

TECHNICAL BULLETIN 10



URETHANE GROUT INJECTION

INTRODUCTION

The bulletin is intended to aid in proper selection and installation of injectable polyurethane (PU.) resin grouts for the repair of water leaks.

FEATURES AND BENEFITS

Urethane grout injection is used to stop active water leakage through cracks and joints in concrete and masonry structures.

Some of the advantages of polyurethane grouting include:

- May eliminated the need for excavation of soil, which is a costly process. Due to field conditions, this may be the only method of repair for a given situation.
- Available in extremely flexible varieties, which can be effective in cracks with limited dynamic movement.
- Fire resistance is possible; some newer polyurethane resins range from self-extinguishing to non-flammable.

DEFINITIONS:

RESIN CHEMISTRIES

Methane Diisocyanate, (MDI)

- Relatively Low Toxicity
- Can Accelerate
- Hydrophobic
- High Expansion Ratio
- Relatively Good Chemical Resistance

Toluene Diisocyanate, (TDI)

- Relatively High Toxicity
- Hard to Accelerate
- Higher Performance (Bond, Tensile & Elongation)
- Relatively Fair Chemical Resistance
- Hydrophilic Only

GROUT COMPONENTS

Single component (one part), some of which an accelerator can be mixed into the resin and pumped as a single component.

Plural component (two parts) resin and activator are pumped through separate lines to a mixing head.

HYDRO ACTIVE (HA):

Contact with water cause resin curing process to begin.

HYDROPHOBIC (WATER-FEARING) RESIN:

Require very modest amount of water to activate and cure. as little as three (3%) percent by volume. Due to its ability

to repel water and not dilute, it is an excellent selection when a large leak is encountered.

Caution: Hydrophobic resins can be prone to over-expansion or over acceleration.

HYDROPHILIC (WATER LOVING) RESIN:

This type of matrix needs to be exposed to water to stay swelled. Hydrophilic resins are susceptible to shrinkage in dry cycles, so the mixing ration can be modified to meet these situations. The ratios can vary by specific resins and the desired consistency, foam or a gel, as follows:

1. Foams are for maximum strength and flexibility and vary from 0.5 up to 2 parts water to 1 resin.
2. Gels are for consolidation of soils to create an exterior barrier from 2 up to 12 parts water to 1 resin.

Caution: Hydrophilic resins will continue to dilute in mass quantities of water, so they are not, suitable for large leaks.

SINGLE COMPONENT PUMP

Typically an adapted airless paint sprayer or grease pump either electric or air operated able to produce injection pressures of up to 3000 psi.

1. For crack injection a 0.4 to 0.8 gal per minute pump is usually sufficient.
2. Large leakages may require larger pump output, consult your manufacturer's technical service department.

MULTI RATIO PUMP

Used on hydrophilic grouts where mixing ratios may be adapted to suit application considerations.

INJECTION PORTS

Commonly called packers are mechanical devices installed into drilled holes intersecting cracks to deliver grout to effected areas.

SERVICE CONDITION CONSIDERATIONS

1. Identification of Environment
 - a. All wet or wet to dry.
 - b. Probable exposure to ultra violet or chemical attack.
 - c. pH ranges of removed water for long-term resin exposure.
 - MDI hydrophobic pH 3 to 12
 - TDI hydrophilic pH 3 to 10

d. Service temperature

- Polyurethane grouts perform best between 0 degrees to 180. degrees Fahrenheit.

e. Is the application (crack/joint) dynamic?

2. Location for Usage:

- a. Stop leaks through walls and slabs.
- b. Sealing wall penetrations (pipes, conduits).
- c. Ground water cutoff in mines and tunnels.
- d. Swimming pool leak repairs.
- e. Sealing elevator sleeves.

INSTALLATION CONSIDERATIONS

PRECAUTIONS ON-SITE SUPPORT

Prior to and during the first stages of the application, a qualified representative of the material manufacturer who has been thoroughly trained and certified for quality control should be on hand to consult with applicator and verify site conditions and material selection.

LOCATE HAZARDS

Prior to commencement of drilling, locate all buried conduits, post tensioning tendons, waterstops and other elements that may pose a hazard. Contact "Dig Safe" or similar local groups well in advance allowing for identification of hazards for a safe installation. Evaluation of adjacent building elements for the expansion/concentration abilities is important while des the location of installation. Injection has potential to cause hidden damage (i.e. plaza decks) if installed incorrectly. Only properly trained applicators with the appropriate equipment should install chemical grouts.

