# *INSTALLATION SPECIFICATION TUFCHEM™ SILICATE CONCRETE FOUNDATION GRADE*

## *1. SCOPE*

1.1 Tufchem Silicate Concrete FG is an inorganic acid-resistant polymer concrete. It can be used in place of Portland cement concrete mixes for structural applications such as floors and walls, or as an overlayment onto existing slabs. It can also be cast to refurbish pump bases pads or trenches and sumps. Use this specification in conjunction with product data sheet CE-252.

1.2 When fully cured, Tufchem Silicate Concrete FG is resistant to all concentrations of most acids including sulfuric, hydrochloric, nitric, chromic, acetic and phosphoric. Tufchem Silicate Concrete FG is not resistant to fluorides or hydrofluoric acid, and it should not be used in alkaline or caustic environments.

## **2.** *USE OF MEMBRANES*

2.1 Tufchem Silicate Concrete FG overlayments should not be considered liquid tight in and of themselves. Like all concretes, there is always the potential for the development of stress and structural cracks. These types of materials also have a measurable degree of moisture absorption. From a design perspective for the purposes of corrosion protection, this means that while the material itself is unaffected by most chemical exposures, chemicals may pass through it over time, potentially degrading the underlying substrate. The length of this time is a function of the frequency of a spill, the housekeeping in the area and the specific chemical service. In some cases, an underlying membrane should be considered. For example, a membrane may not be needed in an area subject to only occasional splash and spill conditions. Where a continuously wet environment is anticipated, an underlying membrane is suggested. The membrane is placed and then further protected by the polymer concrete overlayment.

2.2 The selection of the appropriate membrane to use under the concrete overlayment is a function of several selection criteria, including available down time to execute the overall project, required membrane cure time, specific chemical environment, the capability and familiarity with the material of the installation contractor, and cost. Consult Armor for advice on membrane selection under Tufchem Silicate Concrete FG.

2.3 In cases where a membrane is used in conjunction with an anchoring system the sealing of the membrane system must be dealt with, as anchors can sometimes be installed after the membrane. An anchor penetration through the membrane must be sealed in always-wet environments. Take care to seal around the base of each anchor where it penetrates through the membrane. Consult Armor for specific details if there are any questions in addressing anchor penetrations.

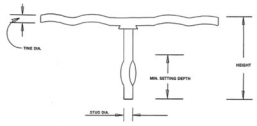
## *3. REINFORCING AND ANCHORS*

3.1 Tufchem Silicate Concrete FG can be used for structural applications in a similar manner to Portland cement concrete. Steel reinforcement must be designed, detailed and placed in accordance with the latest design and construction codes, just as one would do if the design were to use a regular concrete mix of similar physical properties. One difference is epoxy-coated rebar is usually suggested, as most applications for Tufchem Silicate Concrete FG are in corrosive environments.

3.2 It is suggested that all structural reinforcement steel be covered with a minimum 2" (50 mm) thickness of Tufchem Silicate Concrete FG. Generally, the minimum application thickness of Tufchem Silicate Concrete FG is 1.5" (40 mm). For lesser thickness requirements consult Armor for optional suggestions.

3.3 When used as an overlay, reinforcement should be considered. A square welded wire mesh of suitable alloy for the chemical service and with 2” x 2” centers may be used. It is important that the mesh not be stepped on during the concrete overlay installation and end up at the bottom of the overlay.

3.4 In cases where it may be advantageous to utilize anchor system in place of mesh, a long horn anchor such as Anchors Unlimited CA-5 series should be considered. Generally, these anchors are placed at 12” c/c and must be of a height to have a minimum of 1” (25 mm) coverage of the silicate concrete above the highest anchor point. Stress points and changes of direction may require tighter anchor spacing. Anchors should be fabricated from stainless steel alloy.



3.5 For castings on vertical surfaces, attention must be taken to insure the overlayment is stable. Depending on the height of the vertical rise, this could also mean the incorporation of a similar mechanical anchoring system.

## *4. SURFACE PREPARATION*

4.1 Consult SSPC-SP 13/NACE No. 6 for recommended surface preparation procedures before application of any underlying membranes.

4.2 Not all exposures where Tufchem Silicate Concrete FG is being considered for casting on flat floors will require a membrane. In these cases where a membrane is deemed as not necessary, concrete surfaces against which material is to be cast shall be clean, sound, hard and of a roughened profile. To enhance the mechanical bond, the concrete surface should also be roughened as outlined in SSPC-SP 13/NACE No. 6.

## *5. FORMWORK*

5.1 Form work shall be adequately designed and reinforced to withstand 140 pounds per cubic ft (2.2 gm/cm$^3$) wet density castable concrete.

