THISTLEBOND LAMINATES

A DIVISION OF E. WOOD LTD.

ESTABLISHED 1882

TOTAL HULL CARE FOR GRP CRAFT

THE CAUSES OF OSMOTIC BLISTERING OF GRP, ITS PREVENTION AND EFFECTIVE REPAIR

A THISTLEBOND TECHNICAL PUBLICATION

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BLISTERS IN FIBREGLASS BOATS

1. THE NATURE OF BLISTERING

A rash of circular dome-shaped protuberances (blisters) on the bottom of a GRP boat are only the outward symptom that something is happening under the gelcoat as a result of the boat being immersed in water; after all, they do not happen before the boat is launched.

The causes and the potential disaster of gelcoat blistering are fraught with misunderstanding in the mind of the layman. Whilst it is difficult to pinpoint a single cause in every case, a few things are known...

Although blistering has afflicted glass-reinforced plastic (GRP) hulls for decades, many boat owners are blissfully unaware of this insidious investment-destroyer. Why the oversight? Like cancer, gelcoat blistering (GCB) begins with physio-chemical processes which are invisible to the naked eye. Obvious pimple and lump-like imperfections, ranging from pinhead to over 1 inch in size, only appear months or years after a hull leaves the mould.

Can GCB be treated? Repairs using ThistleBond epoxies combined with two-part polyurethane paints, can be used with great success to rectify and prevent the problem. Thanks to research around the globe, our understanding of GCB has reached the point that fibreglass boats can be rendered essentially immune to this problem, providing builders adopt appropriate techniques.

2. THE CAUSES OF BLISTERING

There are two distinct types of gelcoat blisters. The first stems from air voids in the laminate. Voids can sometimes be detected visually, especially in un-pigmented laminates. Voids can cause fractures in the surrounding laminate when the air they contain contracts and expands. Moreover, moisture can enter an intact void, either by penetrating the somewhat porous resin itself, or by capillary action along strands of fibreglass. Once through the gelcoat, water can swell a void and initiate de-lamination. Pressures of several atmospheres are believed possible in water swollen voids.

Apart from causing internal pressure, water in the laminate can hydrolyse free vinyl acetate monomer (used in fibreglass production) and give rise to a solution containing acetic acid (like vinegar). In many cases, the pungent odour of this acid is unmistakable when blisters are ruptured.

Air voids can be induced during lamination when methyl ethyl ketone peroxide (MEKP) is mixed into the base resin, but by far the commonest source of voids is poor laminating technique. Fibre glassing is often carried out by workers who lack the skills needed to remove all the air bubbles from the lay-up.

Although air voids in the laminate can lead to GCB problems, a second type of blister causes even more trouble and has received more attention in the technical literature. These blisters are caused by a process known as osmosis. Osmosis is a scientific term for the movement of a solvent (such as water) across a semi-permeable barrier (such as a typical gelcoat) from a less concentrated solution toward a more concentrated one.

For osmosis to take place in a fibreglass boat hull, it is necessary, not only that the gelcoat and lay-up be somewhat water permeable, but that a more concentrated solution be present within the laminate than outside. Microanalyses of the contents of osmotic-type blisters typically contain acetic acid, trace quantities of un-reacted styrene monomer, phthalic acid, phthalic anhydride as well as soluble copper, calcium, and magnesium salts. Similar substances can be found in air voids that have filled with water. Of course, a lower solution concentration outside the hull would tend to accelerate osmotic blistering, and indeed, GCB sometimes appears to advance more rapidly in fresh water than in the ocean.

