TUFFLON-P80

Pure Polyurea

TECHNICAL DATA SHEET

DESCRIPTION

Tufflon-P80 is a 100% solids (solvent free), pure polyurea spray elastomer with outstanding abrasion resistance, medium hardness of 80 (shore A) and high elongation of 450%.

ADVANTAGES

- High abrasion resistance
- Safe for use with drinking water
- Exceptional toughness and flexibility
- Resistant to puncture and compression
- Safe to use. Contains no volatile or flammable solvents.
- Good chemical resistance to most dilute acids, alkalis, salts and solvents.
- Gels in seconds to form a thick-film seamless lining with a vice-like grip to most surfaces
- Protects against wear, chemical attack and corrosion
- Will not crack or flake and can bridge unintentional hairline cracks in concrete

APPLICATIONS

- Ideal as a waterproofing membrane
- Suitable for protective coatings, tank lining, jointing, anti-abrasion, anti-corrosion and chemical resistance
- When used in conjunction with Aralox primers and renders it is the product of choice for concrete remediation, protection and tanking where a high strength, smooth, durable, seamless, easy to clean finish is required. It exhibits excellent adhesion to freshly blasted steel with or without primers.

PROPERTIES – RESIN (A) HARDENER (B)

Property	Part A (Iso)	Part B (resin)
Density (kg/L)	1.11	1.00
Viscosity (Cps @ 21^{0}C)	1600	750-890
Pack Size (drums)	225kg	200kg

PROCESSING – OPTIMUM PARAMETERS

Proportioning pump	Graco E-XP2 or similar – heated, high pressure, plural component
Gun	Graco Fusion-AP or similar - Impingement mix, airless
Pressure of material at gun	2,000 psi
Temperature of material at gun	65^{0}C
Relative Humidity	<85%
Dew Point	>5^{0}C above surface temperature

PROPERTIES – CURED

PROPERTY	TEST METHOD	RESULT
Hardness	ASTM D 2240-91 Shore A	78
Elongation @ 24^{0}C	ASTM D 412-92	427%
Abrasion Resistance	ASTM D460-10 (CS-17 @ 1,000rpm with 1,000g weight)	50 mg
Tensile Strength	ASTM D 412-92	16.5 MPa
Tear Strength	ASTM D 624-86	9.6 MPa
Puncture Strength (MPa)	CNS 14263 (1998)	5.33
Hydrostatic Pressure Resistance (0.1MPa/cm2, 30 mins)	CNS 10146 (1983)	No Leakage
Water Absorption (%) (23^{0}C, 24hrs)	CNS 4447 (1992)	1.04
Water Vapour Transmission (g/hr*m2)	ASTM E96-05	0.352
Solids (mixed) by volume		100
Flash Point	Pensky Martens Closed Cup	>149^{o}C
Theoretical Coverage		1mm / m2 / litre
Early Fire Hazard	AS1530 Part 3 (1989)	2mm sample
Properties	Ignitability Index (0-20)	16
	Spread of Flame Index (0-10)	8-9
	Heat Evolved Index (0-10)	9-10
	Smoke Developed Index (0-10)	7
	ASTM D 1692-68	Self-extinguishing
Gel time	25^{0}C	5 seconds (will remain “cheesy” for up to 15 minutes after gel)
Tack free time		60 seconds
Ready to walk on		5 minutes with care
Cure time		1 hour
Expose to water		1 hour
Full cure		7 days
Cathodic Disbondment with 3mm thick coating	ASTM G8-90 Method B using an impressed current	Rating D

Once Tufflon gels and becomes tack free it will remain “cheesy” for up to 15 minutes or longer in colder weather. Care should be taken not to damage the coating during this time.

WORKING SAFELY

Tufflon-P80 is a pure polyurea hybrid elastomer and with zero VOC's, Tufflon is safe to apply in almost all situations. Polyurea's are closely related to polyurethanes. Both are two component systems made with Isocyanate-based materials. However, while the second component in polyurethane is polyol resin, the second component in polyurea is polyether amine. Tufflon gels in seconds and cures quickly. As such it can only be applied using specialised plural component equipment. Because of its rapid reaction time moisture will not affect its set-up or curing. This is hugely advantageous in high humidity climates or regions with relatively high rainfalls. In addition it can be sprayed at very low temperatures with minimal effect on tack-free time, allowing for application on substrates such as cold steel that typically act as a heat-sink. Even when Tufflon is exposed to temperatures as high as 120oC and intermittent temperatures up to 180oC it maintains high flexibility and high impact / toughness and still has excellent heat distortion resistance. It is resistant to most petroleum-based chemicals, such as gasoline, hydraulic fluid, diesel fuel, motor oil and toluene. Kerosene will absorb into Tufflon-P80 causing it to swell and soften. Inorganic acids and alkalis such as sulphuric acid, hydrochloric acid, sodium hydroxide, potassium hydroxide and hydrogen sulphide are also well tolerated. Its high tolerance to Sulphuric Acid and Hydrogen Sulphide make it particularly suitable for use in protecting and sealing sewerage assets.

