



# Application Instructions



## PetroFix Remediation Fluid

PetroFix<sup>™</sup> comprises a high-concentration water-based suspension of micron-scale activated carbon and biostimulating Electron Acceptor Blend (EAB). Once appropriately diluted, PetroFix can be mixed in soils, within excavations, or injected into the subsurface via direct push drilling or fixed wells.

PetroFix Safety Data Sheets will be supplied with all delivered products. These should be read and understood prior to PetroFix handling. 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.

## Pre-Application Guidance

PetroFix is usually shipped in **181.4kg (155L)** drums, the EAB is supplied in separate, small tubs. PetroFix is generally delivered to site on pallets via a heavy goods vehicle. Please discuss any site access restrictions with REGENESIS, so an appropriately-sized delivery vehicle is used.

Prior to PetroFix application via direct push or wells, REGENESIS recommends completing a pre-application test injection across the target horizon, 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 PetroFix volume of 500L per point then the water test injection should aim for 575–600L.



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## Mixing Instructions

The PetroFix concentrate should be thoroughly mixed within the delivered container prior to dilution. If supplied in drums, we would recommend using a hand-held paddle mixer to mix the product. Please note the EAB should only be added once the product has been diluted with water, and should not be added directly to the PetroFix concentrate. Ensure the mixer makes contact with the bottom of the container to adequately disturb any settled product, particularly in cold conditions.

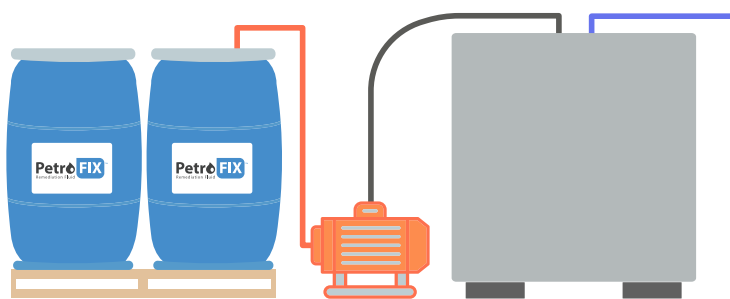
The required quantity of PetroFix, the dilution ratio and dose per point will be specified by REGENESIS at the design stage. The PetroFix should be mixed in an appropriately sized tank, preferably conical or flat bottomed to aid mixing. Mixing can be achieved using a high flow pump via recirculation or mechanically using a paddle mixer.

First, the required volume of water should be added to the mixing tank. Engage the mixing mechanism prior to adding the PetroFix concentrate. PetroFix concentrate is a relatively thick mixture (1500-3500cP) and a drum pump or similar capable of transferring thick substances should therefore be used. Once the required quantity of PetroFix has been added to and mixed with the water in the mixing tank, the EAB should be added to the diluted PetroFix at ratio of one EAB container to one container of PetroFix concentrate. Ensure the liquid is mixed thoroughly so the EAB dissolves fully.

A diaphragm pump, capable of producing a flow rate in the range of 10-40L/minute and 2-6 bar pressure would be suitable for application of PetroFix.



Homogenization of PetroFix using a hand-held paddle mixer



The image shows an example of PetroFix transfer and mixing setup



## Direct Push Application

PetroFix only requires one application per injection location, and therefore direct push is generally the preferred application option (assuming suitable geological conditions) due to lower project costs. REGENESIS would recommend use of retractable screened tips rather than pressure activated tips to facilitate ease of injection. The injection rods should be advanced to the target depth and the PetroFix injected, while note is taken of the flow rate and pressure. Once the requisite volume has been applied evenly over the target horizon, clean water should be used to flush through the pump, hoses and injection tip to ensure all PetroFix has been displaced into the target formation.

Once the point has been completed the injection hole should be sealed with bentonite or cement. The purpose of this effort is to seal off any potential pathways to the surface which may allow “daylighting” (upflow) of injected PetroFix and/or groundwater. If the PetroFix application is based on a grid design, the application should be performed by systematically working from the outside to the centre of the injection array to minimise local pressurisation of the groundwater. Where possible, a suitable distance should be maintained between consecutive injection locations to avoid overloading the formation with injected product (e.g. inject at every 3<sup>rd</sup> point in a barrier).