To form concentrated chemical solutions within the laminate and initiate osmosis, water must either penetrate the gelcoat initially or be incorporated in the laminate during manufacture. Gelcoat is polyester resin, a condensation product formed by the reaction of polhydric alcohols and polybasic acids. In order to obtain a consistency suitable for spraying onto a hull mould, the resin must be thinned with either a simple solvent or a reactive solvent. Use of a simple solvent such as acetone as a diluent is an unacceptable practice that can lead to premature degradation of the gelcoat. The more common practice is to use styrene monomer as a diluent because limited amounts of styrene will form an "additional polymer" with polyester (MEKP and the cobalt initiator activate unsaturated linkages in the polyester where styrene molecules can bond on what is known as a free radical polymerisation).
If too much styrene is used, unreacted styrene monomer will lower the quality of the cured resin. Styrene loading should not exceed 25% to 30%, but some builders use more in order to thin the resin sufficiently to spray with conventional equipment instead of airless spray guns

A cold mould, one that has been stored outside until shortly before use, can become coated with condensation. If resin is sprayed onto a wet mould, the resulting gelcoat will be exceptionally porous, and moist right from the start.

3. HOW EXTENSIVE IS THE INCIDENCE OF BLISTERING IN GRP HULLS?

It is estimated that about 40% of all GRP hulls show symptoms of osmotic blistering within 5 years, and as much as 80% after 10 years. How long the symptoms take to develop will not only vary from hull to hull, depending on the exact hull quality standards and its basic susceptibility level to moisture uptake etc., but will also vary according to the quality of the water in which it is placed.

Water salinity has been found to be an important factor influencing the development of osmotic blistering. Incidence on the Great Lakes, where water is largely fresh, (but may be polluted by other chemicals) is relatively high compared to boats on the same latitude on the coast. Water temperature has perhaps an even greater effect since this can vary considerably from area to area. Boats kept in Florida, certain parts of California or on the Gulf Coast (where water temperatures will be over 80 degrees Fahrenheit at certain times of the year) show not only the worst symptoms, but also symptoms show on a significantly higher proportion of boats than in colder waters. In Sweden and Norway, for instance, the osmotic blistering problem is considered to be relatively minor.

Symptoms, therefore, may take as long as 20 years to develop in areas unfavourable to osmosis, or they could be seen in as few as 2, 3 or 4 years in areas conducive to blister formation.
These observations are consistent with the notion that osmotic blister formation is the result of a chemical process happening under the gelcoat.

The length of time a boat spends in the water is a more obvious controlling influence, hence blistering is rare on the smaller sailing boats which are trailer sailed, or ski boats, which spend 90% of their time on trailer. These boats have no more basic resistance to blisters than larger boats, except that they spend less time afloat.

4. HOW SERIOUS CAN BLISTERING BE TO THE BOAT OWNER?

Like an illness, blistering can start off with humble beginnings, being hardly noticeable, but if left untended and corrective treatment ignored, then it will always progress to become more severe and extensive, be more difficult to treat effectively and cost many times more for correct remedial treatment.

Minor gelcoat blistering represents the first stage in the osmosis damage syndrome (sometimes the blisters may not even be osmotic) and does not, at this stage, threaten the structural integrity of the hull. As the condition progresses, however, an increase in both the number and size of blisters occurs, but what is happening under the gelcoat is hidden. Here pockets of corrosive liquid will gradually develop, this is identified when burst by their increasingly pungent odour and brown coloration. This liquid will invasively penetrate deeper into the laminate causing at first local de-lamination or de-bonding of the glass fibres from the resin. This debonding, in its early stages, is seen as a pronounced local whitening, in patches over the hull. On more severely affected boats where debonding, although slight, is more extensive the condition is very noticeable around the waterline at the junction of the sound fibreglass (above water) and the affected fibreglass (below water) as a pronounced colour change from healthy brown/green colour to one with a general whitish/grey cloudiness. The boundary can be most distinctive and serves to illustrate how corrosive the effects of water on GRP really are!

Boats in temperate waters rarely show any serious laminate degradation other than local patches associated with large blisters. Often the blisters are restricted to the region immediately under the gelcoat. So far as is known, no boat has been known to sink or cause loss of life because of the effects of osmotic blistering, but they can become seriously structurally impaired. Water uptake, even 1 - 2% by weight, can lead to a significant decrease in panel stiffness particularly if it occurs from both sides and some strength loss. Most boats however are naturally built 'over strong' as a consequence of building up sufficient thickness to give unsupported panels enough rigidity, so a little can be spared without any serious consequences. It should always be kept in mind that it is the eventual delamination of the stacks of glass fibre, which will weaken the boat.