APPLICATION TECHNIQUES

Refer to Liquimix for specific recommendations but in general the method of application should always suit the primary purpose for applying the Tufflon. This could be for protecting a surface against the effects of abrasion or corrosion resistance. It could also be to protect the surface it is applied to from being attacked by harsh chemicals. There are many purposes why Tufflon would be specified. However in general the applied Tufflon lining should be free of holes, blisters, runs, unreacted raw material, contaminants, excessive wrinkling and defects. Such defects shall be cause for the rejection of the Tufflon lining.

CONCRETE. To avoid delamination, never apply Tufflon-P80 or Primers directly to smooth shiny concrete. Always abrasive blast smooth concrete to an 80 grit finish or better followed by correct priming and if necessary rendering to provide an even uniform finish. Where abrasive blasting is not permitted, diluted hydrochloric acid (always add acid slowly into the water) may be broomed onto the surface until an 80 grit or similar profile is achieved. Fill all bug holes on vertical surfaces and remove all protrusions and grind sharp 90^0 obtuse angles back to a 45^0, 5mm finish. Old concrete must be either high pressure water blasted (4,000psi, 21 lpm with turbo jet) or abrasive blasted to remove old weakened cement and sludge. Render exposed aggregate with Aralox/Sand or Aqualox/Sand/Cement mix to restore its original profile. Correct priming techniques will ensure even coating thickness, high adhesion and no pin holes (refer Liquimix for specifications). Break large areas up into sections and fully prepare, prime and apply Tufflon to each section before moving onto the next one. Spark Test within a few minutes of the Tufflon being applied and repair any defects immediately. Conduct adhesion tests for each section and if necessary adjust methods until adhesion is at specification.

APPLICATION TECHNIQUES

CONCRETE. *(cont.)*

Only then should the next section be started. It is better to adjust application techniques and methods earlier rather than later. On high walls always apply Tufflon from the bottom and work up. Quite often it is better to coat the floor first before starting on the walls. It is important to mask off finished works immediately adjacent to the work area so as to protect them from overspray. Wire Trim tape used in conjunction with standard masking methods may prove useful. Prior to spraying Tufflon over older previously applied Tufflon it is important to follow recommended repair procedures. If Aralox primer is left for more than 12 hours it will need to be re-activated with another coat of Aralox prior to being sprayed with Tufflon. A non-slip finish can be achieved by waiting 60 seconds before spraying a very fine mist coat of Tufflon sparsely over the last coat. Best results will be achieved by standing well back from the area and moving the gun quickly to apply just the right amount of product. A fine dotted finish is perfect. With some practice this technique can produce a repeatable and predictable finish that is non-slip yet easy to clean.

STEEL. Remove rust, mill-scale and old coatings. Blast clean to a minimum Sa 2 ½ (ISO 8501 1:2007). Roughness: using abrasives suitable to achieve Grade Medium G (50 - 85 µm, Ry5) (ISO 8503-2). Apply Tufflon-P80 as soon as possible with application directly to the freshly blasted, clean steel. Ensure all protrusions and sharp edges are removed. Sharp 90o acute angles should be coved using single pack moisture cure urethane joint sealant. Holes in the steel and welds should be filled prior to coating using a single pack moisture cure urethane joint sealant. Prior to coating the steel remove any settled dust using dry, clean compressed air. It is important to mask off finished adjacent works to protect them from overspray. Wire Trim tape used in conjunction with standard masking methods may prove useful. It is important to follow recommended repair procedures when spraying Tufflon over older previously applied Tufflon. Adhesion testing should indicate 4MPa minimum. Higher adhesion up to 8MPa is often recorded. Spark testing should indicate a sound, pinhole free lining. Using the correct mix chamber and spray tip combination will result in a smooth, uniform, seamless finish. A colour-fast top coat may be applied directly to the newly applied Tufflon within 15 – 60 minutes of spraying to ensure a decorative finish.

RECOAT & REPAIR PROCEDURE

RECOAT. Tufflon may be recoated when tack-free. Older Tufflon should be mechanically abraded with a wire cup brush to remove any oxidised material and cleaned thoroughly with Acetone or Methylated Spirits prior to recoat. Surrounding areas must be masked off using wire trim tape and standard masking sheets to prevent overspray (which will not adhere to previously lined surfaces). When spraying large jobs, for example inside a large concrete water reservoir, it will be necessary to join up with previously coated areas. Those previously coated areas should have been finished off to a neat straight line using wire trim tape and masking sheets. When Tufflon is to be joined up to older previously applied material abrade a 50mm strip of the old coating and mask it off using wire trim tape and masking sheets.

