How to make best use of TeXtreme®

Thank you for choosing TeXtreme® Spread Tow reinforcements. We are confident you will find TeXtreme® Spread Tow fabrics and/or TeXtreme® Spread Tow tapes rewarding. TeXtreme® is a lightweight reinforcement for production of ultra light composites. To get you started we have created this document consisting of advice and suggestions to assist you in using TeXtreme®. Some of them are basic and applicable to composites manufacturing in general and some of them are more specific and applicable mainly to the usage of TeXtreme®. We wish you good luck and hope that TeXtreme® will improve your product and help in reaching your goals.

1. Using dry TeXtreme® fabric

1.1. Handling

TeXtreme® is easier to handle than most fabrics. The binder applied on TeXtreme® allows the fabric to remain intact when handling, moving or cutting it. Additionally, problems with loose yarns at the edges of the cut fabric piece are also eliminated. The integrated structure of TeXtreme® also makes it easier to pick and place the fabric pieces both manually and through automation. The fabric can be cut in any shape desired without the risk of distorting the fabric piece as in many other fabrics. An example of this can be found in Figure 1.

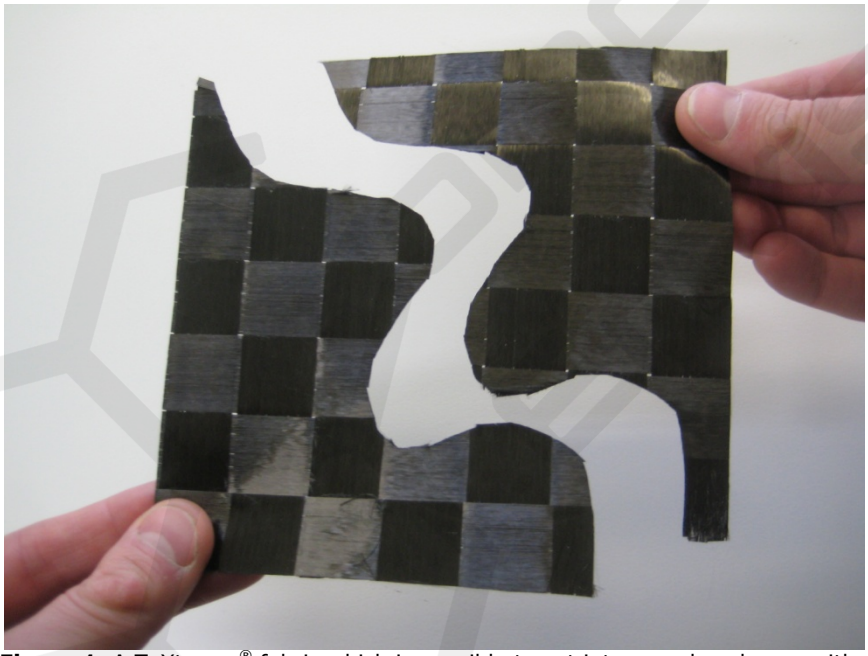

Figure 1. A TeXtreme® fabric which is possible to cut into complex shapes without distorting it.

It is also possible to increase the drape-ability of the fabric by heating it with a heat gun and shaping it while warm. In that sense, the dry fabric is similar to a prepreg since it is possible to activate the binder to be able to drape it more easily.

Please note that the interleave foil the TeXtreme® fabric is delivered with, is NOT to be used in composites manufacturing. Its sole purpose is to ensure that the fabric layers do not adhere to each other on the roll.

1.2. Recommended manufacturing methods

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TeXtreme® is no different from other carbon fiber fabrics in the sense that it can be used with the same manufacturing methods. Bear in mind, however, that a TeXtreme® fabric is denser and has higher cover factor than most fabrics. Due to this, it is recommended that a manufacturing method that utilizes pressure difference either by vacuum bagging and/or using higher external pressure be used. Recommended manufacturing methods include Resin Transfer Molding (RTM) or Vacuum Infusion Processing (VIP). Using these manufacturing methods will allow the resin to impregnate the fabric more easily.

Hand-laminating by using a roller is not recommended since it often results in a composite with more voids and air bubbles. It is also difficult to reach high fiber volume fractions with this technique.

1.3. Allowing complete wet out

1.3.1. Layup

As TeXtreme® has a high cover factor it has very few natural gaps. If dry fabric layers are used for building a composite of several millimeter thickness, bear in mind the effect of the cover factor on infusion time when planning the layup. The resin might need more time to wet out the TeXtreme® fabric compared to regular fabrics. Keep this in mind also if laying up many thin layers. Our sales team will be able to assist with ideas on wet out if building in any of the above described ways.

When laying the fabric plies, place each fabric ply with binder side facing away from the mold if you are using a TeXtreme® fabric with binder on one side. If the first layer is facing away from the mold the binder pattern will not be visible in the produced composite part. Placing every layer with binder side face away from the mold will not result in permeability fluctuations throughout the fiber stack and will allow resin to impregnate the fibers more easily. If a TeXtreme® fabric with binder on both sides is used, both sides are equal and there cannot be permeability fluctuations caused by what way the binder is facing. These facts are mostly applicable in VIP where the resin flow is transverse to the fibers.

Using a peel ply on the backside instead of a release film allows more air to escape and excess resin out which can improve the quality of the composite part produced.

If building a sandwich construction and two surfaces without visible binder pattern are desired, place every layer on each side of the core with binder sides facing the core.

1.3.2. Resin choice and process temperatures

Always degas the resin before injecting it. This removes air and volatiles present in the resin mixture and will reduce the risk of voids and porosities in the final composite.