For the boat owner who has blisters on his hull, the condition of blisters is initially more of a cosmetic importance than structural, in the majority of cases, but at some time that boat will inevitably need repair. High cost normally precludes even repair of minor blistering for some owners. The uncertainty of long lasting repair also makes expenditure on all but the most thorough repair seems unworthwhile. Perhaps these are the reasons why we now have so many boats with quite advanced symptoms, particularly in warmer parts of the World. Costs for hulls requiring even only single layer relaminating, are at least double the normal repair costs.

5. PREVENTION AND REPAIR

PREVENTION

As long as polyester resins are the principal resins used for hull construction, research has shown that the best workshop practices can never guarantee against osmotic blistering. It is the chemistry of these materials and their basic susceptibility of attracting water molecules that lies at the root of the osmotic blistering problem.

Improved polyester resins have been developed offering enhanced resistance to moisture and these are currently being used by quality-conscious builders both in the USA and Europe, but they are still polyester and therefore, blistering can still occur.

The average boat owner, at least for the near future, is therefore left with no choice but to own a boat that is to varying degrees a candidate for osmotic blistering. So what can he/she do to lessen the possibility of this event happening?

He/she can firstly pull the boat out of the water for regular winter storage and at the same time take the opportunity to inspect the hull and make good any physical gelcoat damage incurred in service. This is, of course, a regular annual event in the colder climates. For boats in warmer climates, where they are in service year round, owners are recommended to pull their craft annually to check for this problem or have it done when the boat is out for other reasons. For brand new craft the owner is advised to have a Barcol test on the gelcoat even before the boat is put in the water to test for complete cure. If the gelcoat is found to be incompletely cured, and therefore more susceptible to water uptake, the owner has legal redress for the manufacturer. A surveyor commissioned from SAMS (Society of Accredited Marine Surveyors) with a Barcol hardness meter will perform this task.
<u>Using a good epoxy barrier coat of adequate thickness, before a new boat is launched is always advisable.</u> Considering the advantages of this treatment it is surprising that so few owners have had this done! These measures will be particularly important if the boat is kept in fresh, warm waters - conditions that accelerate the formation of osmotic blisters.

REPAIR

If blisters are noticed they should be treated at the earliest opportunity that time and funds will allow. Experience has shown that treating blisters individually is merely a stop-gap measure delaying the inevitable time when the gelcoat will have to be removed completely. Early effective treatment, though not cheap, pays dividends, and experience has shown that it has the highest chance of being 100 percent successful.

Complete gelcoat removal using gelcoat peeling equipment followed by thorough preparation and a good treatment programme have proved effective long-term solution to the problem of osmotic blistering.

In the UK the **ThistleBond Division of E. Wood Ltd** have developed several high solids epoxy coating products specifically to treat blistering and introduced them in the early 1970's with considerable success. Of the 1,000 to 1,200 boats, which have been peeled and prepared in the UK since 1989, **ThistleBond** have not heard of any boats, which have required re-treatment.

<u>On all these boats the gelcoat has been grit-blasted or ground off and removed.</u> Where the process has not succeeded this is due to a combination of incomplete preparation and/or insufficient thickness of barrier epoxy.

6. HULL PREPARATION.

Sandblasting or dry grit blasting, as it is sometimes called, depending upon the medium utilised, can be used to prepare boats but it is not an ideal method of preparation.

Blasting, to be effective, requires careful control so that only the gelcoat is removed, but being too cautious only results in opening the surface of the blisters, overblasting will damage the exposed laminate (which is softer than the gelcoat and therefore more easily damaged) and extreme cases could cut right through it! The best technique is to carefully remove 50 percent of the gelcoat thickness leaving an extremely rough and pock-marked surface. Where blisters are seen, further blasting should be used and remove additional gelcoat. The sandblasted surface may then required the use of angle grinders to smooth it to some extent, to make it ready for remedial treatment.

