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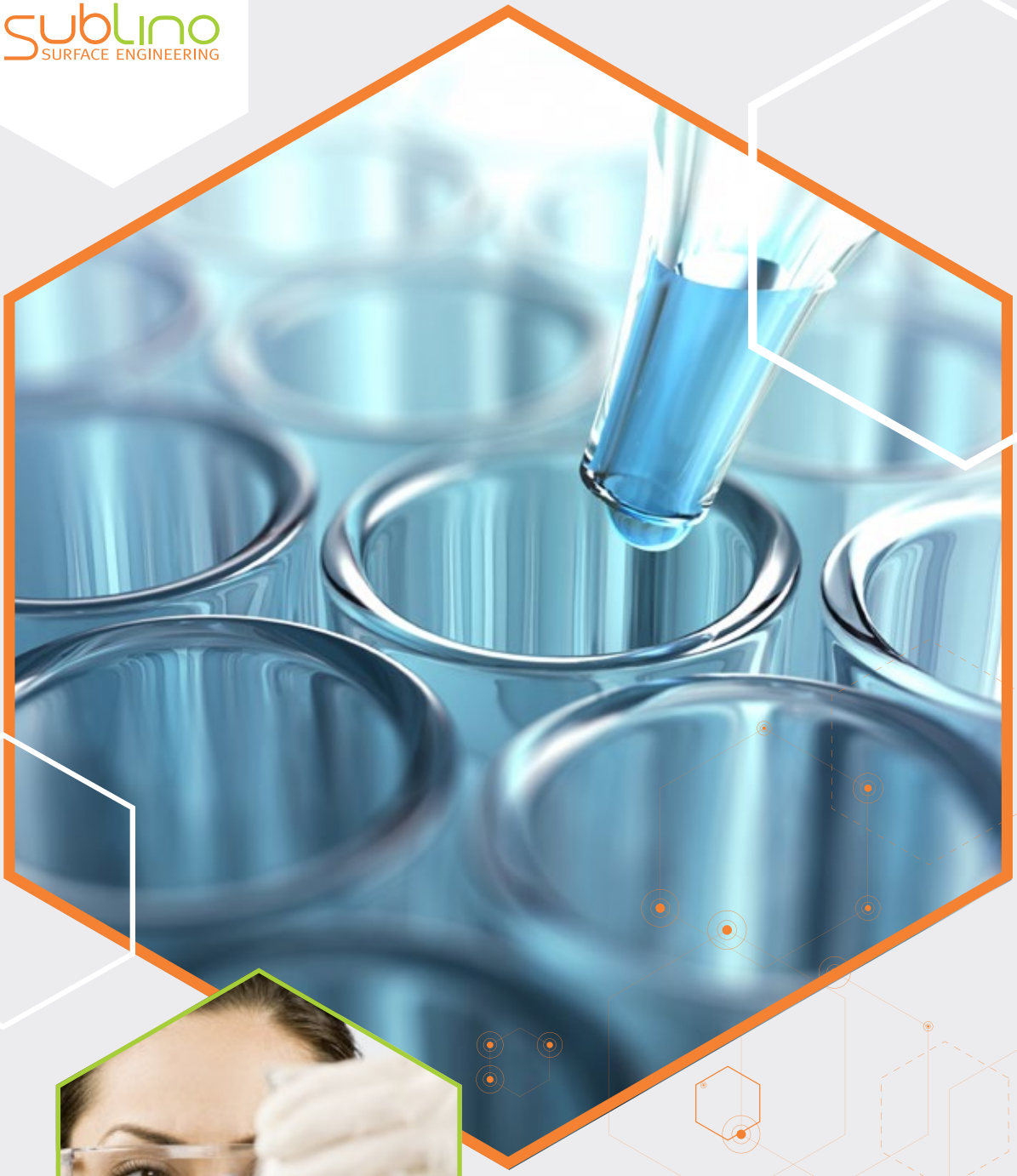

www.sublino.com

About Sublino

Sublino Ltd is a specialty chemical company, part of the RESCHEM group, who supply surface primers into the textile industry. Sublino was founded as a corporate spin-off in 2016 specifically to focus on the development of a new type of polymer chemistry; the patents for which were acquired in 2014.