RECOAT & REPAIR PROCEDURE

RECOAT. *(Cont.)*

Then spray the new lining up and onto the abraded area and onto the masking sheet. After 20 minutes carefully remove the wire trim tape and masking sheets. A straight neat line will be visible where the join is. The repair / recoat procedure for rapid set elastomers is very different from normal paint. Repaired and recoated areas will remain visible. The best one can do is making them look as neat as possible.

REPAIR. If the lining is damaged or blistered some days or weeks after application and it needs to be repaired first cut the damaged or blistered area away back to the substrate using a Stanley knife. Continue cutting away any poorly adhered or unsound coating. Thoroughly clean and abrade the substrate and prime with original system (if primer was used). Mechanically abrade the previously installed coating for at least 25mm out from the edge of the cut lining. Clean the abraded area thoroughly with Acetone. Make especially sure to remove any uncured polyurea from the area. Once this has been completed mask around the repair right up to the abraded surface. Use masking sheets to keep overspray from settling on previously coated areas. Spray Tufflon onto the repaired area to over thickness. Immediately remove masking and after 30 minutes abrade the newly applied Tufflon back to be level with surrounding area. It is important to note that repairs will remain visible. It is nearly impossible to make a repair completely blend in with the old previously applied coating.

RECOMMENDED THICKNESS

Recommended thicknesses as follows...

- High Abrasion Resistance > 5 mm
- Protective Coating > 3 mm
- Tanking Potable Water > 3 mm
- Waterproofing > 1.5 mm
- Corrosion & Chemical > 3 mm

NUMBER OF COATS

Tufflon can be applied in thicknesses from 0.3mm up to several mm in one operation. Unlike ordinary paint it is unnecessary to have to come back and re-apply a second or third coat to build up the thickness. In order to achieve specification thickness, allow just enough cure time for the first coat to become firm and then spray the next coat. Avoid runs.

PIN HOLES

Spark testing should be performed within minutes of application and any defects remedied immediately. To rectify pinholes it is best to immediately fill them with a single pack moisture cure urethane joint sealant. Wait half an hour for the sealant to tack off and then re-spray over them. Pin holes are usually caused by insufficient priming of concrete substrate.

COLOUR

Even though Tufflon is supplied un-pigmented, it is highly recommended that pigment be added just prior to use. This greatly assists the spray operator in judging correct thickness and coverage. It is imperative that the correct pigment is used. Liquimix will not warranty its products that have been coloured with non-approved product. Add the correct quantity of pigment slowly to the part B drum while agitating. An extra 2" bung in the middle of the Part B drum allows an expanding blade or Twistork pneumatic agitator to be fitted. Tufflon pigment is supplied in 5L plastic bottles which are easily poured into the drum. Usually 1 or 2 five litre bottles added to 200kg of part B will give good opacity. Black requires only 1 x 5L bottle added while lighter colours such as white and light grey require 2 x 5L bottles. No more than this should be added. Specified colours are available. Alternatively various colours can be made by mixing supplied base colours. For example 1 x 5L of white and 1 x 5L of black will give a grey. The addition of more or less black will give darker or lighter shades of grey. The same technique can be used with Dark Blue, Dark Green etc. White is a good colour to use for the internal surface of tanks as it makes the inside light and easy to see. Make sure the owner of the asset understands that the white colour will turn creamy yellow almost overnight. This does not affect the long term physical properties of the lining. As well as discolouration slight surface chalking will also occur over time when exposed to sunlight. Discolouration and surface chalking is a cosmetic change only and does not affect the long term physical properties of the system. Some colours change less than others. White will turn creamy yellow almost overnight while dark green will show almost no discolouration. Suitable top coats may be applied over Tufflon to provide long lasting decorative, colour-fast finishes with good gloss retention. Consult Liquimix for additional information.

AGITATING PRECAUTIONS

Avoid air entrapment in the B component material when mixing pigments. When the B drum is full the agitator can be run at near full speed but as the level of liquid in the drum drops it is possible for the uppermost blades of the agitator to entrap air in the liquid. If these small entrapped air bubbles are carried through the system to the gun they will cause problems with the correct mixing of the materials. As the B material level drops in the drum reduce the speed of the agitator.

SERVICE TEMPERATURE

Samples exposed to a continuous temperature of 120^{0}C for 3 days showed no significant loss of tensile strength or elongation. Intermittent temperatures of up to 180^{0}C will also be tolerated.

EQUIPMENT & MIXING INSTRUCTIONS

Introduction

This coating is designed for application through heated, plural component, high pressure, impingement mix, airless spray equipment capable of supplying material pressures to the spray gun of up to 2,500 psi and temperatures up to 80^{0}C. Graco E-XP2 and H-XP3 are ideal. Graco E10hp can be used for smaller jobs when fitted with a mix chamber AW2222 and up to AR2929. Applying Tufflon-P80 through low pressure type equipment using static mixing elements and air atomisation is not recommended for spray application.