The main effect of sandblasting is coarse etching of the gelcoat, which is opened up to reveal laminate in only the most susceptible spots. The other disadvantage of a blasting process are hazardous waste and deposits, copious quantities of sand and grit around the boat, requiring a special treatment area. The process also requires a powerful compressor as well as special protective wear for the operator.

Gelcoat peeling is the preferred preparation as all the gelcoat can be removed to a uniform pre-determined depth with an even surface. This means that very little filler will be required later. Moreover, it is a much cleaner operation that seldom warrants working in a specially designated area. This applies only to the dry type of peeling; indeed it can be done inside a workshop without too much inconvenience - except for the noise! Peeling is usually a faster process than sandblasting and therefore, respective costs are likely to be less.

Once the gelcoat has been removed the surface should be lightly abraded.

An increasingly popular method for abrasion that goes conveniently in tandem with stripping (peeling) is high pressure slurry blasting which will achieve the desired result in terms of etching the surface and finding any soft spots, it will also remove the surface contamination at the same time. The advantages of this technique are, that its eroding effects are easily controlled by either or both sand flow rate and water pressure. If this is not is permissible, then grinding with a coarse Dual Action sander should be used, to prepare the surface.

A special feature of dry peeling machines is that all waste materials are automatically removed to a vacuum tank via a suction hose built into the cutting head of the peeling machine.

On boats that have a tie coat - usually it is a dark colour - underneath the gelcoat, should have this tie coat removed. The reason for the removal of the tie coat is two fold :-

1. It may well be impregnated with liquid contaminants

2. The boat will dry out much better and swifter without it.

7. CLEANING THE HULL

Once the gelcoat is removed steam cleaning and pressure washing should be used to remove the various contaminants leaching out of the laminate, if left on the surface any contaminants will impede the drying out process. Immersing the hull in fresh water immediately after peeling the gelcoat can also be used to remove the contaminants.

8. DRYING THE HULL

The main objective of drying is:-
a) To bring the moisture content of the hull underwater area down to a level where it will not initiate the osmotic reaction.
b) To help restore the strength and panel stiffness properties of the hull.
c) To obtain maximum bonding strength of the repair treatment.

Monitoring the drying programme, using a moisture meter is essential, accurate records should be kept in writing using a permanent marker pen over the centre of the monitored points. In hot, dry environments, hulls without gelcoats will dry outside without assistance within a few weeks. In most other areas however, a combination of outside drying followed by an intensive period of forced drying will be required.

Forced drying can take many forms with the most common being infra red lamps directed onto the hull surface etc. Drying times can vary enormously from boat to boat, dependent upon the depth that the moisture has penetrated the laminate. On average a two-month period outside followed by two to four weeks inside (with assistance) is not unusual for boats with relatively minor blistering.

Adequate ventilation should be provided to all parts of the hull, keeping the bilge’s as dry as possible during the drying period. One of the best recipes for creating a high temperature humidity chamber is to leave a poorly ventilated, tightly sealed boat in the hot sun for a few weeks. Moisture can and will pass through either side of the laminate, a rain forest type environment can be created, providing all the necessary elements for gelcoat blistering. Bilge water is an obvious source of moisture, so it is important to keep the bilge’s as dry as possible.

To monitor the drying progress, it is necessary to determine the moisture content of the hull. Several types of monitoring equipment are available. The Sovereign Moisture Meter is a good example but one must be aware that the reading these units give is relative only and not an accurate representation of the actual moisture content of the laminate. Begin by taking and recording readings at regular intervals above and below the waterline, along the entire length of the boat. During the drying process, it is necessary to periodically take and record new readings at the same locations. After a period of time, the drop in relative moisture content will level out. A meter reading of 2 or 3%, should ensure that the laminate is dry and repairs can proceed.