If injecting behind a contained structure, it is always advised to allow "relief holes or valves" to allow the escape of extreme pressures. Block walls and other concrete structures can bow or deflect under the pressure of large volumes of polyurethane foams reacting in a contained environment.

PROPER DOCUMENTS

At commencement of work the manufacturer's Product Data Sheets and Safety Data Sheets (SDSs) should be on file at the site for reference and to demonstrate compliance with the specified requirements, such as OSHA, and/or local,

state, and national VOC regulations. Locate and highlight manufacturers' medical emergency response telephone numbers from supplied SDS, other documents, or website. Be aware of other required documents such as confined space permits.

SURFACE PREPARATION

Remove loose, deteriorated, porous materials and contamination to allow clear delineation of crack. Prior to injection of grout, cracks should be flushed with clean potable water to remove any dirt or foreign objects from cracks. This will allow for better flow of grout. If the crack shows abundant lime deposits, a maximum of 5% muriatic acid may be added to flush water to remove excessive efflorescence. Crack must then be flushed again with clean potable water to neutralize acid flush.

Caution: Do not inject any solvents as they may contaminate work area or may cause damage to injection ports.

Cracks should be mapped out and marked prior to the installation of injection ports. Crack gauges should be used to determine if a crack is moving or not prior to grout selection. An actively leaking crack in excess of 1/8-inch in width or that has excessive water flowing should be sealed with an approved surface sealing material and method. A water diverter may be required to allow for port installation. Injection ports (packers) should be drilled into concrete at a 45-degree angle to the object surface to intersect the crack, alternating from each side of the crack.

Note: For walls up to 12-inch-thick, the wall thickness divided by 2 will determine the drilling distance from the crack up to a 12-inch wall. Beyond 12 inches, the drill angle should be reduced to accommodate a maximum 36-inch drill bit. For vertical cracks, inject from the bottom up, and for horizontal cracks, it is common to start at the widest section, and work out to chase the water from largest flow to termination.

Prior to starting the injection process, separate pumps should be dedicated for water and grout. The pump that will be used for injecting the polyurethane grout should be flushed with a non-water washing agent or solvent. By flushing the pump, you eliminate any moisture and lubricate the system. After the injection work, the grout pump must be flushed to remove any liquid residue.

Flushing the cracks with clean water will indicate how the crack will behave during grout injection. The water primes the crack for the chemical reaction with the grout. Reaction water for all resins must be within the neutral pH range 3 to 10.

DO NOT USE THE WATER PUMP FOR INJECTING THE GROUT!

During injection, the grout will displace the water in the crack. Continue injecting until the grout appears at the adjacent packer. Disconnect and start injection at the adjacent packer. After injecting 3 to 4 packers, disconnect, and return to the first packer and re-inject all of the ports for a second time. Some of the ports may take additional grout and this will densify the previously injected grout. Injection pressure will vary from 200 psi to 3000 depending on the width of the crack, thickness of the structure, and condition of the concrete. Travel of the resin will indicate where next port shall be placed. To aid cleanup, the surfaces surrounding the cracks should be wet down with water to reduce the grout's bonding ability.

Upon completion of the grout injection, each packer should be re-injected with water. This will react any resin in the drill holes. After the grout cures, the packers can be removed and patched or cut off flush with the concrete surface.

If existing cracks are too wide for injection methods, Oakum saturated with grout may be used to fill wider cracks yielding similar results.

Caution: Hydrophilic resins will continue to dilute in mass quantities of water, so they are not, suitable for larger leaks.

SAFETY EQUIPMENT

All necessary personal protective gear including: safety glasses, face shields, rubber gloves, Tyvek type suits, and hard hats, etc., should be utilized.

SAFETY PROTOCOL

Prior to application a safety meeting with all appropriate personnel should be held. If injection area is in a confined space, all local and federal regulations regarding installation, ventilation, safety equipment must be followed.

LIMITATIONS

Manufacturer should be consulted for limitations, design considerations, and their recommended personal protective equipment. Review application for long-term chemical exposure and consult manufacturers' chemical resistance charts for product specific capabilities.

Test grout water for pH and consult manufacturer for the various pH threshold limitations for their products. If grouting application occurs when concrete is green, the pH may be too high for some products (particularly hydrophilic materials) which may adversely affect injection grout durability. Avoid applications where significant future movement is expected in the grouted joints. The cured material is not intended to function as an expansion joint.

ENVIRONMENTAL CONDITIONS

Do not commence with installation of chemical grout when air and/or substrate temperature is below 35 degrees Fahrenheit (2 degrees Celsius) and falling, or above 100 degrees Fahrenheit (32 degrees Celsius) unless approved in writing by the material manufacturer.

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