Spray Pressure & Temperature. Each spray application will have its own optimal pressure, temperature and spray tip combination. However never drop below 2,000 psi or 60^{0}C processing parameters. For spraying into small tight areas use a small mix chamber such as AW2222 or use a flat pattern. For large floor areas requiring high flow rate use AR5252 or similar. Application pressures should never drop below 2,000 psi. Temperatures up to 75^{0}C can be used. At lower pressures and temperatures physical properties will be compromised. Always consult with Liquimix prior to using Tufflon outside recommended parameters.

EQUIPMENT SPECIFICATION

Mix Ratio

Tufflon-P80 requires 1:1 (A:B v/v) mix ratio pumps.

Drum Heaters

In very cold weather flexible, 1,000W adjustable band heaters can be used to condition materials in drums to the optimum temperature of around 25^{O}C. Alternatively fit a Recirculation Kit to the Graco E-XP2 or H-XP3 and use the drum transfer pumps to recirculate the material with the proportioner heaters on. This method will heat the drums up within 10 to 15 minutes.

Drum Transfer System

The proportioner should be supplied direct from the drums by transfer pumps of at least 2:1 ratio. Normally a 3m long, 19mm (3/4") I.D., 500 psi rated, moisture lock transfer hose connects each pump to the proportioner. There should also be a screen filter of about 40 mesh in place between the transfer pump and the proportioner.

Proportioning Pump

A plural, 1:1 ratio, proportioning pump capable of developing at least 3,000 psi pressure is required.

Material Primary Heaters

Material heaters are necessary in the system to reduce and maintain material viscosities at optimum levels. These primary heaters are usually mounted on the proportioner and are connected in line after the proportioning pump. These heaters should be capable of raising the temperature of the material by at least 50^{0}C at the flow rate during normal application. They should be rated to withstand the maximum pressures the system can develop. These heaters function better in the system if they are controlled accurately by a thermostat.

EQUIPMENT SPECIFICATION

(Cont.)

Heated Hose Assembly

Moisture-Lock hoses for each component rated for the proportioning pumps maximum pressure are used to transfer the material under pressure from the pump to the spray gun. These hoses should be heated and controlled thermostatically by temperature controls at the proportioner. The hose heat should be capable of maintaining the material temperature set by the primary heaters to the spray gun. The hose assembly is usually insulated with flexible pipe insulation and the airline necessary for the operation of the spray gun is incorporated into the package. These hoses are usually 10mm (3/8") I.D. with the air feed hose to the gun being 6mm (1/4") hose. A short 3m section of hose assembly (known as a “whip hose”) of 6mm (1/4") hose is usually attached to the gun end of the hose to aid in the manoeuvring of the spray gun in application. This assembly should also be heated.

Spray Gun

Plural component spray gun utilising impingement mixing and air purge is required. Choose correct mix chamber / spray tip combination to give optimal spray pattern and flow. Generally a flat pattern tip achieves a smoother uniform finish but produces a lot more mist. However for most Civil applications a round mix chamber is preferable because it produces less mist, is easier to clean and delivers higher volumes. Both flat and round patterns are available in different sizes depending on the flow rate required and the work being performed. Graco’s Fusion-AP gun has been used successfully for many years while the more recent Fusion-CS gun is lighter and allows for flow rate adjustments to be made without having to change mix chambers. Whilst the gun operator is spraying it is critical that a second operator continually monitors the two pressure gauges back at the machine to ensure they are equal. A very slight pressure imbalance of up to 10% can be tolerated but once it exceeds that stop spraying. Remove the gun mix chamber and thoroughly clean using the correct drill sizes. A blockage in the mix chamber or check valve filters is almost always the cause of pressure imbalance. The mix chamber orifice should be regularly drilled out using the pin-vice drill holder with the mix chamber still in the gun. Always ensure the gun safety lock is on during maintenance.

Material Protection

Moisture vapour entering the resin drum through the small bung hole, which is normally used as a vent, can cause unwanted blowing or microcellular structure in the spray film. Moisture vapour entering the isocyanate drum can cause formation of solid contaminants. Use a desiccant dryer system on both drums to remove most of the moisture from the air as it passes through the desiccant to equalise the pressure in the container as material is used.

Drum Agitator

Mixing is not required for Tufflon-P80 part A. However mixing is required for part B when pigments are added. See previous section under Colour.

PROCEDURE

Pre-conditioning

In very cold weather it helps to warm the drums prior to spraying. This can be achieved by fitting thermostatically controlled drum band heaters or by using the drum pumps to recirculate the material through the Proportioner with the primary heaters on.