The patented chemistry, known under the brand name LoVOC®, was originally developed by the British Ministry of Defence to make chemical warfare suits out of elastomer coated aramid textiles, printed with tactical camouflage patterns. Since its founding, Sublino has been developing and re-formulating the technology to create a product range suitable for industrial application within the textile market.

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About LoVOC®

LoVOC® is a treatment technology which employs a new type of polymer chemistry allowing the polymer properties to be altered without affecting the backbone and polymerisability. The primary purpose of LoVOC® treatments is to increase the surface energy of a substrate and to add specific functionality to a surface. This allows the surface to behave more favourably towards certain processes (e.g. increasing the surface energy makes bonding more effective, adding fluorinated functionality will give hydro- and oleo-phobic effects).

There are over 300 LoVOC® monomers covered by more than 40 patents. All of these monomers can be copolymerised and formulated together to give a treatment with the desired properties. This means that through proper selection of monomers and their formulation with various curatives and additive, LoVOC® treatments can be applied to any surface and can be designed for almost any purpose!

The R&D facilities at Sublino have been focusing on the two original applications for the LoVOC® technology, which is to improve the dyeability of textiles and to be used as a bonding agent for textiles. A range of LoVOC® products are now available which can satisfy both of these markets.

Dyeability of textiles

The dyeing of textiles is an ancient process, with the earliest dyed flax fibres found being dated to 34,000BC. The types of textiles and dyes, along with the processes used, have evolved drastically over the years. Traditional natural fibres, like cotton and silk, have functionality available to interact with various types of dye. This functionality makes the dyeing of such textiles relatively easy, where the colour and printing patterns available are limited only by imagination.

The first semi-synthetic fibre (artificially created from natural materials) was viscose, which was produced commercially in 1905. Nylon was the first fully synthetic fibre, created in the 1930's. Synthetic fibres are much less functional than natural fibres, meaning they are less receptive to dyeing. New dye chemistry was created to overcome their poor performance with traditional natural dyes.

Since then, many more synthetic fibres have been created with ever more unfavourable dyeing performances. One such textile is Aramid, which is an aromatic polyamide. This textile has many desirable properties but almost no functionality for dyeing. Currently, Aramids can only be dyed in a limited range of colours using expensive processes.

Sublino has formulated an aqueous treatment from its wide range of functional monomers which can be applied to textiles, such as Aramids, to greatly improve their dyeability. Treating a textile with LoVOC® can allow any textile to be easily dyed or printed using standard techniques. The LoVOC® treatment is receptive to the following dyes;

- Acid dyes
- Vat dyes
- Disperse dyes
- Reactive dyes
- Solvent dyes

(other dyes may work but may not have been tested)

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Bondability of Textiles

Elastomers are amorphous polymers that exist above their glass transition temperature. There is a huge variety of chemistries available giving different chemical and physical properties which can be engineered to meet specific applications. Elastomers have visco-elasticity and weak intermolecular forces, allowing the polymer to be stretched or compressed. These properties provide the material with great flexibility; however, they are not very strong. Textiles are used to reinforce elastomers by bonding them together to increase the elastomers strength.

Elastomers can be split into two categories; thermosets and thermoplastics. Thermoset elastomers, also known as rubbers, are polymers that get vulcanised (cross-linked) when heated resulting in an un-meltable, rigid assembly. Thermoplastic elastomers are polymers which melt when heated. Textiles are used as reinforcing materials for both rubbers and thermoplastics.

In order for good reinforcing to be achieved the textile and elastomer need to be bonded together. With poor bonding, the textile will move independently of the elastomer and will give poor reinforcement. There are many solvent based adhesives available which can provide some bonding. Any application needing a higher level of bonding (hoses, drive belts, tyres etc.) requires the industry standard Resorcinol-Formaldehyde-Latexes (RFLs) and/or isocyanates bonding systems.

