



PROJECT: IS-216 – Queens – Boiler Pit & Coal Storage Room
Leak Repair and Waterproofing Membrane

Objective: To propose and gain approval for the grouting techniques and waterproofing barrier criteria required to stop the leakage through the boiler pit slab and coal storage floor and walls at school IS 216 Queens located at 64-20 175th Street, New York.

Requirements of the Grout Material:

- penetrate as extensively as possible
- displace any water present
- gel or otherwise consolidate to cease and/or divert flow
- harden to form a strong solid waterproofing barrier that remains in place for the life of the repair
- maintain hydrophilic characteristics - reversible swelling process
- remain flexible in the grouted medium while providing an active seal
- durable (no aging)

Requirements of Grout Performance:

The properties of the selected grout material that relate specifically to their ease of application within the confines of the site conditions, penetrability (i.e., viscosity), strength, and gel time control.

The division between working time and set (gel) time are based on values that will be calculated through jobsite demonstration, laboratory testing, and physical test results by hand-mixing prepared samples at predetermined mixing ratios.

“*Gel time control*” is the degree to which the gel time can be set in advance by properly proportioning the ingredients (e.g., by adding accelerators or retarders (water) to the grout mix). Gel time is important as it defines (together with the pumping rate and pressure) how far the grout will travel into medium (i.e., behind the wall and under the slab).

Selection of the Proper Grout and Grouting Techniques:

To create a waterproofing barrier which acts as a swelling membrane behind the walls and under the slab. The BBZ Certified Applicator is to utilize a rehabilitation technique which consists of injection through the concrete slab and behind the walls with the use of a low viscosity, acrylate-ester resin injection grouts called, Duro Soil and Inject 2000.

Selection of the Proper Grout(s) and Grouting Techniques: (Cont'd)

These materials are specially formulated resins designed specifically to seal soil covered areas, fill cracks and voids and to create swelling membranes. Due to their low viscosity and low resistance to flow, a homogenous gel membrane is created at the concrete and soil interface void areas.

Also, in the case of dynamic vibrations inherent to the structure, the consistency of the waterproofing barrier will be guaranteed by the swelling and re-swelling characteristics of the material.

Duroseal Inject 2000

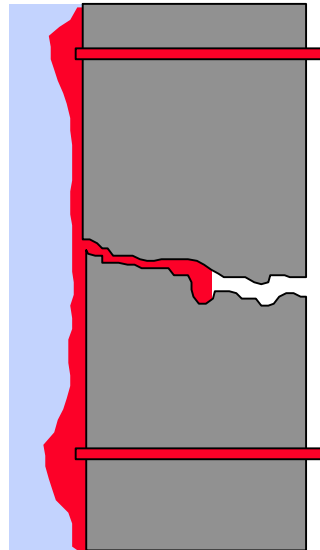
Application:

- Sealing of the entire defective areas against water pressure, moisture and non-active cracks
- Packer injections of systematically set drillings

Duro Soil

Application:

- Soil stabilization and impermeable waterproofing Barrier for below grade civil engineering projects
- Mixing ratio
 - 1:02 for high compressive strengths
 - 1:1 for sealing and filling voids



Duro Soil's excellent water displacing properties come into play when injecting the material into water-bearing soil or stone formations. The hydrophilicity of Duro Soil means that the material can incorporate water that has not been displaced into its polymer matrix. This is what differentiates Duro Soil from other hydrophobic properties, such as epoxy. The incorporation of water is a physical process and guarantees that the structure of the solidified material is homogeneous. The formation of voids and/or honeycombs resulting from trapped water which effect the structure of the material is eliminated. Unlike polyurethane products, there is no chemical reaction with water, therefore, there is no formation of gaseous reaction or by-products resulting from uncontrollable build up of pressure. The user during the entire injection process can control Duro Soil's reaction and pressure, therefore, "self-injection" never occurs.

Duro Soil's slight swelling capabilities (up to 10%) provides an additional benefit. Disturbances, which occur in the injected area, can be brought under control by the swelling at the edges. Duro Soil only swells in the layers which come into contact with water; water is not transported within the material.

Duroseal Inject 2000 is a solvent-free, water-soluble injection gel for use with two-component injection pumps.