5.2 Forms must be sealed to prevent leakage of any liquid from the mix, and they shall be coated with a non-reactive form release agent. Release agents such as form oil, grease or plastic-lined formwork are acceptable release agents.

5.3 Metal form ties shall be cut off flush with the casting surface after forms are removed.

## *6. MIXING AND APPLICATION*

6.1 The latest published Armor Data Sheet for Tufchem Silicate Concrete FG (CE-252) shall be also consulted and followed.

6.2 Tufchem Silicate Concrete FG is not a hydraulic cement (Portland Cement, calcium aluminate cement) based concrete, and thus certain aspects of its installation must be duly followed as noted herein. Temperatures of 70°F to 85°F are ideal for placing Tufchem Silicate Concrete FG. Temperatures below 50°F (10°C) begin to significantly retard the setting time and rate of strength development. Installation below 50°F/10°C is not recommended.

6.3 Paddle type mortar mixers capable of mixing a minimum of 5-7 cubic ft. (0.15-0.2 cu. m) of a 140 pound per cubic ft (2,243 kg/m3 ) wet density product shall be used for the mixing of the concrete.

6.4 Sufficient mixing capacity shall be available (backup mixer on site is recommended) to allow continuous placement of mixed Tufchem Silicate Concrete FG.

6.5 Mixers shall be clean and dry at their time of use. Any dried remnants of hydraulic cement-based concrete or mortar mixes which are attached to the mixing drum or mixing paddles shall be removed or neutralized before charging the mixer with the Tufchem Silicate Concrete FG components to prevent any contamination of the polymer concrete's hardening system.

6.6 Do not begin to mix or place Tufchem Silicate Concrete FG if precipitation is expected, unless a shelter is constructed to protect the mixing and casting operations to prevent contamination of the mix.

6.7 Tufchem Silicate Concrete FG is not exothermic and can be mixed in large volume mixers, including ready mix concrete trucks, subject to its work life and set time properties. The ideal ready-mix truck will have separate compartments for each concrete component - sand, cement, etc. and a separate compartment for the water, although conventional trucks have also been used. Consult Armor for specific equipment details for large pours.

6.8 Standard concrete pumping equipment will suitably pump Tufchem Silicate Concrete FG. The recommended hose diameter when pumping is 3-4" (75-100 mm).

6.9 All equipment used for handling, mixing, pumping, conveying and finishing the Tufchem Silicate Concrete FG must be clean, dry and free of any remnants of hydraulic cement-based products or other contaminants.

6.10 Hoses, mixing equipment, and pumping equipment are to be first wetted with either water or Tufchem Silicate Solution before being contacted with the specialty concrete components. After wetting the surfaces of the mixer, pump and hoses, any excess liquid shall be drained/discarded from the equipment.

6.11 The mix ratio of filler:solution shall be between 5.5 to 6.5 parts filler:1.0 part of solution by weight depending on the degree of slump required. The slump of the wet mix as measured using a standard slump cone will range between 4" and 6" (100 to 150 mm).

6.12 Tufchem Silicate Solution shall be added first to the mixer followed by the addition of the Tufchem Silicate Concrete FG Powder. The combination of Solution and Powder shall be mixed until a uniform fully wetted out mix is achieved. Typically, a mixing time of 2 minutes after the addition of the last bag of Powder will result in a satisfactory mix. A very practical field test to determine a good approximate mix ratio is the "wet-ball-in-hand" test. If a baseball-sized (75 mm dia) handful of mixed concrete can be tossed by hand upwards 2-3" (50-75 mm) without falling apart, the mix is suitable, and not too dry.

6.13 Never add sand, pea gravel or other aggregates to Tufchem Silicate Concrete FG under any circumstances. Do not add water or any other liquid additives to Tufchem Silicate Concrete FG.

6.14 Pencil vibrators can be used and will aid in the proper placement of the wet concrete mix. They shall be held either against the formwork, against the steel reinforcing, or used in the concrete itself. Do not vibrate to excess to cause separation of the liquid component. With the measured slump of the mix being between 3" and 6", (75-150 mm) this action will be enough for proper placement of the concrete.

6.15 Finishing of the surface of Tufchem Silicate Concrete FG shall be undertaken with a wood float and/or a steel trowel. Do not over-finish, creating a skin on the placed material. Tufchem Silicate Concrete FG is an industrial material and cannot be trowelled glass smooth. If the placement of the Tufchem Silicate Concrete FG is disrupted or stopped at the end of the work shift, the surface against which new material is to be placed when the operation resumes shall be left as a roughened finish edge so that resumed placement of the product will wet the interface and provide good mechanical bond. Consult Armor for further suggested construction joint details, but in general treat these details as if the pour was being made using Portland cement concrete-based mixes.