RFL type bonding systems have been used industrially since the early 1900's. This is a water based textile primer applied as a textile pre-treatment before the desired elastomer is introduced. RFL systems require the use of two hazardous chemical species, Resorcinol and Formaldehyde. Both of these species have significant health issues; Resorcinol is a corrosive chemical and Formaldehyde is a class 1B carcinogen. An RFL solution can take over 24 hours to prepare and must be used within a couple of days, before it 'goes-off'. The solution is used by immersing a textile in a reservoir of RFL solution before padding-off the excess and thermocuring. Despite the long and labour intensive mixing process along with the associated hazards, this is still often not enough to provide the high level of bonding required. Pre- or Post- treatments are often used to increase the level of bonding (e.g. epoxies are used as a pre-treatment to para-Aramid textiles to increase the bonding of RFL systems).

Isocyanates are used as cross-linking bonding agents due to their high reactivity. They can be highly toxic. In the textile industry isocyanates can be used either as a textile pre-treatment (similar process to the RFL system) or they can be mixed into the first layer of elastomer which is applied to the textile, known as a bonding coat. Once a solution of isocyanate has been prepared it is generally used within hours due to its very high reactivity. Isocyanates are often used in combination with other treatments to achieve the level of bonding desired, as an example; bonding coats are often used in combination with RFL bonding systems.

There is considerable drive in the industry to find alternative bonding systems. Sublino has formulated a range of non-hazardous, water based textile primers which can outperform RFL & isocyanate systems and combinations thereof.

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LoVOC® and **Textile Bonding**

Sublino has been using patented chemistry to pioneer the future of rubber-to-textile adhesives. The resulting textile primers can be used to replace the industry standard RFL and isocyanate bonding systems. After extensive R&D Sublino now has an aqueous polymer range for textile to rubber bonding. Sublino's LoVOC® technology allows textiles such as Nylon, Polyester and Aramids to be bonded to rubbers such as;

- **EPDM**
- **NBR**
- **SBR**
- **NR/SBR**
- **HNBR**
- **CSM**
- **NR**
- **Silicone**

This green, non-hazardous and aqueous product range can achieve bonds in excess of 40,000 N/m (800 N/2cm). At this strength the failure is in the cohesive strength of the elastomer i.e. the rubber rips internally before it can be removed from the textile. The bond strength is retained at elevated temperatures, over 100°C.

Sublino's product range has been designed as general use adhesives between textiles and rubbers; however, other materials (such as thermoplastics) can also be bonded. The treatment applied to the textile becomes covalently bonded to the rubber during vulcanisation which creates an exceptionally strong bond. The product and processes required depends on the textile and the cure package of the elastomer.

Peroxide cured elastomers can be bonded to a textile using a single-stage LoVOC® treatment by dipping, padding and thermocuring (160-220°C). Once treated, the elastomer should be vulcanised directly in contact with the LoVOC® functionalised textile without the need for any type of bonding coat.

Sulphur cured elastomers can be bonded to a textile using a two-stage LoVOC® treatment. The textile should first be treated with a LoVOC® solution by dipping, padding and thermocuring (160-220°C). The second treatment depends on the customers processing requirements and involves a secondary cross-linking species which can be selected from the LoVOC® approved list of safe and efficient coupling agents. The first option is to use a bonding coat (similarly to the way in which isocyanates are currently used) which incorporates the chosen cross-linking species. Alternatively, to keep the treatment fully water based, the textile can be treated again with a mix of emulsified cross-linking species and VP latex. This can be done by dipping, padding and thermocuring (160-220°C). After the second treatment, the elastomer should be vulcanised directly in contact with the LoVOC® functionalised textile.