Thinning

Absolutely no solvent should be added to 100% solids coatings. Viscosity may only be reduced by increasing temperature.

Setting Up to Spray / Start-Up Procedures

Follow the equipment manufacturer's instruction manual. For new equipment individual components should be connected as previously described. Be sure to lubricate all pumps as per manufacturer's instructions. Ensure the Iso side wet cup reservoir is filled with fresh LiquiLube plasticiser. Check and clean all fluid filters. Check and clean all air traps and filters. Check electrical system to ensure proper power requirements are satisfied and there is complete continuity in all circuits. For existing equipment thoroughly clean the system including the line filters. For new equipment decide which side will contain the isocyanate component and which side will contain the resin. Mark all isocyanate pumps, inlets, outlets, heaters, hose fittings and gun inlets "A side" or mark with Red tape. Mark all B side pumps, inlets, outlets, hose fittings, and gun inlets "B side" or mark with Blue tape. Retain this identification and use only as indicated to avoid cross contamination. Turn on the heaters and bring the system up to temperature BEFORE PRESSURISING the hoses. Pressurise the system and test spray to ensure proper operation. Always spray off the project first to check proper operation and cure of materials. Have another operator check that while the gun is being triggered both A & B pressure gauges at the machine are equal. Observe the sprayed material and if necessary make additional equipment adjustments, then proceed with the project.

Spraying

Use a 50% to 70% overlap to ensure an evenly coated surface free of stripes. Keep the gun at 90^0 to the surface rather than using an arc pattern. To help avoid striping and maintain a uniform coating thickness, move the gun fast in a regular and repeatable pattern. Spray continuously as much as possible and minimise triggering the gun. Anytime there is even a small change in pressure, spray pattern, colour or consistency of the material, the sprayer should stop immediately and troubleshoot the equipment. Filters in both the gun and the proportioner should be checked periodically for any build-up of material. Blockages in the gun check valve filters are the second most likely cause of pressure imbalance. If the whip hose is unheated, the material that is contained in the whip will cool down during extended periods when not spraying. This material will not be the proper temperature and will not yield a quality pattern or product. Spray off the project until this material is cleared and the warmer material sprays properly. The temperature of the material near the gun can be checked by inserting a small thermometer in the hose jacket along the hoses.

PROCEDURE

Shutting Down the Plural Component Equipment

Follow the equipment manufacturer's instruction manual for both the Machine and the Gun. Soak any parts covered with overspray in SWELL. Drop all gun mix chambers, spray tips, gun covers etc. into SWELL so that they will be easy to clean the next time you go to use them.

Equipment Clean-Up

Methylated Spirits or Acetone are both inexpensive and readily available from most hardware stores, paint shops and supermarkets. These solvents may be used for general clean-up of equipment and hoses. They may also be used for cleaning all gun parts. Ensure that side A and B gun parts are cleaned or soaked in separate containers to help minimise cross-contamination. After having cleaned the parts they can then be soaked in SWELL. This will soften any cured polyurea or epoxy which can then be easily cleaned away. Keep all gun A side components in soak containers on the left side of the work bench and all B side components on the right side of the work bench. The use of plastic soak containers with clip on lids and removable baskets makes the job easier. As soon as the SWELL becomes cloudy replace it in order to retain maximum cleaning ability.

TESTING

The THREE MOST IMPORTANT physical properties to check during spray application are thickness, adhesion and defects in the coating such as pin holes. It is always best to find a problem early in the spray process rather than later. For example if it is found that the adhesion is lower than expected in the first spray area, then the application team should stop and reassess their substrate preparation techniques in order to achieve the expected results. If the whole job is completed BEFORE checking for adhesion then it is too late.

Thickness Testing (DFT)

During the specification process, Tufflon would have been specified at a certain thickness. This is the MINIMUM thickness NOT THE AVERAGE thickness. Any less is considered a fault.

- **Steel –** Non-destructive thickness test instruments are available for steel. The test should be conducted within a minute of spraying and areas shown to be less than the minimum thickness should immediately be re-sprayed in order to achieve the correct thickness. Carefully follow the Thickness Tester manufacturer's set-up and calibration instructions prior to testing.
- **Concrete –** Non-destructive thickness test instruments using ultrasound technology don't work that well for sprayed polyurea and polyurethane. Trapped air bubbles scatter the ultrasound and can give false readings. A better way to monitor thickness on concrete is to check the thickness of the coating after adhesion testing has been completed by measuring the plug that is removed.

TESTING

(Cont.)

Spark Testing (also known as Holiday Testing or High Voltage Porosity Testing)

It is recommend to use a high voltage porosity tester to discover pin-holes, defects and embedded foreign objects in the Tufflon-P80 coating within minutes of application on both steel and concrete. If a defect is found the gun operator should be called back to re-spray the defect as soon as possible. Ensure that in corners or where the Tufflon covers other PU sealants that the voltage is increased. Pay particular attention to areas where overhangs are present. Carefully follow the Spark Tester manufacturer's set-up instructions and calculate the voltage required as follows. Test Voltage (KV) = √T x 250/1000 (where T is thickness in microns).