Direct push injection



Retractable screen tip

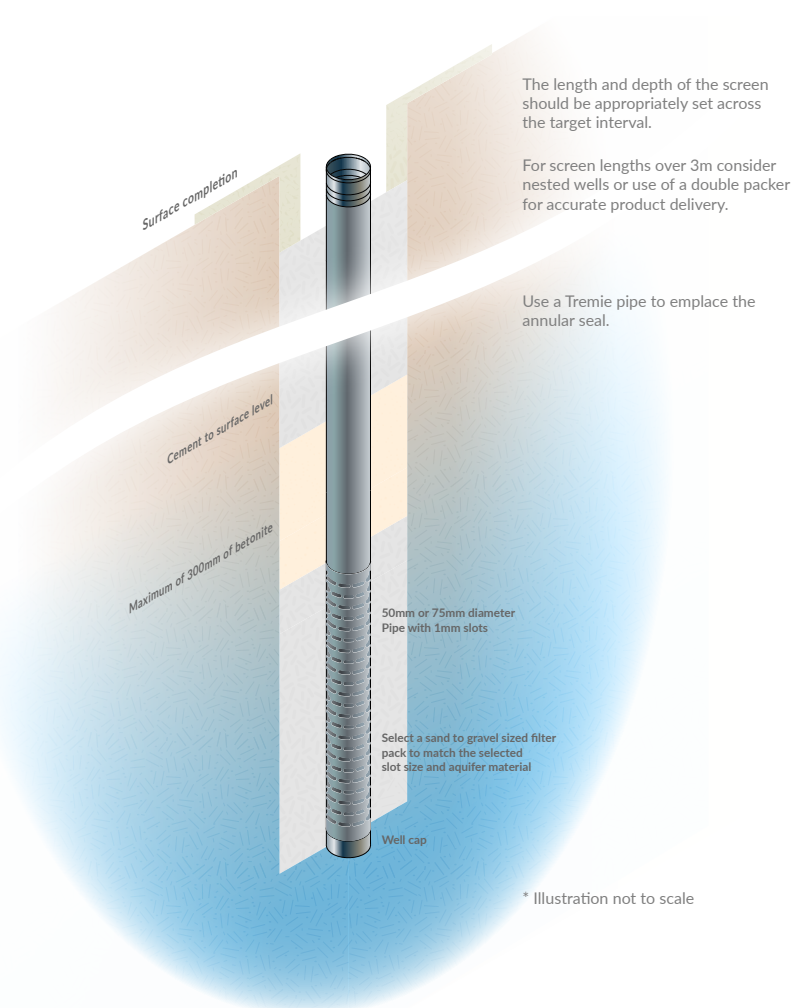
## Well Application

PetroFix can be injected via fixed injection wells where direct push is not considered practical. REGENESIS recommends that injection wells should generally be constructed using  $\geq 50\text{mm}$  diameter HDPE with a slot size in the range of 0.5-1.0 mm. Where possible, the well seal above the slotted section should consist of a maximum of 300mm of bentonite pellets, above which a sand & cement mix should be applied to seal 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.