The composition of rubbers has an almost infinite amount of variability. Each variation gives rise to different properties, such as; reactivity, flexibility, hardness, chemical resistance, compression set, viscosity etc. This has a huge influence on the strength of the bond formed to the treated textile. The dilution rates and thermocuring temperatures used during the textile treatment process needs to be optimised for individual materials to maximise both the bond strength and processing efficiency to account for these variabilities.

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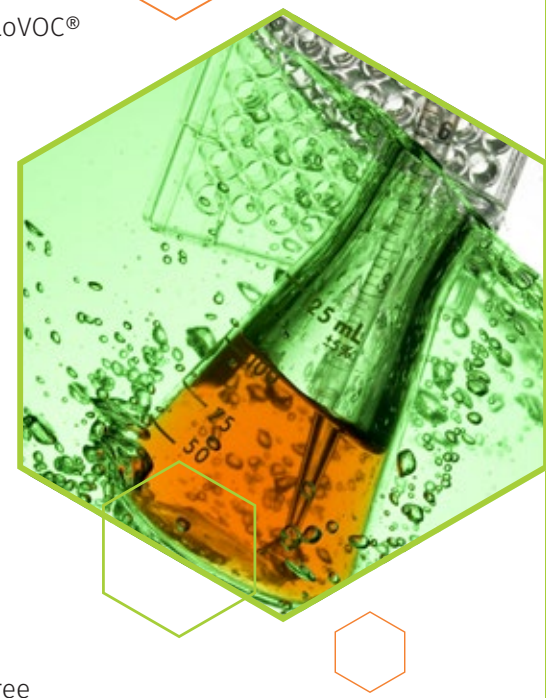
Benefits



- **Low Application Weights** – Applied weight after LoVOC® treatment may be <1gsm
- **Outperforming RFL** – LoVOC® products have outperformed every RFL bonding system it has been tested against
- **Inherently Safer** – All of the chemicals used in the LoVOC® system have minimal chemical hazards (see MSDS for details)
- **General Use Adhesives** – Sublino has developed products which have excellent functionality as general use adhesives, however, stronger bonds can be created by tailoring the formulation to specific materials
- **Solvent free** – All LoVOC® products are solvent free (VOC<0.1%)
- **Reduced Handling** – LoVOC® products are much less labour intensive than industry standard techniques, requiring only simple mixing before use
- **Great Shelf-life** – LoVOC® RFL replacement products are much more stable than typical RFL products with shelf lives of over 3 months
- **Competitive Pricing** – This technology has been priced to give a cost per meter of textile/yarn that is competitive with the current industry standard

Our **Mission** and **Sustainability**

Sublino's short-term mission is to become a leading supplier of functionalised treatments into the textile market for the reinforcing and dyeing industries. This will help to increase global sustainability by reducing the amount of harmful chemicals both people and the environment are exposed to. This impact can be greatly increased by using more modern processing methods. LoVOC® treatment can be applied to a textile using supercritical CO2 to give a water-less and waste-less application method. The LoVOC® treatment can also be cured using UV or microwave radiation which drastically reduces the amount of energy required compared to thermocuring.

There are many other areas of application for the LoVOC® technology which Sublino is currently investigating. Sublino's long-term mission is to become a leading supplier of functionalised coatings to all industries and as a result, have a significant impact on global sustainability. Some of the other areas of application include;

Bonding to other substrates

- Metal surfaces
- Plastic surfaces
- Glass surfaces
- Concretes
- Composites

Functional Coatings

- Hydrophobic (<C6)
- Oleophobic (<C6)
- Anti-microbial
- Anti-icing
- Friction reducing
- Corrosion resistant
- Flame retardant

