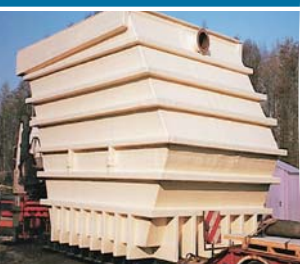




Norpol FI- and Colle- Series

Surface Fillers, Sandwich Adhesives and Bonding Pastes
for the Composite Industry



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Versatility and Ease-of-Use

In many composite applications individual components are combined or attached with other parts, while surfaces may need treatment and finishing. Dedicated materials systems that are easy to use at a competitive system cost can help you to manufacture composite parts with improved performance.

Over 80 Years of Expertise

As a company with a long history in innovation and technology development, Reichhold is well positioned to support you with novel material systems and technical expertise. With technology centres and a network of manufacturing plants around the world, Reichhold can provide you with the appropriate backup and security of supply. This will give you peace-of-mind in delivering performance to your customers. Visit our website at www.Reichhold.com or call our experts for more information.





Offering New Opportunities

Norpol FI- Series and Norpol Colle- Series have been specially developed for the composite industry. These material systems allow designers to turn novel ideas into real-life parts. Reichhold has a long tradition of working closely with customers that are at the forefront of innovation. Norpol FI- Series and Norpol Colle- Series are well known for their good workability, whether applied manually or by machine. This helps to keep the manufacturing process simple.

The Norpol FI- Series and Norpol Colle- Series are divided into four main areas:

Thixotropic Paste

A highly viscous paste, suitable for addition to gelcoat for making a pigmented repair kit compound. These thixotropic pastes may also be suitable as a bonding paste.

Surface Filler

Surface fillers have a high content of fillers, rapid curing characteristics and are easy to sand. Reichhold supplies Norpol surface fillers that are recommended for filling larger irregularities and grooves, leaving a coarse surface. Additional surface fillers are recommended when a smooth and pore-free surface is required.

Sandwich Adhesive

Sandwich adhesive is used for bonding core materials to core materials and to GRP laminates. These products are characterised by low specific weight, high tensile elongation and a low exotherm during cure.

Multi-Purpose Bonding Pastes

A wide group of bonding pastes primarily developed to obtain optimum adhesion to GRP laminates. The products have a variation of strength properties, tensile elongation, temperature tolerances and curing characteristics.





Applications

Model Work

Norpol surface fillers are used in model work for filling grooves and irregular surfaces. In many cases key requirement is the absence of sagging when applied in thick joints. Also, as tolerances can be small achieving smooth and accurate surfaces is important. Norpol surface fillers provide quick-curing characteristics, easy sanding and low shrink properties.

In the Norpol surface filler range, Reichhold has products recommended for the basic or first application layer, and for the top layer where a smooth surface is required. These products offer a nice and even surface with very few pores.



Sandwich Constructions

For sandwich constructions, a sandwich adhesive is mainly used to bond single core material sheets together and for bonding core material to GRP laminates. It is important that the sandwich adhesive temperature remains low during the entire curing cycle in order to avoid deterioration of the core material.

By selecting adhesives with high tensile elongation, sandwich constructions obtain good fatigue properties. This reduces the risk of curing cracks in the bond so shear cracks in the core material will then unlikely occur. Low weight is an important parameter in the choice of adhesives for sandwich constructions. Several of the Norpol sandwich adhesives contain lightweight spheres that provide low specific weight.



Applications

Bonding GRP Laminates in Marine

In the construction of boats and vessels, decks and hulls have to be bonded together, as well as single components to the hull or deck. Reichhold offers a range of bonding pastes that allow for reliable bonding of GRP laminates. Some of these have a white colour, and therefore are preferred for Marine applications. Vinyl ester based bonding pastes provide higher toughness and are currently being used for bonding stringers and the engine bed on to the hull.



Using bonding pastes for the bonding of GRP laminates has proven to simplify manufacturing processes and hence save time. Meanwhile the workshop logistics are easier and gives operators better control. In many applications the strength of the bond is at least as high as the strength of the laminate it is supposed to adhere to.

The Norpol bonding paste series is formulated to obtain optimum bonding properties to GRP laminates. If the laminates are "green" and do not contain wax, it is possible to directly bond the laminates together. Otherwise, it is recommended to abrade the surfaces in advance in order to obtain maximum adhesion. Bonding paste intended for bonding GRP laminates should have a tensile elongation of 1.5% minimum. The actual bonding property can be checked with a simple adhesion test.



High tensile elongation is vital for a high quality bonding paste. This ensures a tough joint with high tolerance to dynamic loads. Tests carried out with advanced testing equipment have proved that bonding pastes from the FI- Series have high strength. Tensile tests, in accordance with ASTM C287-80, reveal that it is the GRP laminates, and not the bond itself, that will start to crack. This proves the excellent strength and bond properties of these products.

References from the lifeboat industry confirm that Norpol bonding pastes meet the highest safety standards. The Norpol product range consists of a wide range, each formulated for various applications and processes, with different viscosity and curing characteristics to suit customer needs.



