the use of a special designed infusion resin. Some sort of solvents, contained in unsuitable resins, tend to boil in deep vacuum.

Handling the MTI® hose – Take care not to hurt the membrane of the hose (e.g. during unpacking the received package with a knife or handling in the shop). Finally make sure one end of the membrane hose is sealed well (refer to the Instruction Manual - Episode 5 to see how to do that in a simple way with sealant tape) and the other end is connected accurately with the vacuum line. -

For further information in regards to the proper application of the MTI® hose please refer to the GAComposites YouTube channel which provides also the entire Instruction Manual video series.