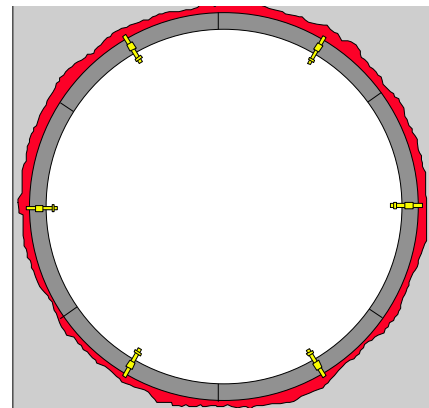


It is used for the injection and sealing of joints and cracks in concrete and stone against pressing and non-pressing water using an injection packer. Due to its low viscosity and therefore low flow resistance **Duroseal Inject 2000** is able to penetrate into the smallest of hairline cracks and capillaries, sealing them reliably and permanently. **Duroseal Inject 2000** is perfect for sealing surfaces, for example, as an injection application between structural concrete and soil in defective areas.

Even if the injected structure subsides or the dimensions change, the seal created by the **Duroseal Inject 2000** remains in tact, because the material is able to swell up to a factor of 2 (double its volume) on contact with water. The swelling is reversible, meaning that the self-healing properties remain even after dry periods. The swelling and re-swelling is solely dependant on the availability of water or liquid. In a wet or damp environment a state of equilibrium is set up between the water content of the surrounding medium and that of the **Duroseal Inject 2000**. Due to the moisture in the concrete, the material remains in a swollen state.

Duroseal Inject 2000 as a result of its hydrophilic components, is able to respond even to damp surfaces (as opposed to other products, such as, polyurethane resins. Because **Duroseal Inject 2000** does not chemically react with water, a foam layer which would reduce adhesion is not produced. **Duroseal Inject 2000** has Standard 61 NSF approval for drinking water use.

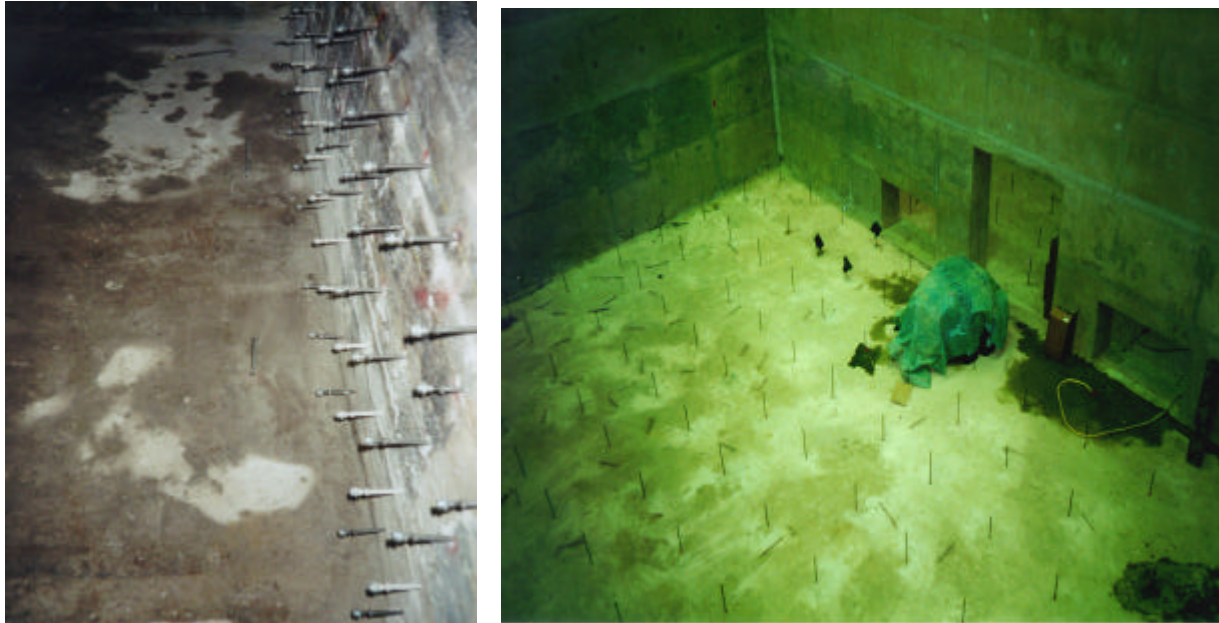
This material has been successfully utilized in creating swelling membranes as shown below:



Grouts:

Provide a pumpable two-component hydrogel acrylate-ester resin capable of infinite number of wet-dry cycles used for the stabilization of rock and fine soils and for the creation of a solid waterproofing membrane between the soil and concrete interface. Material shall be free of solvents, environmentally safe, with a viscosity of 0.5 cPs to 5 cPs and reaction time capabilities of 1.5 to 20 minutes.

Application Steps – Injection Procedures :

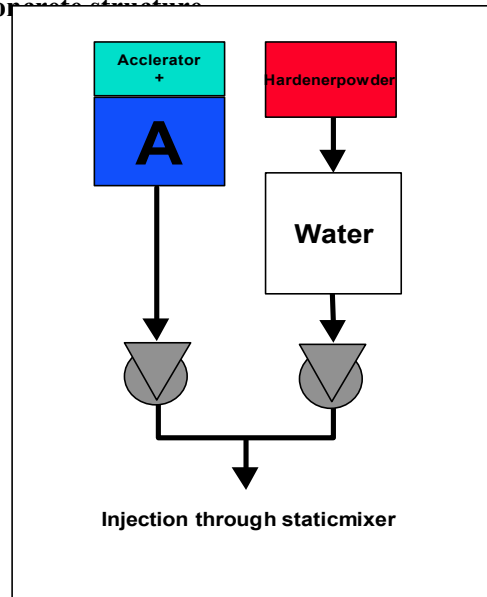


- The drilling pattern is based on a scheme of injection port holes. Jobsite conditions, placement of steel rebar and other variables dictate spacing of injection port holes along with constructability issues and safe access around equipment and piping.
- Injection port holes shall be drilled with 14mm or approx. 5/8" inch diameter drill bits to accommodate injection port diameters.. All holes will be protected following drilling and filled with a rapid cement after the injection process has been completed.
- Prior to injecting any material all open joints shall be closed with mortar or rapid cement in order to ensure that injection material does not flow out of the structure during the initial injection process.
- The injection material shall be Duro Soil, acrylate-ester resin at the vertical walls and Duroseal Inject 2000, acrylate-ester resin on the base which will create the waterproofing barrier behind the walls and under the slab.
- The Certified Applicator will furnish all labor, equipment and materials necessary to inject Duro Soil behind the vertical foundation walls and beneath the horizontal basement slabs in the Boiler Pit and Coal Storage Room per NYC SCA Sketch included hereto.

- Injection pressures shall be kept as low as possible to allow material to thoroughly permeate the void space between the soil and the concrete structure.
- Mixing Duro Soil and Duroseal Inject 2000 requires the same process and the use of a two component pump with a static mixing head for injection.

MIXING PROCEDURE:

- Put accelerator into Component A and Dissolve completely
- Dissolve hardener powder into equal parts of water – volume determined by grout dispenser unit on pump – equal parts of A&B
- Inject material with 2 component pump having Stainless steel parts on the Component B side



DUROSEAL INJECT 2000



Properties:

Highly reactive hydrogel
 (2.5 to 5 minutes) injection resin
 active (swelling factor 2.0)
 hydrophilic resin
 variable acceleration
 low viscosity (< 3 cPs)
 clean up with soap and water
 no solvents – NSF Approved
 2 component technique

DURO SOIL



Properties:

Highly reactive hydrogel
 (1 to 20 minutes) injection resin
 active (slightly swellable ~10%)
 degree of stabilization is adjustable
 “acceleration” adjustable
 low viscosity (0.5 to 5 cPs)
 clean up with soap and water
 no solvents, environmentally safe
 2 component technique