Applications

Containers, Vessels and Pipes

There are numerous industrial process- and application areas where the Norpol FI- Series and Norpol Colle- Series have proved most appropriate, such as in the production of containers, vessels and pipes. The products are very versatile and have proved suitable for filling grooves and corners.



For surface treatment of GRP laminates, such as leveling uneven surfaces, the Norpol surface filler recommended is one that builds well, is easy to apply, offers quick curing and is easy to abrade.

To obtain a smooth surface that needs less finishing treatment, selected Norpol surface fillers are recommended as a top layer.



For general applications such as joining pipes, securing sleeves, bonding laminates or bonding single GRP details, the Norpol bonding paste range offers a selection of products.



Applications

Transportation

The Norpol bonding paste series has proved very well-suited to the transportation sector. The products are used for bonding and filling styling parts on cars where the chassis or parts of the chassis have been made out of GRP laminates. Some of the bonding paste range have also been successfully used for attaching metal parts to GRP laminates.

Another application area is filling corners, voids and areas where there is a risk of air pockets forming when laminating. When it comes to surface treatment, Reichhold offers products ideal for smoothing the surface before a suitable primer and coating system is applied.



Manufacturers of sports cars, horse carriages and refrigerated vehicles and containers are frequently using products from the Norpol bonding paste range.

Special Types

Bonding pastes containing glass-fibre flock are well suited for bonding GRP laminates. The glass fibres work as extra reinforcement and provide greater impact, strength and toughness.



Materials for Extreme Conditions



Windmills

Rotor blade bonding is an especially demanding area where bonding paste from the Norpol FI- Series is tested thoroughly. The rotor blades' light constructions are typically moulded in a vacuum infusion process as two individual shells and then bonded together. The rotor blades, often more than 50 metres long, are subjected to extreme loads and tremendous dynamic stress. Norpol bonding pastes comply with all quality standards and are used in all joints.



Material for Extreme Conditions

Lifeboats

For manufacturers of lifeboats the slogan Safety First is the guiding principle in product development. Consequentially the design and construction as well as the use of materials are of uttermost importance in part engineering. All vessels have to pass the strongest quality and strength tests before they are released to the market. Here, there is no room for compromise. Lifeboat free fall systems provide cutting-edge technology, particularly developed for the rough seas in the North Sea, including the world's largest lifeboat for vertical free-fall. The system needs to ensure a lasting performance under extreme weather conditions and enable fast and safe evacuation in an emergency situation.

The boats in this system have been tested in a 40-metre free-fall drop – a test that exposes the material to extreme stresses.

Several free-fall lifeboat manufacturers use bonding pastes from the Norpol FI- Series mainly to bond the inner liner/ interior parts to the lifeboats.

Together with the lifeboats' other components, the Norpol FI- Series has passed numerous tests, and been proven over time to meet service requirements.





Technology that Performs



Advanced Test Equipment

Specific end product requirements as well as directions given by the classification authorities, has led to focussed R&D resources. Advanced test-equipment has made it possible to develop products that comply with the highest quality standards, such as bonding pastes used in the windmill industry.

One of Reichhold's strengths is the well-structured Technical Service Team which ensures that further development of the FI-Series product range will continue to be in line with real, specific customer demands. Some of the tests that can be performed are:

- Tensile and flexural strength from -76°C to $+300^{\circ}\text{C}$
- Impact strength
- Tension tests in flatwise plane for adhesion and bonding strength (ASTM C297-80)
- Water resistance
- DCB testing of adhesion properties



Technology that Performs

The Laminate Should Break Before The Joint

The main quality requirement to Norpol FI- Series bonding paste products is that the laminate, and not the joint, should actually be the first to break, regardless of the forces the laminate is exposed to. More customers demand documentation confirming that the material meets the required properties. We recognise the importance of offering thoroughly tested and documented products. In contrast to static testing, proper utilisation of dynamic testing provides a possibility to evaluate the products' long term performance.

When a material is exposed to changing loads, it is likely to break eventually, even though stresses in service might be lower than the breaking strength revealed by static load tests. The material has reached its fatigue limit and a fatigue break occurs. The number of cycles the material is able to withstand before a break occurs is valuable information for the estimation of the material's lifetime.

Adhesion Test

In order to obtain optimum strength in a bonded joint, the adhesion to the surface is of crucial importance. An adhesion test can easily be made by simple means.

With a standard torque wrench it is possible to identify the forces that are needed to part the bonded joint. A torque of 30 Nm is the minimum for a properly cured bonded joint.





Technology that Performs

Packaging Sizes

The Norpol FI- and Colle- Series is generally supplied in 20 kg or 225 kg packages. A limited range are also supplied in 9 kg package sizes. Some product types have minimum order sizes.

Curing Systems

For the major part of the FI- Series range standard MEKP (Norpol Peroxide 1) can be utilised.

Application

The Norpol FI- and Colle- Series are known for its good working properties, and the products can be applied either manually or by machine for most of the product types in the range. For operations where the material consumption per part is estimated at more than 20 kg, application by machine is normally a rational and time saving method.