A simpler method, more in line with the average boat owner's needs can be used; this involves taping a 150mm x 150mm square of 150 micron (6 mil) clear plastic to several locations on the hull, above and below the waterline. The edges should be tightly sealed, using masking tape. As the hull dries, moisture will condense on the plastic. Every three or four days, remove the plastic, wipe the hull and plastic dry and tape it back in place. When the hull is nearing the lowest possible moisture content, very little condensation will appear inside the plastic. There are other variables to keep in mind, such as changing relative humidity and temperature. So before the hull is finally pronounced dry enough - allow the patch to stabilise over several days. Like the moisture meter, this test is only an indicator of relative moisture content.

9. APPLYING THE THISTLEBOND TREATMENT

Once the boat has been peeled and the hull dried out the cavities must be filled and the surface faired. During the drying period, trace particles of solutes may have leached out and remain on the surface. These elements must be removed by flushing the surface area with fresh water. Although time has been spent drying out the boat, this brief exposure to the fresh water wash down will not increase the moisture content of the laminate. Generally, wiping the surface dry with clean, white paper towels and then allowing the hull to dry overnight (or using fans or heaters) will sufficiently dry out the hull surface.

Prior to staring any repair work, it is important to be properly organised, remember the five P's - Perfect Preparation Prevents Poor Performance. The time spent on setting up pays dividends!

9.1 Equipment Required

Lay all the materials needed on a table near the boat. This equipment should include the **ThistleBond Resins and Hardeners** with the appropriate Technical Data Sheets. A screwdriver for levering off lids, strong straight sided stirring sticks approx. 30 x 40.5cms, electric drill and paddle mixer, **Thistlebond SFE Thinners**, clean tack rags, kitchen roll (white only), roller frames and covers, roller tray, cling film (cut and lay the cling film in the tray before use. This technique saves using new trays), plastic buckets or paint kettles of sufficient volume to stir up to 2 litres of mixed product before transferring to roller trays. A supply of graduated clear measuring cups, paint brushes, paper and pencil for mix ratios and keeping track of the volume of product used on each side of the boat, it should be the same. Wet film paint gauges, plastic gloves, two plastic squeegees for filler application, a mixing board, electric hot air gun (paint stripper type), dust masks, protective clothing, abrasive paper 40 and 60 grit, sanding tools, 125mm random orbital sander, 60 grit discs, masking tape, Stanley Knife, foam roller brush, this is an inexpensive tip-off brush made from a foam roller cover. To produce this foam brush, using a utility knife cut a roller cover in half, then cut each half into thirds. Insert one of the roller segments into a 45º slot cut into a small stick. For tipping-off large areas, simply cut the entire roller into length-wise thirds. This handy little brush is disposable and very inexpensive and the cardboard backing provides firmer support than does a commercially made foam brush.

9.2 Getting Started

It is important to note that **ThistleBond 152 SFE** is thicker and more thixotropic than normal paints, being made up of a thick Resin component and a thinner Hardener component. Being a two-part system, the mix will not cure properly unless the two components are *blended and mixed thoroughly together.*
Before blending the two components together, stir the contents of the Resin component, continue stirring and gradually add the total contents of the Hardener component. It is essential to use a paddle mixer attached to an electric drill for mixing and to mix for a minimum of four minutes. When combining the entire contents of each can to make up a 2.5 litre unit, scrape the entire Activator component from the sides of the container using a plastic spatula or a similar tool and mix until a total homogenous mix is obtained. Ideally an average 30-foot hull requires two or three personnel. The **ThistleBond 152 SFE** and **ThistleBond Low Viscosity MP Primer** have a limited pot life so to avoid wastage, it is advisable to mix successive small quantities with the volume per mix depending upon the number of applicators - remember the mix ratio is by volume.

The ideal application temperature is between 15 and 30ºC.

To mix less than full units of **ThistleBond 152 SFE** 3 mixing cups should be lined up next to each other. Use one for the Hardener component and the other two for the Resin component. After measuring out, carefully scrape the contents into the bucket or paint kettle and mix thoroughly with the mixer. During mixing the side of the bucket should be scraped with a stirring stick to ensure and even mix leaving no un-reacted components on the sides or bottom of the bucket.