Use a resin with as low viscosity as possible. This will allow the resin to wet out the fibers more easily. Use a resin with long enough gel time to allow it to wet out all fibers before gelling. This is of even greater importance when building thicker composites.

Control the temperature during production. In e.g. RTM this is controlled, but in VIP the tool is most likely not heated. The temperature in the production facilities will therefore affect the resin viscosity. Higher temperature will lower the viscosity and facilitate impregnation. Even a few degrees can have a large impact on the impregnation and result in a composite part with better surface quality.

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The temperature of the tool and fiber stack can affect the impregnation process. Heating the tool and fiber stack will lower the resin viscosity and facilitate impregnation.

1.4. Process equipment and parameters

As the TeXtreme® fabric is woven using TeXtreme® Spread Tow tapes it has less crimp, low crimp angles and provides improved surface smoothness compared to most conventional fabrics. There are although some general aspects that should be considered.

The surface quality of the tool is an important factor. If the tool is made of composite and has not been used for a while it is a good idea to run it through a cure cycle to evaporate the moisture. Otherwise, steam can form while curing the composites which might greatly affect the surface quality.

Additional air evacuation can be allowed by gritting the tool, for example by using an 800 or 1000 grit sandpaper. This will allow more air to escape via the surface of the tool to provide superior surface quality of the composite part. The composite surface will be a little rugged compared to one made from a completely smooth tool.

Use a suitable release agent and/or gelcoat. There is no simple answer on which to choose since most release agents on the market should work well with most types of tools and resin systems. If matrix cracks or air pockets on the surface are present in the produced composite, one idea is to look into other types.

If using vacuum bagging techniques, make sure that the air has been sufficiently evacuated by keeping the fiber stack under vacuum a sufficient time before the injection is performed.

1.5. Visual defects

Observe that the fabric has one front side and one back side. To avoid a visible binder pattern in the produced composite part, place the fabric layer closest to the mold with its binder side facing away from the mold. To avoid increasing the local permeability make sure to place every fabric layer the same way.

2. Using TeXtreme® prepreg

2.1. Recommended manufacturing methods

TeXtreme® prepregs can be used with the same manufacturing methods as other carbon fiber prepregs. When using a prepreg of as high cover factor as TeXtreme® it is important to utilize external pressure and/or vacuum to be sure to evacuate air from the prepreg. Using Autoclave Molding (AM) or Compression Molding (CM) is recommended to facilitate air evacuation and thus produce parts of superior surface quality and minimized void content.

2.2. Handling

Most composite technicians find TeXtreme® prepregs easy to work with while a few find them difficult to shape and drape. TeXtreme® is a reinforcement which is flat like a UD but have fibers in two directions which makes its characteristics rather unique. The handling of such reinforcement does therefore differ a bit from a common fabric. Due to this fact a guide on how to work with TeXtreme® prepregs has been put together. The guide is available online in form of a PDF document at the link found below:

http://www.oxeon.se/index.php?mact=News,cntnt01,detail,0&cntnt01articleid=177&cntnt01returnid=86

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If the link does not work, the guide is possible to download through www.textreme.com. Navigate from there through the headlines by clicking "News room" which has a subdivision "Technical Literature" where the news post "A recommended guide for how to work with TeXtreme® Spread Tow Fabrics" posted 2011-09-19 can be found. By clicking the link a page opens where it is possible to access the PDF document.

2.3. Avoiding dry spots / Air bubbles

2.3.1. Prepreg resin choice

When using prepregs, some resin systems are easier to evacuate air from than others. Choose a resin suitable for the application based on mechanical and thermal properties when cured, curing temperatures, fiber compatibility and (for sandwich constructions) core compatibility. What also should be kept in mind is that different resins have different viscosity profiles and behaves differently during the cure cycle.

If using one sided prepreg, make sure the dry side is positioned towards the mold to allow proper air evacuation.

2.3.2. Layup

Debulk the first ply and every sixth ply afterwards to reduce the amount of air entrapments. Debulking the first layer is crucial in reaching superior surface quality.

Combining dry fabric layers with prepregs can be done to create a path for air evacuation in e.g. AM when vacuum is applied. Having the second ply from the mold dry and every third ply afterwards dry can allow air to be evacuated from the stack and can also increase the fiber volume fraction. Make sure to have the dry layers slightly wider than the prepreg layers to ensure vacuum connection. If only using two layers and having problems with air entrapments it is possible to use one ply dry and one ply prepreg. With this layup, make sure to have the prepreg on the mold side. Calculate the fiber-resin ratio to make sure that the amount of resin is reasonable to be able to wet out both plies.

2.3.3. Process equipment and parameters

Use a cure cycle which allows the resin to wet out the fabric and volatiles to escape before it starts to gel. Adding a dwell time at a lower temperature can help as this allows the resin to flow at a lower viscosity for a longer time for trapped volatiles to escape. Most prepreg manufacturers will supply customers with the temperature/viscosity/gel-time profile of their resin system to be able to determine a good dwell time and temperature. Increasing the temperature ramp to reduce the cycle time is not recommended since this can make the resin gel too quickly.

If using AM, the choice of perforated/non-perforated release film can affect the surface quality of the composite part. Which to prefer can depend on e.g. the layup and the fiber to resin ratio in the prepreg. A recommendation both to obtain lower void fractions and increased fiber volume fraction would be to use a perforated release film to allow air to escape and excess resin out.

Away to allow additional air evacuation can be to grit the tool, for example by using an 800 or 1000 sandpaper. This will allow more air to escape via the surface of the tool to provide superior surface quality of the composite part. The composite surface will be a little rugged compared to one made from a completely smooth tool.

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