So for example 3.5mm = 15kv, 3mm = 13.89kv, 2.5mm = 12.7kv, 2mm = 11.2kv. In order to comply with most standards 100% of the coated surface area needs to be tested. Brass brushes of various size and shape can be purchased to work with the Spark Tester for large areas or inside or outside of pipes.

Adhesion Testing

Correct adhesion of the Tufflon to the substrate is paramount and is what all the preparation leads to. A "dolly" is glued to the Tufflon and later (when the glue has cured) the dolly is pulled off using a special instrument. A result (usually in MPa) shows the force required to remove the dolly and lining from the substrate. Quite often the adhesion of the Tufflon system to the substrate is so strong that the dolly will break away at the point where it is glued to the Tufflon. Carefully follow the Adhesion Tester manufacturer's set-up instructions and look for the following results.

- Adhesion of Tufflon to steel should be > 7 MPa
- Adhesion of Tufflon to concrete should be > 3.5 MPa

STORAGE AND HANDLING

PRECAUTIONS

Under normal storage conditions and in properly sealed containers, both the isocyanate and resin have a storage life of 18 months. Protect from frost. If crystallisation occurs, heat the material to 80oC whilst agitating to melt it. On no account should the materials be heated above 80^{0}C. Storage temperatures above 50^{0}C are not recommended since they can accelerate the formation of insoluble solids and also increase the rate of viscosity increase on extended storage. If either component is opened and partially used, it should be purged with nitrogen or desiccated air and resealed.

COMPARISON TO POLYURETHANES & EPOXIES

In terms of performance, conventional polyurethanes and epoxies require a catalyst to drive the reaction. Such systems are sensitive to temperature and moisture. Low temperatures can slow the reaction and moisture can interfere with the reaction causing blistering and other negative effects giving them a narrow window for application. Catalysts often contain metal salts such as mercury to improve their performance. These metal salts can be leached out of under-cured polyurethane lining systems causing health concerns, especially in tanks used to store drinking water or foodstuffs. Tufflon does not require a catalyst and reactivity is fast (typically 3-10 seconds). Consequently it is able to cure at temperatures as low as -20^{0}C and in the presence of moisture. Having no catalyst makes Tufflon very safe for use with drinking water, foodstuffs and aquariums. Epoxies have slow cure time and little or no elongation properties. This leads to frequent failure of such coatings with them flaking and cracking due expansion or movement of the substrate.

The following information will help specifying engineers and project managers make an informed decision about where to use Polyurea versus Epoxy.

When used as a coating or lining system on concrete or steel Tufflon exhibits many of the advantages of epoxies but with the added benefits as shown below….

- Higher abrasion and wear resistance than epoxies
- Permanent elasticity
    - will not tear, crack or peel
    - will bridge small cracks in substrate
    - "moves" with substrate movement
    - Automatic expansion joint seal
- Rapid gel time of 3 to 10 seconds (can be walked on, rained on with no damage after only 5 minutes of application). Full cure of 30 minutes or less (fast turnaround of plant and rapid access to coated areas by other trades)
- Unaffected by cold temperatures or high humidity (achieves full physical properties even when applied at -20^{0}C)
- Full specified coating thickness of several millimetres can be achieved in several passes of the gun at the one time. No need to come back to re-coat hours or days later
- Very fast application rate using plural component equipment (up to 1,000sqm per day can be applied with one machine and a team of three operators).
- No VOC's or solvents present. No thinning with solvent needed to help in application (many epoxies require addition of solvent to aid application)
- May be pigmented white or cream for ease of application in confined dark spaces (some bitumen or coal tar modified epoxies only available in black)
- Very safe to use and apply. Because of the rapid reaction rate of 5 seconds there is very little chance of amine contact with skin leading to sensitisation (epoxies take hours to cure and it is far more difficult to completely eliminate skin contact with amine)

Tufflon ticks all boxes for surface protection in aggressive environments…..

TUFFLON / EPOXY COMPARISON

For use in coating concrete and steel surfaces used to contain aggressive chemicals, wastewater, sewage, potable water and bunding, etc.