9.3 The Repair Programme

Before coating begins the hull surface should be abraded again with 80 grit sandpaper to remove any contaminants on the surface. The surface should then be wiped clean with plain white paper towels the hull can now be masked at the waterline with masking tape. Before starting coating the hull should be checked for condensation which may have occurred when the ambient air temperature has risen faster than the temperature of the hull and keel. Solid lead keels may take considerably longer to warm than the hull and it may be advisable to bring the surfaces to a suitable temperature using heat lamps.

9.3.1 Using the ThistleBond Low Viscosity MP Primer

First the Technical Data Sheet should be read, then only sufficient quantities that can be used within a 10 to 15 minute period should be mixed then transferred to a roller tray. The product should initially be rolled out thinly to wet out any dry fibres, this will saturate exposed reinforcing fibres and will provide a good secondary bond to the cured polyester resin. The Low Viscosity Primer being thin allows this operation to be completed quickly.

The Low Viscosity Primer can be overcoated as soon as it is touch dry (2 hours @ 20°C) and must be overcoated within 24 hours at this temperature. The primer should be applied to achieve coverage of 10m² per kilo of mixed product.

9.3.2 Using the Thistlebond MGF Surfacer

The Technical Data Sheet should be read prior to starting the application. **ThistleBond MGF Surfaces** is supplied as two components in metal cans, with a mix ratio of two parts to one by volume. To ensure correct mixing of the product the Base should be scooped out component into two golf ball sized mounds, and one golf ball sized mound of Activator component should be scooped onto a mixing board. The three mounds can then be mixed together with a spatula or mixing knife until a uniform grey colour is obtained with no streaks showing, running the spatula through the mix at intervals to check the colour consistency.

ThistleBond MGF Surface should be used for filling any gouges left by the peeling machine, rebuilding sharp leading or trailing edges of foils or stems and for the majority of the filling around the waterline, where the aim is to blend the coating into the original gelcoat and to avoid any steps or unevenness. The **ThistleBond MGF Surfaces** should be used first before any coating (unless the lay-up is very dry). The filler should be allowed to harden then sanded with 40 or 60 grit paper on a block or abraded using the random orbital sander.

9.3.3 Repairing Laminate Damage

Areas of local delamination of the glass fibre can be seen once the gelcoat has been removed, these areas should be ground out with a coarse sanding disc on an angle grander, exposing clean, solid laminate.
The edge of the repair should be bevelled to a minimum 12 to 1 angle, this bevel improves the bonding area and tends to reduce stress concentrations. The new skin must be laminated to approximately the same thickness and strength as the original skin. Multiple layers of lightweight cloth will develop the same or greater strength than a single layer of heavy cloth. An appropriate number of pieces of fibreglass cloth the same shape as the repair area should now be cut, the first piece should be the size of the inside of the bevelled edge with subsequent pieces gradually getting larger. The piece for the top layer should be slightly smaller than the outside of the hole and the combined thickness of the layers should be slightly thinner than the original panel to allow for final shaping and fairing. A piece of heavy plastic and peel ply - both several centimetres larger than the repair area should also be cut, these will be used to smooth the patch into place.
ThistleBond Low Viscosity MP Primer mixed as detailed above should now be applied to the repair surface. 406 Colloidal Silica filler should be added and mixed to produce the consistency of mayonnaise, this mix should now be applied to the wetted repair surface including the bevelled edge. A further mix of **ThistleBond Low Viscosity MP Primer** should now be prepared and the smallest piece of cloth should be laid out on a flat plastic-covered surface and a small amount of the mixed Low Viscosity Primer poured into the centre of the piece and then worked into the cloth with a squeegee, as the cloth is wetted out, it becomes transparent. Wearing disposable gloves, the cloth should be lifted into position and smooth out bubbles any excess epoxy with the squeegee. This process should be repeated for each layer of fabric until the largest piece is finally bonded in place. It is not necessary to wait for each layer of fabric to cure; bond to the still wet previous layer. The repair should then be covered, first with peel ply, then with the plastic and the patch smoothed with the squeegee, squeezing out excess product. The excess should then be removed from the surrounding areas with a bevelled mixing stick or plain white paper towels before it cures. The Repair should then be allowed to cure and then the surface sanded with 50 grit paper followed by 80 grit paper with all dust then being removed from the surface.