6.16 Tufchem Silicate Concrete FG does not cure like concrete. There is no "fat" or cement paste in the material, and hence it does not respond to attempts to float cement paste to the top to work back and forth and tightly close the surface. Generally, place the Tufchem Silicate Concrete FG, follow by a single wood float finish and/or a light steel trowel finish, and leave it. Tufchem Silicate Concrete FG develops surface skin within 20 minutes to a few hours after placement depending upon temperature and will appear to cure from the top down. Once this skin has formed, do not disturb it. Material has passed the point where further finishing can be achieved.

6.17 Tufchem Silicate Concrete FG shall be protected for a minimum of 24 hours while curing at 70°F (21°C). Do not apply curing compounds, burlap or water for curing. Lower temperatures (do not install below 10°C) of the wet concrete mix or its components, application temperature, ambient air temperatures, or curing temperatures will significantly retard the setting time and rate of strength development.

6.18 It is recommended that the Tufchem Silicate Solution and Tufchem Silicate Concrete FG Powder be brought to a minimum temperature of 50°F (10°C) at time of mixing. Ambient air temperature at time of mixing and placement and immediate to the location of material casting shall be a minimum of 50°F (10°C). The minimum curing temperature of the placed castable shall be 70°F (21°C). Curing temperatures should not exceed 100°F (38°C).

6.19 Formwork may be removed when compressive strengths of at least 1500 psi (10 MPa) have been achieved. Test cubes made in accordance with ASTM 579 at time of gunning to serve as controls.

6.20 If the surface of placed Tufchem Silicate Concrete FG is exposed to hot direct sunlight, small bubbles of silicate may appear at the surface. Shading or covering from the sun will minimize this phenomenon.

6.21 CURE TIME: The amount of required cure time is dependent upon a variety of factors including the temperature of components during mixing and placing, substrate temperature, ambient air temperature during cure, anticipated loading, traffic and exposure conditions. Consult the applicable technical data sheet for guidelines. If not sure, consult Armor to discuss specifics.

## *7. STAINLESS STEEL FIBER ADDITION*

7.1 Steel fibers have been shown to enhance the abrasion resistance of Tufchem Silicate Concrete FG in very special applications such as coke wharf docks. Consult Armor for further details as to the use of steel fibers.

## *8. SURFACE TREATMENT*

8.1 It is important that the first chemical exposure of cured Tufchem Silicate Concrete FG be acidic in nature, whether from general industrial processes or acidic solution splash and spill events. If the initial exposure is alkaline rather than acidic or is water, the surface of Tufchem Silicate Concrete FG may be affected and show

an etching, exposing the aggregate matrix. Conditions to avoid prior to acidic exposure include general water exposure from plant cleanup or washdown procedures and exposure to rain or run-off onto the newly installed Tufchem Silicate Concrete FG. This surface etching does not affect the structural integrity of the Tufchem Silicate Concrete FG, but rather is a surface appearance issue. Application of surface treatment outlined below is offered to eliminate or minimize this effect.

8.2 The optional surface treatment can proceed as early as the installed Tufchem Silicate Concrete FG has cured enough to accept foot traffic. This time will vary depending on environmental conditions. It is acceptable to wait up to 24 hours to apply the surface treatment, if there is no possibility of the Tufchem Silicate Concrete FG being exposed to water from any source.

8.3 This surface treatment procedure involves diluting muriatic acid and spraying the solution onto a Tufchem Silicate Concrete FG substrate. Observe all precautions associated with handling muriatic acid and use all appropriate personal protection equipment.

8.4 Acid dilution presents many hazards and should only be done by a knowledgeable and competent person who fully understands all the hazards involved and is trained in the proper techniques of this operation.

8.5 Use appropriate safety equipment when handling acid. Appropriate safety gear includes, but is not limited to, rubber gloves, rubber boots, goggles and face shields. Consult muriatic acid SDS for full caution advisements and recommendations.

8.6 Treatment Materials:
- Muriatic Acid, available from hardware or pool supply stores, typically 31 % concentration.
- Plastic five-gallon pail for preparing acid mixture
- Plastic handheld garden sprayer for applying diluted acid
- Clean/potable water for acid dilution
- Wooden or plastic stirring stick

8.7 Use all applicable personal protection equipment as specified in the muriatic acid container label and SDS. Prepare this acid mixture in a safe, well-ventilated area, away from other workers or equipment that may be affected by acid or mixture exposure or contact.

8.8 <u>ALWAYS add ACID to WATER</u>. Never add water to acid. This order of addition can create dangerous heat generation and splashing of the mixture out of the mixing container.