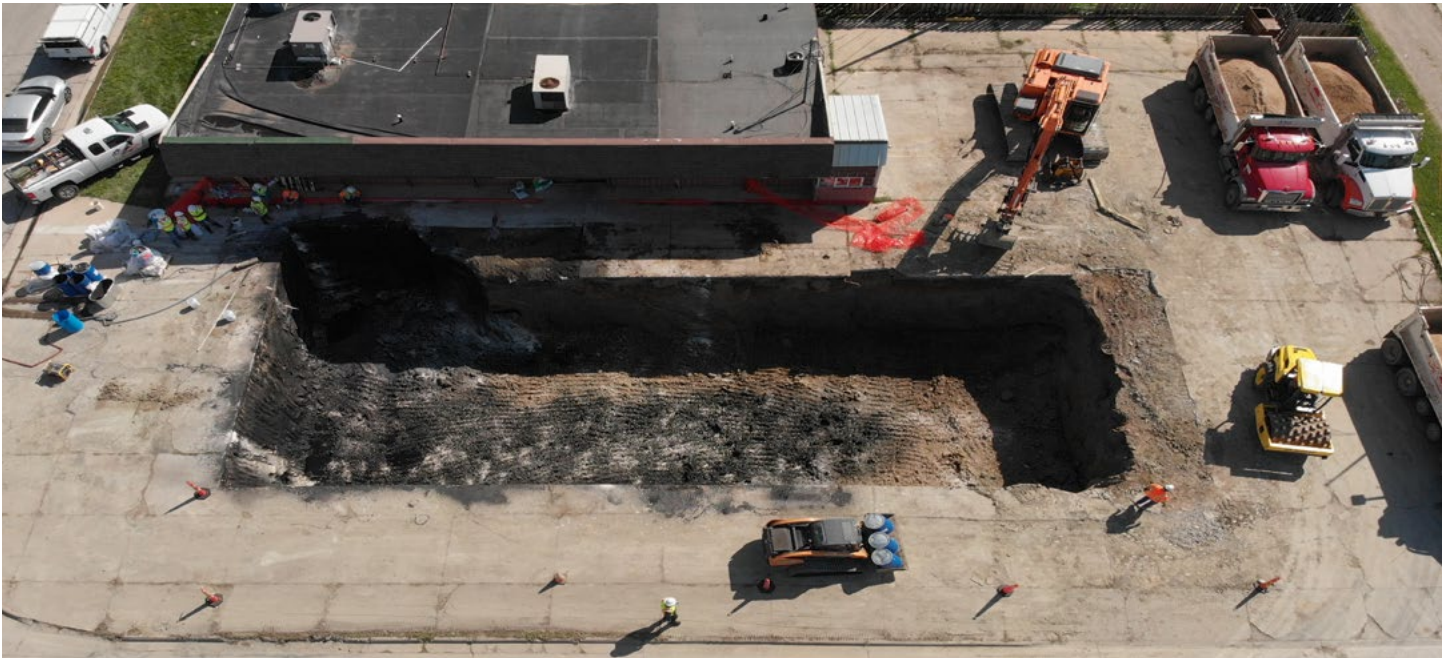
When wells are used for PetroFix injection, the injection wells and nearby groundwater monitoring wells should be either tightly capped or alternatively equipped with a pressure gauge and relief valve. This will reduce potential for short circuiting to the surface.

Once the requisite volume has been applied to the well, clean water should be used to flush through the pump, hoses and well to ensure all PetroFix has been displaced into the target formation.



Injection well construction diagram

## Excavation Application



Example of a PetroFix application in an excavation

The diluted PetroFix mixture can be applied directly to excavation sides and base using a high-volume pump. Application should be targeted at areas of the excavation where full excavation of contaminated soils was not possible or there is concern for contamination rebound. Application can be coincided with excavation backfill to achieve good PetroFix distribution on excavation sidewalls. Alternatively, PetroFix can be mixed in the base of the excavation mechanically using an excavator attachment such as a rotary tool, auger, or toothed bucket.

**Remediation products should not be applied by hand from within the excavation unless this has been specifically assessed by the user as a safe method.**

REGENESIS would advise that all equipment is flushed through with clean water at the end of each working day and on completion of the injection works.



## Radius of Influence Testing

Where PetroFix has been applied via direct push or wells, visual verification of its distribution in the subsurface can typically be completed easily onsite, due to its black colour.

Prior to the injection works commencing, take a baseline soil core covering the target injection depth. This is best done on the outer edge of the injection zone. Backfill the point with bentonite and cement so this does not become a preferential pathway to the surface during the injection works.

The baseline core is taken so subsequent confirmatory cores can be compared to this for the presence of PetroFix. This is particularly useful in areas where the soil is dark in colour or there is heavy hydrocarbon staining. Start the injection work as described above. After 2-3 points have been applied with PetroFix, take a confirmatory soil core over the target depth, halfway between two adjacent points. A black colour should be seen coating the permeable zones of the aquifer. If a black coating is observed, then you have the desired radius of influence and can continue with the injection. We would ideally recommend taking a core intermittently through the injection works to check the distribution of PetroFix.

If a black coating on a core is not observed check the following and discuss with your REGENESIS contact:

1. Did the geology in the baseline and confirmatory cores match what was expected to be found onsite?
2. The injection pressure and flow rate – is the pressure and flow steady? Does it vary with depth? Consider increasing the injection pressure.
3. Is daylighting from the point of injection (or nearby) being observed?
4. Check injection point spacing – does it match the design?
5. Check the amount of PetroFix concentrate used and the amount of dilution water – does it match the design?
6. What injection tip is being used – is it providing even distribution?
7. Has black coloured water been observed in nearby monitoring wells?



The photo on the top shows a soil core collected before a PetroFix application.

The photo below shows a soil core collected after a PetroFix application exhibiting black soil where the PetroFix was successfully distributed