ThistleBond MGF Surfacer should now be mixed as detailed and applied with a squeegee, working into all voids and depressions, smoothing the product along the contour of the repair area. Excess product should be removed before it becomes hard, then after a minimum of 8 hours curing the surface can be sanded with 80 grit paper to fair the product into the surrounding area.

9.3.4 Making Low Density Filler Mixes

A feature of the **ThistleBond** treatment programme is the ease with which a filler can be created which is both easy to apply and easy to sand using **ThistleBond 152SFE**. High or low viscosity mixes can be produced depending upon the depth of hollow to fill, the quantity of filler added, controls the viscosity. Prepare approximately ½ litre of mixed product then transfer to the plastic bucket, then add scoops of filler and stir vigorously until the desired consistency is achieved, three uncompacted scoops is usually more than sufficient. The filler should be stirred until the mix resembles whipped cream. One ½ litre mix plus microspheres filler will cover about 4 to 6 square metres, the masking tape around the waterline areas should be removed **before** the filler has started to cure.

9.3.5 Sanding the Hull

Once the filler has been left to cure until sandable (normally 24 hours), sand the surface with a random orbital sander fitted with a 60 grit disc until the high spots start to appear. A regular pattern of vertical 'lines' over the hull formed by the filler occupying the 'low spots' created by the peeling machine will become noticeable. Any areas of the hull inaccessible to the sander will have to be sanded by hand until the same pattern appears.

9.3.6 Using the Thistlebond 152SFE

The Technical Data Sheet should be read prior to starting the application. **ThistleBond 152 SFE** is designed to achieve a high build without sagging and hence it is naturally thixotropic. The first coat should be rolled on fairly hard so that it penetrates the small voids on the laminate surface. As a guide 6 to 7 square metres per 1 litre of mixed product should be used for this first coat.

For large hulls, application is best carried out be a team of two people, with one mixing the product and the second person carrying out the applications. The person doing the mixing can, between mixes, carry out a tipping off the applied coat using the foam roller brush which will smooth out the stippled effect caused by the main roller application. Continuous multi coats (3-4 coats) to give a total applied thickness of 750-800 microns will produce the best results.

In most cases, by the time the entire hull is coated, the first section should be ready for the next coat. It is possible to apply the next coat as soon as the previous coat has cured sufficiently to support the weight of the following application of **ThistleBond 152 SFE**; usually 45 minutes at 20ºC. At lower temperatures a longer period before overcoating will be required.

Repeat this process for the remaining two or three coats of **ThistleBond 152 SFE**, ideally coats should be applied in the same day. If the coating operation extends, and the epoxy is allowed to cure overnight, surfaces should be wiped down with damp clean paper towels and then sanded to a dull finish before re-coating.

Once the final coat of **ThistleBond 152 SFE** has been applied and allowed to cure for a minimum of 3 hours, the **ThistleBondMA3/9 Primer** tie-coat should be applied. This procedure results in superior adhesion between the tie-coat and the epoxy system but more importantly, saves the time and expense of having to wash and sand the epoxy coated hull prior to painting which is required if the system is allowed to cure overnight. For a smooth racing finish, after the bottom paint has dried for 12 hours, 160 fine grit pad should be used to remove minor surface flaws. Additional coats of **ThistleBondMA3/9 Primer** can then be applied directly to this surface, again following the instructions on the Technical Data Sheets.

