



## Clarifier Grout for Clarifier Tank Overlays

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Five Star® Clarifier Grout is a sulfate resistant and moderate heat of hydration, cement-based, non-metallic grout which can be used for clarifier tank overlays. This overlay is typically done using 3,000 lb. bulk bags, coarse aggregate, and mixed via ready mix trucks.



A CLARIFIER TANK PRIOR TO INSTALLING GROUT.



GROUT BEING PUMPED AND INSTALLED. NOTE THE USE OF THE SLUDGE RAKE AS A FINISHING TOOL.

### A. Surface Preparation

To develop maximum bond strength, the clarifier concrete floor must have a very rough surface profile. The properly prepared surface will have a surface profile with greater than a ½ inch peak to valley roughness. This is equivalent to an International Concrete Repair Institute (ICRI) Concrete Surface Profile (CSP) of 10 or greater. To obtain this profile mechanical means must be employed to remove the surface laitance and expose aggregate. Care must be taken not to fracture the concrete subbase and introduce micro cracks. Mechanical methods to obtain an acceptable surface profile are:

#### A.1. High and Ultra-High Pressure Water Jetting

On existing concrete floors, this is the only method mentioned by ICRI that consistently achieves a CSP 10 surface profile that does not introduce micro cracking.<sup>1</sup>

It has also been reported but not specifically mentioned by ICRI that two direction scarifying can also achieve a surface profile close to a CSP 10.

<sup>1</sup> Surface profile references and photos are from the International Concrete Repair Institute Guideline No. 310.2R-2013 (October 2013), "Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, Polymer Overlays, and Concrete Repair". For more information on Ultra- High Pressure Water Jetting see ACI RAP Bulletin 14 "Concrete Removal Using Hydro demolition".



CSP10 - SURFACE PREPARED USING HIGH-PRESSURE WATER JETTING.

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### A.2. Surface Retarder Application

An acceptable surface profile is also obtainable by applying a surface retarder to the concrete when constructing the clarifier. The effectiveness of the surface retarder depends on the depth of the retardation and appropriate timing to remove surface laitance. If a retarder is used, the surface must be thoroughly cleaned to remove the retarder and loose material following the use of the retarder.

Whichever method is employed, it is recommended that the surface preparation method be tested and evaluated prior to preparing the entire surface. The desired outcome of the profile is the same as with pre and post construction surface preparation.

- Expose the aggregate to 1/4 inch above the cement (paste) line. The peak to valley profile should be 1/2 inch.
- The exposed aggregate should be clean, crisp, and angular (rounded aggregate is not optimal for maximum bond)<sup>2</sup>



*SURFACE PREPARATION USING A "SURFACE RETARDER". ADDITIONAL SURFACE PREP MAY BE REQUIRED TO ACHIEVE CSP10.*

Once the surface has been prepared, pressure washers or water blasters are often used to clean the surface of dust/debris. The sloped floor which is usually part of the clarifier design can often be utilized to collect debris. Care must be taken to protect the drains and any apparatus on the bottom of the clarifier.

### B. Pre-Installation Surface Saturation

When installing Five Star® Clarifier Grout, the bonding surface must be at a saturated surface dry (SSD) condition. The best way to ensure an SSD condition is to flood the clarifier floor with water for 24 hours prior to installing the grout. Then just prior to installing the grout, drain the clarifier tank and vacuum up (shop vacuum) any ponded water. The surface is then kept in a wetted condition by misting right up to the time the grout is installed.

### C. Aggregate Extension

For grout depths of 2 inches or greater, or if Five Star® Clarifier Grout is to be batch mixed in something other than a mortar mixer, the addition of coarse aggregate is required. Locally sourced clean washed pea gravel conforming to ASTM C33 should be used because it is readily available and it lends itself well to flowing, pumping, and finishing. Refer to Five Star® Technical Bulletin *Concrete Repair Aggregate Extension Guidelines* or consult Five Star Products for aggregate extension recommendations.

The addition of coarse aggregate will affect the amount of water required to achieve the desired consistency. The amount of water that coarse aggregate can contain can vary depending upon how it is packaged, stored, etc. This variation in the water content will affect the slump of the mix. To maintain a uniform water content in the mix and minimize variations and prevent over watering, it is recommended that coarse aggregate be pre-soaked to "fully wet" and drained prior to adding it to the batch mix. This will ensure that all the extension aggregate has the same water content.

The maximum water content in the batch mix including the water in the coarse aggregate should never exceed the maximum water specified on the Five Star® Clarifier Grout Technical Data Sheet.

<sup>2</sup>This is often a function of the aggregate that was used in the base concrete mix.

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### D. Extra Material

Five Star Products recommends a minimum of 10 - 15% more material be ordered than the actual amount calculated, and this additional material should be kept on hand. The most common reason for running short of material is that the depth of the installation is greater than originally calculated.

The depth of the material to be placed should be reviewed after the surface preparation has been completed. Installation of the overlay should not begin unless there is sufficient material to place the overlay at full depth. Once the material mixing and placing begins it should be maintained continuously until the installation is complete. If you run short of material, it will be necessary to add a construction joint which is not desirable. Some additional material should also be ordered and available to determine the proper mix ratio and test the workability.

### E. Temperature Requirements

Be sure to keep all the raw materials (dry product, coarse aggregate, potable water) and surfaces (clarifier floor, mixers, pumps, chutes, hoses, etc.) as close to 70°F (21°C) as possible. Condition everything in contact with the grout to end up with a batch mixture that is between 60°F and 80°F (15°C and 27°C). The temperature of the extension aggregate can be adjusted (cooled) as part of the “pre-wetting” described above. Ice water can also be used to keep the mixture cool and maximize the working time of the material.