PROPERTY REQUIRED	SUITABILITY OF TUFFLON	SUITABILITY OF EPOXY
Protect all internal concrete and steel surfaces against corrosive process fluids and gases	Very chemically inert. See chemical resistance chart Tufflon	Very chemically inert. See chemical resistance chart for each brand of epoxy
The coating to be resistant to wet biogas containing H2S	Tufflon scores an "A" rating for immersion in 20% H2SO4 solution after 6 months. Therefore highly suitable	Most epoxies have good resistance to H2SO4
The coating to be resistant to wet biogas containing CO2 and CH4	Tufflon highly resistant to these gases and the acids formed by them	Most epoxies have good resistance to such chemicals
For Suitability for Secondary Containment (Bunding) areas. Resistance to Low pH (HCl 32%) and High pH (NaOH 50%)	Tufflon is resistant to these chemicals as temporary containment only. Therefore in bunded areas where concrete is to be protected by an inert coating Tufflon would be recommended	Most epoxies have good temporary resistance to very high and very low pH.
Suitability for protecting concrete and metal surfaces against aggressive wastewater chemicals and gases, applicable for sewers, wastewater treatment plants, pumping stations	Tufflon is a polyurea hybrid with very high chemical resistance and extremely low moisture transmission rates. It is highly recommended for such application as outlined to the left	Most epoxies also show very high chemical resistance and extremely low moisture transmission rates. They are also recommended for such application as outlined to the left
Environmental impact. Two component system – solvent free	Tufflon is 100% solids and contains no solvents, VOC's or diluents other than the reactive components	Most epoxies are 100% solids and contain no solvents or VOC's. However in order to apply them they are often thinned using solvents
Water and moisture to have minimal effect on curing properties	Tufflon will not scavenge moisture to take part in the reaction. It is highly tolerant of moisture and will cure quickly even when sprayed directly onto water to give full physical properties	Most epoxies are only reasonably tolerant of moisture and in fact moisture in the atmosphere or on the substrate can cause "blooming" to occur with negative results on the final physical properties of the coating system
Colour	Tufflon can be pigmented any colour. For ease of applications in large concrete tanks and confined spaces a light colour such as white (resulting from TiO2 addition) or cream make application much easier	Coal Tar or Bitumen modified epoxies are generally only available in black. This can make application in confined spaces very difficult to see and gauge correct thicknesses etc
Full cure time & return to service time	Tufflon gels in 5 seconds and can be walked on, rained on and re-coated within 5 minutes with no detrimental effect. Full cure will take place within 12 hours. This dramatically increases turnaround times and alleviates problems associated with rainfall during coating works. CHEMICALLY RESISTANT AFTER 12 HOURS	Most epoxies have long gel times of several hours which can cause problems in turnaround times. Epoxy bloom is also a common problem. Furthermore rain can severely compromise the curing process thereby reducing the final physical properties. CHEMICALLY RESISTANT AFTER 7 DAYS
Wear and Abrasion resistance	Tufflon exhibits outstanding wear and abrasion resistance. Far better than any epoxy. See data sheet for specific data.	Epoxies have good abrasion resistance but not as good as Tufflon
Approved for use with Potable Water and Foodstuffs	Tufflon has Potable Water approval AS/NZS 4020-2006	Some Epoxies may have passed AS/NZS 4020-2006.
Adhesion to concrete and Steel	Tufflon has outstanding adhesion to properly prepared substrates. Even though it is self-priming use of correct primer can aid in even better adhesion. Use specific primer for Concrete and steel	Most epoxies exhibit outstanding adhesion to both concrete and steel.
Surface hardness	Tufflon when applied using plural component, high pressure, heated equipment will produce a smooth continuously elastomeric surface finish with a hardness of 90 (shore A).	Most epoxies exhibit a smooth hard finish

TUFFLON / EPOXY COMPARISON

For use in coating concrete and steel surfaces used to contain aggressive chemicals, wastewater, sewage, potable water and bunding, etc.

PROPERTY REQUIRED	SUITABILITY OF TUFFLON	SUITABILITY OF EPOXY
Effect of ambient temperature during coating works	Tufflon is unaffected by cold temperatures and shows excellent adhesion and achieves full cure at -20^{0}C.	Epoxies are notoriously poor performing at low temperatures. Caution must be exercised at under 12^{0}C as final physical properties may never reach their full potential.
Surface Preparation	Tufflon requires that the surfaces are prepared well and in accordance with standard procedures such as… • Sand blast • Fill cracks, holes, with epoxy cement • Remove all high points and protrusions • Tape all expansion joints, internal corners and edges • Profile all surfaces with a thin layer of epoxy cement • Apply Tufflon to 3mm thickness in one operation	Epoxies require that the surfaces are prepared well and in accordance with standard procedures such as… • Sand blast • Fill cracks, holes, with epoxy cement • Remove all high points and protrusions • Tape all expansion joints, internal corners and edges • Profile all surfaces with a thin layer of epoxy cement • Apply Epoxy in several operations over many hours or even days to specified thickness
Technical competency required by applicator	HIGH COMPETENCY REQUIRED Tufflon must be applied by fully trained and certified plural component equipment operators. The applicator must possess thorough knowledge of the equipment and must have carried out the required maintenance prior to spraying. Equipment is expensive.	MEDIUM COMPETENCY REQUIRED. Applicators must be able to accurately and consistently measure parts A & B, mix them properly and apply them within the working life of the product. Equipment required is not expensive.