9.3.7 Bottom Paint Maintenance

For the **ThistleBond System** to continue protecting the hull from unwanted moisture permeation, care must be taken to ensure the integrity of the barrier coats. Each year, when the boat is hauled, the bottom should be inspected for scrapes or abrasions. These areas should be sanded and re-coated with **ThistleBond 152 SFE**. It may be advisable after several years of use, to thoroughly sand the bottom, removing all bottom paints and then apply 2 to 3 coats of **ThistleBond 152 SFE** to maintain the desired epoxy barrier coat thickness.

9.3.8 Cold Temperature Application

ThistleBond systems can be used under cold weather conditions, but special application techniques are required to achieve acceptable long-term epoxy performance. When the resin and hardener are mixed together, a chemical reaction is started which produces heat, this is called an exothermic reaction. The ambient temperature in which the chemical reaction takes place impacts the rate of the reaction. Warmer temperatures accelerate the reaction, while cooler temperatures retard the reaction time.

If the temperature is too low, even though the epoxy may harden, it will not achieve its designed physical properties. This is where the danger lies, for the improperly cured epoxy may possess enough strength to hold the structure together, yet it may very well fail after being subjected to repeated loading during normal operations.

Temperature has a profound impact on the working properties of an uncured epoxy system. Ambient temperature will drastically change the viscosity of the resins, the colder the working temperature, the thicker they become, reducing the ability to flow. This change has three important consequences.

1. It is more difficult to mix the Resin component and the Hardener component together
2. The mixed material is much harder to apply
3. Air bubbles which may be introduced when mixing are held in suspension due to the increased viscosity, this will lead to surface defects.

All of these problems can be addressed and their consequences avoided by adhering to the following simple guidelines.

1. Pre-warm Resin and Hardener before using
2. Stir the Resin and Hardener thoroughly
3. Warm the working surfaces
4. Prepare the surfaces carefully between applications
5. Store all materials above 10°C.

10. FINAL NOTES

Mix only as much product as can be applied in a 10 to 15 minute period. Apply the product to achieve a uniform coating. Disposable, firm urethane foam rollers such as West System 800 Roller Covers are the most practical. Cut the roller into small sizes to reach difficult areas and roller on with long easy motions. The surface will be slightly stippled when the material is applied with a roller.

Reduce stippling and remove any air bubbles by smoothing the surface with a foam roller brush. Fill major voids, gouges etc. anytime after the first coat becomes tack free. To produce a fairing compound which sands easily, add low-density filler to the mixed **ThistleBond 152 SFE** until a whipped cream consistency is reached.

11. THISTLEBOND FORMULATED PRODUCTS GUIDE

The **ThistleBond** ranges of products are designed to give the best possible solution for the treatment of osmotic blistering. Based upon the very latest technology and continued research and development at its Northallerton headquarters. **E. Wood Ltd.** offers a full range of Marine application systems to suit all types of craft constructed of steel, marine ply, GRP or Ferro cement, the whole year round.

E. Wood Ltd. was established in 1882 and operated to a quality system accredited to BS EN ISO 9002.

All Thistlebond Products are:

- Chemically compatible (for wet on wet application if necessary)
- Easy to use
- Can save on both materials and labour costs compared to comparable products currently available

Osmosis protection products include

ThistleBond Low Viscosity MP Primer (VOC Free) for wetting out dry glass fibre and for use as a laminating resin when glass fibre replacement is necessary

ThistleBond MGF Surfacer (VOC Free) a formulated easy to use epoxy filler for the permanent repair of large voids within the laminate

ThistleBond 152 SFE (VOC Free) a 100% high solids epoxy coating system with outstanding non-sag properties for application all year round

ThistleBond MA3/9 Primers for brush, roller or spray (or spray only) tie-coats for preparing surfaces for anti-foul paint systems or as race finishes for yachts.

Ultra-light Microspheres an easy to handle lightweight filler additive which, when mixed with the **ThistleBond 152 SFE** produces an easy to apply and easy to sand filler/fairing compound, ideal for all applications in osmosis repair work.