At time of placement, if temperatures of equipment, surfaces, and the environment are above 90°F refer to Five Star® Technical Bulletin *Concrete Repair & Foundation Installations Hot Weather* and/or contact Five Star Products for hot weather installation procedures. Temperatures should be monitored and recorded as part of the quality control process.

### F. Trial Mixing and Placement

It is important to know the precise volume of potable water and the wetted extension coarse aggregate by weight or volume that will achieve the desirable consistency (slump) prior to mixing batches of grout for placement. Five Star Products recommends a “Trial Mix” be conducted several days or weeks in advance of the installation. Sufficient time should be allowed to make any necessary adjustments (securing additional extension coarse aggregate, ice water, etc.). The conditions of the Trial Mix should replicate the anticipated conditions to the greatest extent possible.

The Trial Mix is essential to installations where bulk mixing is planned. Unlike small batch mixes of bagged product, adjustments to a large batch may not be possible.

The primary goal of the Trial Mix is to determine the exact amount of water required to deliver a mixed product that will be stiff enough to hold the desired slope (since most clarifier floors are sloped to a central drain). The Trial Mix also allows the installer to verify that the product is workable and finishes well. If QC samples are planned as part of the installation, the Trial Mix should be sampled to verify that the mixture will produce a product that meets the project specifications.

A “Trial Placement” is also recommended. To conduct a Trial Placement, a concrete substrate should be prepared using the same method planned for the actual application. The delivery method should also be verified (test the pump, chutes, etc.). The clarifier grout should be placed and finished in the manner that is planned for the actual installation. Flood cure the Trial Placement area for 3 days and then allow to dry for 1 day.

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### F. Trial Mixing and Placement continued

A test of the adhesion or the bond of the grout to the prepared surface, can be accomplished by lightly hammer tapping the installation to detect hollow sounding locations. The bond may also be evaluated by conducting standardized testing such as a direct tensile bond test (ASTM C1583/C1583M) or some other approved test method. If issues with the bond are revealed, the surface preparation, the mixing, and the application procedure must be reevaluated.

If pumping the material is part of the installation plan, the Trial Mix and Placement are good opportunities to test if the product can be pumped and the pump is working properly.

The Trial Mix and Placement also offer the cement finishers a first opportunity to work with the product to see how it performs and how it will finish.

Record and maintain a record of every batch including mixing time duration, water addition, aggregate addition, slump, and temperature when mixing procedure is completed. Make and record adjustments as the temperature increases or field conditions change. Once the correct water/product ratio is determined, containers that hold the precise amount of water should be employed if bagged products are being used. It is always a good idea to add slightly less than the desired amount of water. Additional water can always be added to the mix but too much water is very difficult to remedy once the mixing has begun.

### G. Mixing

If the material is supplied as a bagged product, multiple mortar mixers should be employed to ensure a steady and even supply of material for placement. If the product is to be delivered in bulk and mixed in ready mix trucks, follow the guidelines in Five Star® Technical Bulletin *Mixing Bulk Bags in Ready Mix Trucks*.

It is important to consider the working time of the product when planning the mixing and the placement (working time starts with the addition of water to the dry product). For this reason, the mixing of the material should happen onsite near the installation. Mixing onsite will maximize the amount of working time that is available to place the material.

### H. Delivery and Placement

Consideration should be given as to how the material will be delivered to the clarifier floor. Pumps, chutes, etc. are often employed for this function.

Scrub coating the material with a stiff bristle broom is recommended for maximizing the bond. Applying the scrub coat immediately ahead of the placement and not allowing the scrub coat to dry out is essential. If this cannot be achieved, then it is better to not apply a scrub coat.

The material should be slightly stiff at the time of placement such that it can be delivered and “worked into the substrate concrete” prior to leveling and finishing. This will maximize the bond to the base concrete. The material should be placed at full depth.

### I. Quality Control Testing

If project quality control testing is required, it should be sampled prior to placement to ensure that the product is properly mixed.

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### J. Finishing

Once the material has been worked into the concrete substrate and the desired level is achieved, the material can be finished. Note: High performance materials do not finish like regular ready-mix concrete. The installation contractor should plan to screed/bull float and finish by hand with wooden tools. In some installations the sludge rake or screed is used as a gauge to finished surface elevation. Light brooming, with a fine finish broom, in the direction of the rake's rotation is acceptable. Do NOT use steel trowels. If a steel trowel is used excessive scaling will develop in the finished surface. Misting the surface to improve the finish is not allowed.

### K. Curing

Once the material has been placed and finished, it should be allowed to set. The color of the placed material will change (lighten) when the material is set. This is typically around 3-4 hours after the material is mixed, however these times often vary based on temperatures.

Once the material has set it is very important to begin wet curing. The best way to wet cure a clarifier grout is to flood the clarifier (cover the material with water) and keep the material covered for 72 hours. After 72 hours the excess water can be pumped off and the material can be coated if desired.

### L. Coating

If the clarifier is to be "coated" or have something installed on top of the grout, the grout should be allowed to dry once the wet cure is completed. Depending on the environment, it can take an additional 72 – 96 hours (3-4 days) before the new grout is ready to accept a coating. The coating manufacturer's product requirements should provide information as to how dry the surface needs to be and what type of surface profile needs to be achieved prior to the application of the specific coating and what type of surface profile needs to be achieved prior to the application of the specific coating.

### M. Pre-Installation Meeting

The need to have a pre-installation meeting and a qualified manufacturer's representative involved in the process is critical to the success of the installation. Any deviations from the recommendations mentioned above should be discussed with Five Star Products prior to installation.

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