CHEMICAL RESISTANCE

Tufflon technology provides one of the best candidates for coating applications in harsh environments but it is not just a matter of looking at the following test results.

There are many factors which affect the chemical resistance of elastomer systems. These include:

- Application design (surface preparation, primer application, thickness Tufflon applied)
- Elastomer system formulation
- Service and exposure temperature
- Length of time of exposure or immersion
- Type and amount of impurities that could be present in the chemical and or environment.

All Tufflon applications must be approved by LiquiMix's industrial chemist or civil engineer prior to issuing any warranty of performance.

The following chart describes the chemical resistance of Tufflon spray elastomer systems.

For testing purposes, both ASTM D 1308 and ASTM D 3912 methods were utilized. These tests were performed at 25^{0}C with visual observations being noted at the end of the test procedures. Because of the simplicity of these tests and due to the factors listed above, which are beyond the control of LiquiMix Pty Ltd no guarantee or warranty concerning the use of these elastomer systems is either intended or implied. These test results are reported to serve as a guide only as to the suitability of Tufflon spray elastomers in a variety of applications. It is the responsibility of the user to assess the suitability of Tufflon spray elastomers for specific applications.

Acetic Acid 10%	**A**
Acetone	**A**
Ammonium Hydroxide 20%	**A**
Ammonium nitrate	**X**
Ammonium persulphate	**X**
Animal fats	**A**
ASTM oil #1 (70°C)	**A**
ASTM reference fuel	**A**
Benzene	**C**
Benzene <1,000ppm	**A**
Barium chloride	**A**
Barium hydroxide	**A**
Barium sulphate	**A**
Barium sulphide	**A**
Borax	**A**
Brake Fluid	**B**
Butane	**A**
Calcium bisulphate	**A**
Calcium Chloride	**A**
Calcium Hydroxide	**A**
Calcium nitrate	**A**
Calcium sulphide	**A**
Carbon dioxide	**A**
Carbon monoxide	**A**
Castor oil	**A**
Citric acid	**A**
Copper cyanide	**A**
Copper sulphate	**A**
Cottonseed oil	**A**
Cyclohexane	**B**
Diesel	**A**

Ferric Chloride	**A**
Freon – 12 (54(C)	**A**
FREON – 113	**B**
Gasoline (unleaded)	**A**
Gelatine	**A**
Glucose	**A**
Glue	**A**
Glycerine	**A**
Hexane	**A**
Hydraulic Oil	**A**
Hydrochloric acid 5%	**A**
Hydrochloric acid 37%	**X**
Hydrofluoric acid conc. (cold)	**X**
Hydrofluoric acid conc. (hot)	**X**
Hydrogen gas	**A**
Isopropyl acetate	**A**
Kerosene	**B**
Liquefied petroleum gas	**A**
Magnesium chloride	**A**
Magnesium hydroxide	**A**
Methanol	**A**
Mercury	**A**
Mineral oil	**A**
Motor Oil	**B**
Natural gas	**B**
Nickel sulphate	**A**
Nitric acid conc.	**X**
Nitric acid dilute	**C**
Nitric acid red fuming	**X**
Nitrogen	**A**
Octadecane	**A**

Olive Oil	**A**
Oxygen – cold	**A**
Ozone	**A**
Palmatic acid	**A**
Phosphoric acid 20%	**A**
Phosphoric acid 45%	**A**
Potassium chloride	**A**
Potassium cupro-cyanide	**A**
Potassium cyanide	**A**
Potassium dichromate	**A**
Potassium hydroxide 20%	**B**
Potassium nitrate	**A**
Potassium sulphate	**A**
Producer gas	
Radiation	**A**
Soap Solutions	**A**
Sodium Chloride	**A**
Sodium hydroxide (25%)	**A**
Sodium hydroxide (50%)	**B**
Sodium hypochlorite (1%)	**A**
Sodium phosphate	**A**
Sodium sulphate	**A**
Sodium thiosulfate	**A**
Stearic acid	**A**
Sulphuric acid conc.	**X**
Sulphuric acid (20%)	**A**
Tannic acid (10%)	**A**
Tartaric acid	**A**
Toluene	**C**

Key: **A**: Recommended, Little or No Effect **B**: Minor to Moderate Effect
C: Moderate to Severe Effect **X**: Not Recommended

Figure 1. Open Concrete Water Supply Channel BEFORE remediation with Geofabric and Tufflon polyurea

Figure 2. Open Concrete Water Supply Channel DURING remediation with Geofabric and Tufflon polyurea

Figure 3. Open Concrete Water Supply Channel AFTER Remediation with Geofabric and Tufflon polyurea

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