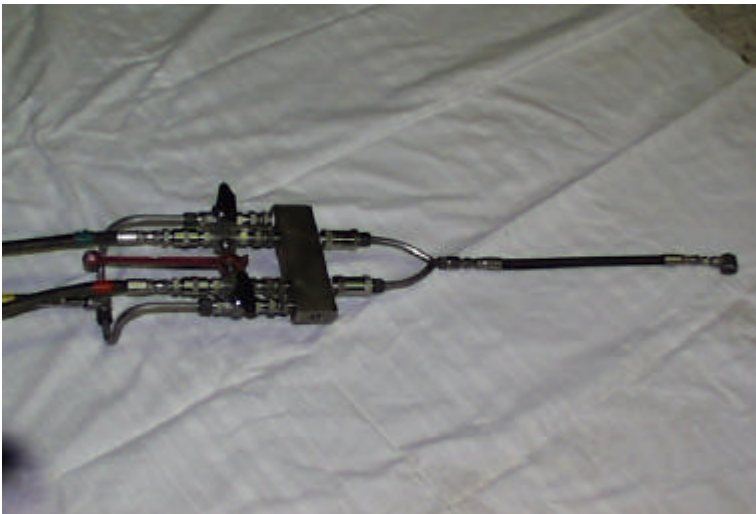
EQUIPMENT - TWO COMPONENT INJECTION PUMP:

Two component injection pumps are utilized to inject highly reactive grout materials. Materials that have reaction times within the range of seconds now become possible to work with. Duro Soil and Duroseal Inject 2000 are typical materials that are injected with the use of a two-component pump. Injecting highly reactive materials with a two-component pump is the only suitable technique to seal a crack with hydrostatic pressure.

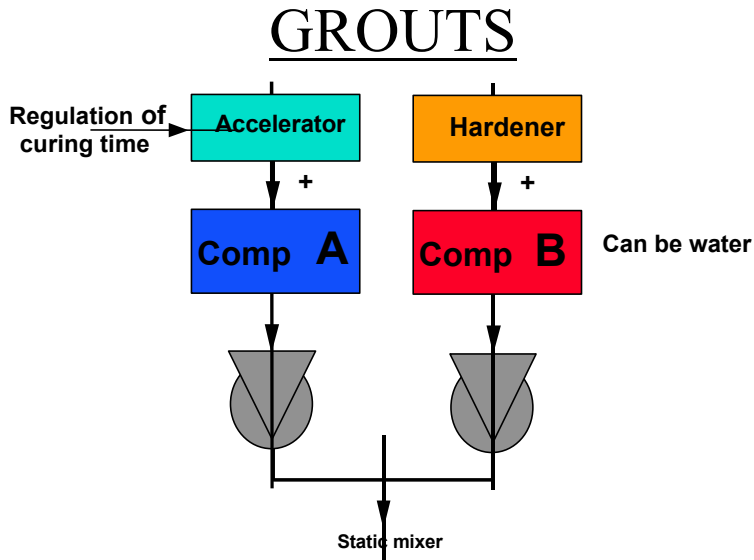
Another benefit of two-component pumps is the probability to constantly inject large quantities of grout over a long period of time.



Two component pumps eliminate the need of pre-mixing material. The material is mixed in the “head” by the static mixer prior to injection into the injection packer. The cleaning of the static mixer will run automatically when injection is stopped, therefore, making it possible to inject resins and gels with very short reaction (cure) times.



TECHNOLOGY OF TWO- COMPONENT INJECTION



Applications for two component materials would be sealing of the entire defective areas of the structure against water pressure, moisture (dampness/weeping) at active and non-active cracks. Packer injection of systematically set drillings to permanently seal medium-to-high water pressure.

Filling of large cracks and voids utilizing a method of systematic drilling with distances calculated in accordance with actual test performances and materials mixing with ratios that reflect actual test results for cured material.

