

PERSULF

Catalyzed Persulfate



Application Instructions

PersulfOx Quick Reference Table

The following table is a quick reference guidance providing only the most relevant information. Please review the entire document carefully, plus the product Safety Data Sheet prior to any application. Please contact REGENESIS Technical Support if you need any further assistance.

Viable application methods	Direct push In wells In excavation
Compatible materials	Persulfate based compounds are corrosive. Carefully review the compatibility of PersulfOx with application equipment, injection locations and below ground infrastructure Examples of compatible materials: stainless steel, PVC, polyethylene Examples of non-compatible materials: aluminium, carbon steel, iron
Number of injection campaigns	Typically, multiple campaigns are required Typical distance between campaigns: 1 to 2 months Campaign structure to be discussed with REGENESIS
Typical dilution factor	15% (exact dilution to be discussed with REGENESIS) 15 kg of PersulfOx powder in 85 litres of water
Mixing activities	Add PersulfOx powder to tank <u>already</u> filled with water Mix carefully to dissolve completely Maintain mixing throughout injection process
Recommended injection pump	Diaphragm pump
Recommended Injection pressure	Low to average pressure injection. Typically 1-5 bar Adjust pressure using pressure regulator Take note of pressure and flow rate for each step
Direct push injection	Retractable screen tip recommended; pressure activated tip as an alternative Typical injection steps every 30 cm More info on direct push applications
In well application	Pressure injection; DO NOT gravity feed Use single or double packer Flush well with clean water after application Slight reduction in well efficiency to be expected, due to residual solids More info on well applications
Excavation application	Mix with water before application Place at the bottom of excavation Mix carefully with soil at the bottom using excavator, to enhance contact
Other recommendations	Always wash and flush equipment with clean water Seal injection direct push points after injection Do not operate P&T or other activities likely to disturb groundwater in surrounding area during and after injection
Recommended monitoring	Typically, monthly monitoring after last injection campaign. Monitoring period typically 3 to 6 months Monitoring between injection campaigns recommended Parameters: contaminants of concern. Supporting evidence: O ₂ , redox, pH, electrical conductivity, eventual daughter products

Application Instructions

Subsurface application of PersulfOx® via pressure injection is commonly performed using either direct push technology (DPT) or wells. PersulfOx is a single-part, sodium persulfate – based in situ chemical oxidant with built-in activation. It is a dry white powder that ships as a 5.1 Class Oxidizer in 25kg bags. An SDS is provided with each shipment, which should be studied carefully by the user to ensure the PersulfOx is handled and stored appropriately.

Prior to application any sub-surface utilities in or near the treatment must be identified and an assessment made as to the suitability of applying PersulfOx.

It is assumed that the user is appropriately trained and competent and will have completed a comprehensive site-specific health, safety & environmental risk assessment for the works they intend to carry out. This should include a thorough review of the required personal protective equipment and its proper use.

Pre-Application Process

Prior to PersulfOx application, REGENESIS recommends completing a pre-application test injection using clean water. This procedure is useful to determine the quantity of liquid the target zone is able to accept and will provide valuable flow rate and pressure information. REGENESIS recommends the injection test volume of water is in the range of 15-20% greater than the single-point design volume e.g. if the design specifies a PersulfOx volume of 1,000L per point then the water test injection should aim for 1,150 – 1,200L.

Injection Solution Mixing Procedures

Before application, the PersulfOx (usually provided in 25kg bags) is mixed with water to create an injectable solution. PersulfOx can be mixed into solution with water ranging from 5% to 20% PersulfOx. For most applications REGENESIS suggests a 15-20% solution.

Solution to be prepared (%)	Amount of PersulfOx (kg)	Amount of mix water (L)	Approximate final volume (L)
5	25	475	500
10	25	225	250
15	25	142	167
20	25	100	125

If the product is supplied in a different packaging size, the same mixing proportion still needs to be maintained, as per the table above.

The PersulfOx solution should be mixed in appropriately sized tanks that match the project's requirements. Ideally the tank should be conical or flat bottomed to ensure thorough mixing and no settlement of undissolved solids. PersulfOx solution is corrosive acidic therefore, the tanks, mixing equipment, pumps, hoses and all associated connections should be made of chemically resistant materials such as stainless steel, PVC, polyethylene. Materials such as aluminium, carbon steel, iron should not be used for PersulfOx applications.

We recommend slow addition of dry PersulfOx powder to water and mixing using appropriately sized equipment to ensure complete mixing throughout the vessel. REGENESIS would not recommend reliance on recirculation to mix the PersulfOx, although this method can aid the mixing process.

PersulfOx mixes readily into water when batched at the recommended solution ranges. Once mixed, PersulfOx will dissolve and remain in solution; though, as with all chemical mixtures, we recommend that the PersulfOx solution be checked periodically throughout the workday. The PersulfOx solution will typically have a cloudy white appearance that is associated with the formation of a small amount of flocculent (<1%). This flocculent is associated with minerals present in most mix waters. Once a mixing tank has been emptied it is recommended to use clean water to flush/clean out the tank to ensure there is no build-up of undissolved solids over time. This will also help to flush out the injection pump and hoses. REGENESIS would also advise that all equipment is flushed through with clean water at the end of each working day and on completion of the injection works.



Fig. 1 Petrofix in mixing tank. Equipment used is made of chemically resistant materials.

Direct Push Application

The injection rods should be advanced to the target depth and the PersulfOx injected, while note is taken of the flow rate and pressure. Once the requisite volume has been applied, clean water should be used to flush through the pump, hoses and injection tip to ensure all PersulfOx has been displaced into the target formation.

Once the point has been completed the injection hole should be properly grouted/sealed upon completion of the injection activities. The purpose of this effort is to seal off any potential pathways to the surface which may allow “day lighting” of injected PersulfOx and/or groundwater.

Whenever possible, the application should be performed by systematically working from the outside to the centre of the injection array to minimise displacement of contamination from the target area.

Well Application

REGENESIS recommends that injection wells should generally be constructed using ≥ 50 mm diameter HDPE, with a slot size in the range of 1-0.5mm. Where possible, the well seal should consist of a minimum of 300-600mm of bentonite pellets, sealed with cement to the surface. Prior to injection of any remedial reagent, REGENESIS recommends that the injection wells be purged of fine-grained particles present in the well bore to the extent practicable.

After each PersulfOx injection event, each injection well should be flushed with clean water. The volume of the clean flush should be equivalent to approximately 2-3 borehole volumes. When wells are used for PersulfOx injection, the injection wells and nearby groundwater monitoring wells should be either tightly capped or alternatively equipped with a pressure gauge and relief valve. This will reduce potential for short circuiting to the surface.

Whenever possible, the application should be performed by systematically working from the outside to the centre of the injection array to minimise displacement of contamination from the target area.