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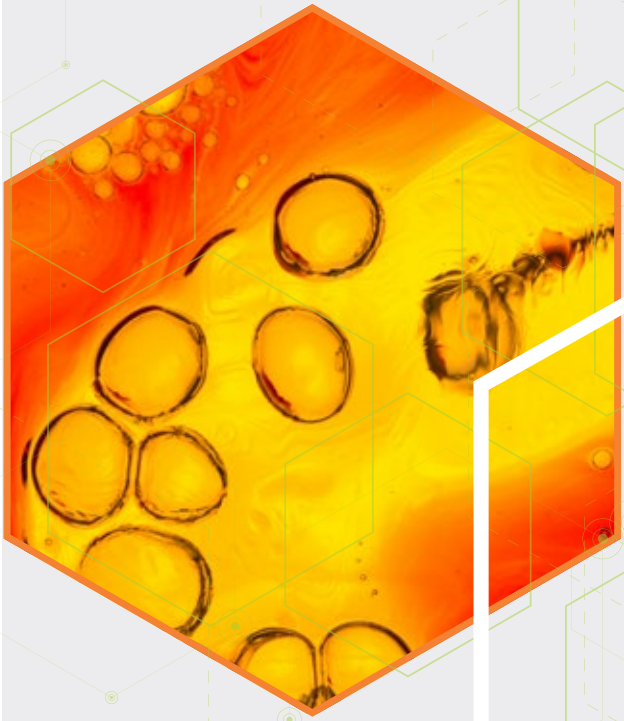

Products & Services

There are a number of products available to improve the dyeability and bondability of Nylons, Polyesters and Aramids. Please get in touch with Sublino who will recommend products for your application.

The differences in elastomers and textiles have a huge impact on the bonding achieved. The general use bonding agents available perform extremely well using the materials they have been tested against. However Sublino offers a bespoke formulation service. This includes optimising certain aspects of the general use products for specific materials.

Sublino is always looking for the best new direction to take the LoVOC® technology and will be working to expand the product range. If there is an application which does not currently have a suitable LoVOC® product please contact Sublino who can create you a bespoke formulation for your requirements.

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Glossary

- **Acid Dyes** – A dye that is typically applied to a textile at low pH used for dyeing non-cotton fabrics
- **Additives** – A substance added to something in small quantities to improve or preserve it
- **Adhesives** – Substance applied to one or two separate items that binds them together
- **Amorphous** – Lacking a clear structure, not crystalline
- **Application weight** – Amount of substance applied to a substrate
- **Aqueous** – Forms a homogeneous mixture when added to water
- **Aramid** – Aromatic polyamide fibre
  - **Meta-Aramid** – Aramid with a specific chemical structure in the meta- position
  - **Para-Aramid** - Aramid with a specific chemical structure in the para- position
- **Bond Strength** – Amount of force required to separate two substrates
- **Bonding** – Process of binding one substrate to another
- **Bonding Agent** – Substance used to bind one substrate to another
- **Bonding Coat** – Thin layer of substance containing a bonding agent which is coated to a substrate
- **Carcinogen** – A substance capable of causing cancer
- **Cohesive Strength** – Internal strength of a material
- **Compression Set** – Permanent deformation remaining when a force that was applied is removed
- **Copolymerise** – Two or more unlike substances being polymerised together
- **Coupling Agent** – A compound which provides a chemical bond between two dissimilar materials
- **Covalent Bond** – A chemical bond that involves the sharing of electron pairs between atoms
- **Cross-linking** – Linking of two or more polymer chains by chemically bonding them together
- **CSM** – Chlorosulfonated polyethylene synthetic rubber
- **Curatives** - A substance added to something in small quantities to initiate polymerisation reactions
- **Cure Package** – A number of species formulated together to provide an efficient polymerisation reaction
- **Dilution Rates** – Amount of water added to a solution before use
- **Disperse Dyes** - A dye that is free of ionizing groups that are less soluble in water and are used for dyeing synthetic fibres
- **Dope Dyeing** – Process of adding pigments or insoluble dyes to the fibres as they are spun
- **Dyeability** – Ability of a substance to accept and retain dyes
- **Elastomer** – A natural or synthetic polymer having elastic properties
- **EPDM** – Ethylene propylene diene monomer rubber
- **Epoxy** – Colloquial term for a species containing the epoxide functional group
- **Flax** – Otherwise known as linseed, a fibre crop used to make natural fibres
- **Fluorinated** – To add fluorine atoms
- **Formulated** – To create or prepare a product to perform a specific purpose
- **Glass Transition** Temperature – Temperature region where a polymer transitions from a hard, glossy material to a soft rubber material
- **HNBR** – Hydrogenated nitrile butadiene rubber
- **Hydrophobic** – Water repellent
- **Inherently Safety** – A low level of danger, even if things go wrong
- **Intermolecular Forces** – Interaction forces between two molecules
- **Isocyanates** – Family of highly reactive, low molecular weight chemicals
- **Microwave** – Form of electromagnetic radiation with wavelengths ranging from 1 m to 1 mm
- **Natural Dyes** – Dyes derived from plants, invertebrates, or minerals
- **Natural Fibres** – Fibres derived from plant or animal sources
- **NBR** – Nitrile butadiene rubber