8.9 1) Add three (3) quarts of water to a clean five-gallon plastic pail.
2) Slowly add one (1) quart of muriatic acid to the water, gently stirring as the acid is being added
3) Some heat will be generated while making this dilution. Allow the temperature to stabilize before transferring it to the plastic sprayer/application equipment.

8.10 Adjust the pattern to a wide fine spray.

8.11 Apply just enough of the acid mixture to the Tufchem Silicate Concrete FG surface to wet the surface. Do NOT over-apply the mixture to create puddles or standing pools of acid.

8.12 After applying the acid mixture, keep the area protected from water exposure until the surface has completely dried. Allowing 16 - 24 hours before water exposure will insure that the surface treatment has had time to achieve the full conditioning effects.

## *9. QUALITY ASSURANCE*

9.1 The mix ratio of filler: solution should be between 5. 5 and 6.5 parts filler: 1.0-part solution. Within this range of allowable mix ratios, the slump of the wet mix as measured using a standard slump cone will range between 4" and 6". Where sections to be cast are heavily reinforced, placement will be enhanced with mixes exhibiting slump values of 5”-6" (125-150 mm). Too dry a mix will result in voids in the concrete. Too wet a mix will result in lower strengths.

9.2 For determining compressive strength, cubes or cylinders can be used. 2 sets of specimens per set shall be prepared for every 4 cubic yards (3 cu. m) to be installed. Test cubes shall be prepared in accordance with ASTM C579.

9.3 If the mixed Tufchem Silicate Concrete FG is placed by pumping techniques, the molds shall be filled at the hose discharge and externally vibrated as they are being filled. The filled mold shall be screeded flush with the top of the mold. The molds shall be suitably coded to identify placement location, time, date, and ambient temperature.

9.4 If the mixed Tufchem Silicate Concrete FG is placed by casting techniques the molds shall be filled at the point of placement. The molds shall be filled in thirds and externally vibrated at each filling. The filled mold shall be screeded flush with the top of the mold. The molds shall be suitably coded to identify placement, time, date, ambient temperature.

9.5 The prepared test specimens shall be cured at the same temperatures as the field installed product.

9.6 When the castings are cured at 70°F (21°C) temperature, formwork may be removed when the test specimens exhibit compressive strength results of at least 1500 psi (10 MPa) when tested in accordance with ASTM C579.

9.7 Test specimens shall be used if necessary for compressive strength gain determination. The curing temperature and ambient air temperatures during the curing period shall be reported.

9.8 After twenty-eight (28) days of curing time, final specimens from each set shall be crushed at ambient temperature to determine the ultimate compressive strength. The curing temperatures and ambient air temperatures shall be reported.

## *10. EXPANSION JOINTS AND CURING STRESSES*

10.1 Large flat pours of Tufchem Silicate Concrete FG toppings require joints to accommodate curing stresses as well as thermal stresses while in service.

10.2 Experience has also shown the possibility for development of cracks at the intersection of a flat floor slab and a pump base or pad. Try to avoid 90 degree turns or angles. If possible, a rounded or angle-sided base will develop less stress during cure, and sharp corners should be round-ground. Additional reinforcing at the corner should also be considered. In general, it is advisable to bond fresh concrete “panel to panel” against a previously poured panel-to-panel to minimize the number of expansion joints. Panels should be poured against each other within 24 hours.

## *11. EQUIPMENT CLEANING*

11.1 Mixing equipment and tools may be cleaned by scraping off all excess material and scrubbing with a scouring pad and soapy water and then rinsing with cool water. Use water for cleaning tools, mixing equipment and paddles, wheel barrels, shovels, conveyors, etc. For cleaning the mixer, the placement of pea gravel stone or other rounded aggregate into the mixer with water will help clean the surfaces of the mixer.

## *12. SAFETY PRECAUTIONS DISCLAIMER CONTACT INFORMATIOM*

12.1 Consult current Safety Data Sheets before commencement of work.

12.2 Mixes and applications of this product present a number of hazards. Read and follow the hazard information, precautions and first aid directions on the individual product labels and safety data sheets before using. While all statements, technical information, and recommendations contained herein are based on information our company believes to be reliable, nothing contained herein shall constitute any warranty, express or implied, with respect to the products and/or services described herein and any such warranties are expressly disclaimed. We recommend that the prospective purchaser or user independently determine the suitability of our product(s) for their intended use. No statement, information or recommendation with respect to our products, whether contained herein or otherwise communicated, shall be legally binding upon us unless expressly set forth in a written agreement between us and the purchaser/user. For all Terms and Conditions of Sale see armor-inc.com.

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