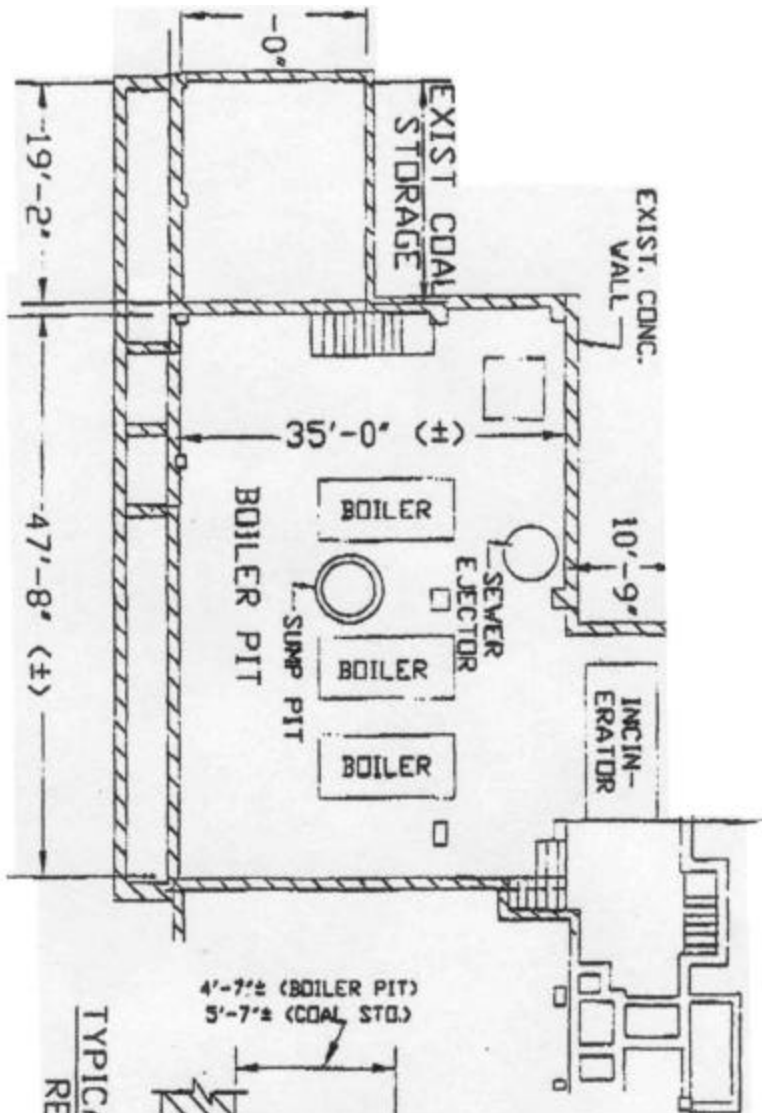
BUDGET COST ESTIMATE:

The following estimate is based on creating a waterproofing membrane beneath the floor and behind the walls in the basement at IS-216 – Queens assuming a square footage of 50' X 50' sq.ft. floor area (2,500sq.ft.), a perimeter of 200' x 6'ft. high (1,200 sq.ft.), an adjacent floor area of 20' x 20' ft. (400 sq.ft.), and a wall area of 80' x 6'ft. high (480 sq.ft.).

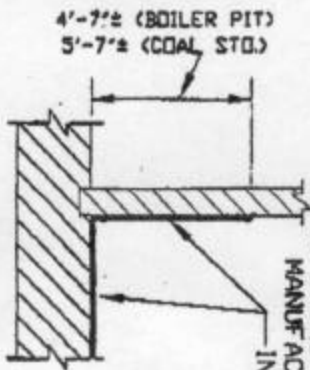
This would give an aggregate total of 4,580 square feet.

A preliminary budget estimate based on \$75.00 per square foot including all labor, equipment and materials would be: \$343,500.00 or approximately \$350,000.00 as a budget.

Depending on access, quality of the concrete, and the preparation work required, our experience with the injection of waterproof membranes on similar structures in the New York Area has fallen within a budget cost factor of approximately \$40.00/sq.ft. to \$100/sq.ft. of completed membrane with a five (5) year guarantee.



TYPICAL WATER-PROOF
REPAIR DETAIL



EXIST. CRACKED 1' HYDRO
WATERPROOFING. SCRAPE
& CLEAN RUSTY REBAR,
APPLY BOND AND FILL
CONCRETE FLUSHED
TO ADJOINING SURFACE
AT 2' WALL (3' X 6' X 9')
& 1' FLOOR (6' X 2'-3' SQ.)
TEST PROVES. APPLY WATER-
PROOF REPAIR WORK AS PER
SPECIFICATION AND
MANUFACTURER'S
INSTRUCTION.

BOILER PIT AND COAL STORAGE PLAN