- **NR** – Natural rubber
- **NR/SBR** – Blend of natural rubber and styrene butadiene rubber
- **Nylon** – Generic designation for a family of synthetic polymers containing amide functionality, polyamides
- **Oleophobic** – Oil repellent
- **Peroxide Cured** – The use of peroxide to crosslink a polymer
- **Polyester** – Family of synthetic polymers containing ester functionality
- **Polymer** – Large molecule or macromolecule composed of many repeating units
- **Polymerisation** – Process of joining a series of small molecules, called monomers, into larger molecules, called polymers
- **Primer** – A substance used on a substrate to prepare the surface for a specific application
- **Reactive Dyes** – A dye that attaches to a substrate by a chemical reaction that forms a covalent bond between the dye molecule and fibre
- **Reactivity** – The degree to which something is reactive
- **Receptive** – Ability to accept dyes or other treatments
- **Reinforce** – Strengthen or support an object or substance, especially with additional materials
- **RFL** – Resorcinol Formaldehyde Latex
- **Semi-synthetic Fibres** – Made from raw materials with naturally long-chain polymer structure and are only modified and partially degraded by chemical processes
- **Solution** – A liquid mixture in which the minor component (the solute) is uniformly distributed within the major component (the solvent)
- **Solvent Based** – Formulations using flammable organic solvents as the dilutant
- **Solvent Dyes** – A dye that is typically insoluble in water but soluble in organic solvents
- **Substrate** – The material on which a process is conducted
- **Sulphur Cured** – The use of sulphur species to crosslink an elastomer
- **Surface Energy** – The energy associated with the intermolecular forces at the interface between two media
- **Synthetic Fibres** – Chemically synthesised from low molecular weight compounds
- **Thermocuring** – The use of thermal energy to cure a polymer
- **Thermoplastic** – Type of plastic that becomes soft when heated and hard when cooled
- **Thermoplastic Elastomer** - Class of copolymers or a physical mix of polymers (usually a plastic and a rubber) which consist of materials with both thermoplastic and elastomeric properties
- **Thermosets / Rubbers** – Type of elastomer joined together by chemical bonds, acquiring highly crosslinked polymer structure. Will not melt or deform when heated
- **UV** – Ultraviolet radiation, form of electromagnetic radiation with wavelengths ranging from 10 to 400nm
- **VAT Dyes** – A dye which is only water soluble in a reduced form. They are often applied to the textile in the water soluble, reduced form before being oxidised back to the insoluble form
- **Visco-elasticity** – Having both viscous flow and elastic properties
- **Viscose** – Semi synthetic fibre derived from cellulose
- **Viscosity** – The state of being thick, sticky, and semi-fluid in consistency due to internal frictions
- **VOC** – Volatile organic components
- **VP Latex** – Latex of Vinyl Pyrrolidone
- **Vulcanised** – Process of crosslinking a rubber
- **Water Based** – Formulations using water as the diluent where the active ingredients are not fully soluble and are held in solution by additives

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OFFERING YOU **BETTER BONDING** SOLUTIONS

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