The ideal application temperature range in the workshop is the same as the general recommendation for polyester, 18–23°C. Lower temperatures give increased viscosity and longer geltime, and will require increased attention when the peroxide is mixed. All the products in the FI- and Colle- Series are pre-accelerated and therefore easier to work with.

In general, most of the products in the Norpol FI- and Colle- Series have high viscosity. This means thorough mixing of the peroxide is required in order to obtain even and correct curing characteristics. In some types a colour indicator has been added, this enables the user to see when the peroxide has been properly mixed.



Product Range Selector

Application	Product	Description	Chemistry	Thixotropy measurement method	Viscosity
Thixotropic Paste	Norpol FI-160	Semi light weight	ISO	Brookfield HBT Sp.TB/5 rpm at 23°C	250000 - 350000
Thixotropic Paste	Norpol Colle 59 T AC	Low viscosity bonding paste	ORTHO	Brookfield RVT Sp.6/5 rpm at 20°C	23000 - 33000
Surface Filler	Norpol FI-167	Smooth surface	ORTHO	Brookfield HBT Sp.TB/5 rpm at 23°C	250000 - 350000
Surface Filler	Norpol FI-175	Coarse surface	ORTHO	Brookfield HBT Sp.TB/5 rpm at 23°C	210000 - 300000
Surface Filler	Norpol FD-8411	Smooth surface, low viscosity	ORTHO	Brookfield HBT Sp.TC/10 rpm at	100000 - 150000
Sandwich Adhesive	Norpol Colle 5115 RD	Semi light weight	ORTHO	Brookfield HBT Sp.7/5 rpm at 23°C	130000 - 250000
Sandwich Adhesive	Norpol FI-177	Light weight	ISO	Brookfield HBT Sp.TB/5 rpm at 23°C	120000 - 190000
Sandwich Adhesive	Norpol FI-177-10	Light weight for vacuum infusion	ISO	Brookfield HBT Sp.TB/5 rpm at 23°C	35000 - 55000
Bonding Paste	Norpol FI-170	General purpose, white	ORTHO	Brookfield HBT Sp.TB/5 rpm at 23°C	125000 - 145000
Bonding Paste	Norpol Colle 2550-85	High thix	ORTHO	Brookfield HBT Sp.7/5 rpm at 20°C	600000 - 800000
Bonding Paste	Norpol FI-180-10	High thix, with glass fibre	ORTHO	Brookfield HBT Sp.TC/10 rpm at	600000 - 700000
Bonding Paste	Norpol Colle ARMEE 2825 BR	With glass fibre	ORTHO	Brookfield RVT Sp.7/5 rpm at 20°C	350000 - 400000
Bonding Paste	Norpol FD-8403	With glass fibre	ORTHO	Brookfield HBT Sp.TC/10 rpm at 25°C	400000 - 500000
Bonding Paste	Norpol FI-184	High toughness	VE	Brookfield HBT	105000 - 125000

Norpol FI-160: PER. 62 equals BPO (50%)



Density	Curing system	Geltime	Linear Shrinkage %	Tensile strength MPa	Tensile elongation %	HDT °C	Ease of sanding	Application method
1.14 - 1.18	1.5% PER. 1 at 23°C 5% PER. 62 at 23°C	40 - 60 10 - 16	2.6			84	Heavy	Hand
1.15 - 1.20	1.5% PER. 1 at 20°C	30 - 50	2.4	70	3	80	Heavy	Hand
1.70	1% PER. 1 at 23°C	10 - 20	1.7		< 1		Light	Hand
0.90	1% PER. 1 at 23°C	20 - 30	0.8		< 1	80	Light	Hand
	2 % M50 at 25°C or 2 % PER.1 at 25°C	7 - 10					Medium	Hand
0.85 - 0.95	1.5% PER. 1 at 20°C	15 - 30		12	3.1	35	Medium	Hand, machine
0.50 - 0.60	1.5% PER. 2 at 23°C	35 - 45	1.6	10-11	3.5 - 5.0		Medium	Hand
0.60 - 0.65	1.5% PER. 2 at 23°C	90 - 120	1.6	10-11	3.5 - 5.0		Medium	Hand
1.22 - 1.26	1.5% PER. 1 at 23°C	30 - 45	2.2	45	2.0 - 2.5		Heavy	Hand, machine
1.40 - 1.60	1.5% PER. 1 at 20°C	35 - 55	1.2 - 1.6	15	2.5	40	Heavy	Hand, machine
1.20 - 1.30	1.5% PER. 1 at 23°C	10 - 15					Heavy	Hand
1.25 - 1.35	1.5% PER. 1 at 20°C	10 - 14					Heavy	Hand
	2 % M50 at 25°C	15 - 20					Heavy	Hand
1.14	2% PER. 24 at 23°C or 2 % PER.1 at 25°C	55 - 65	1.8	35-45	2.5 - 3.5	70	Heavy	Hand, machine