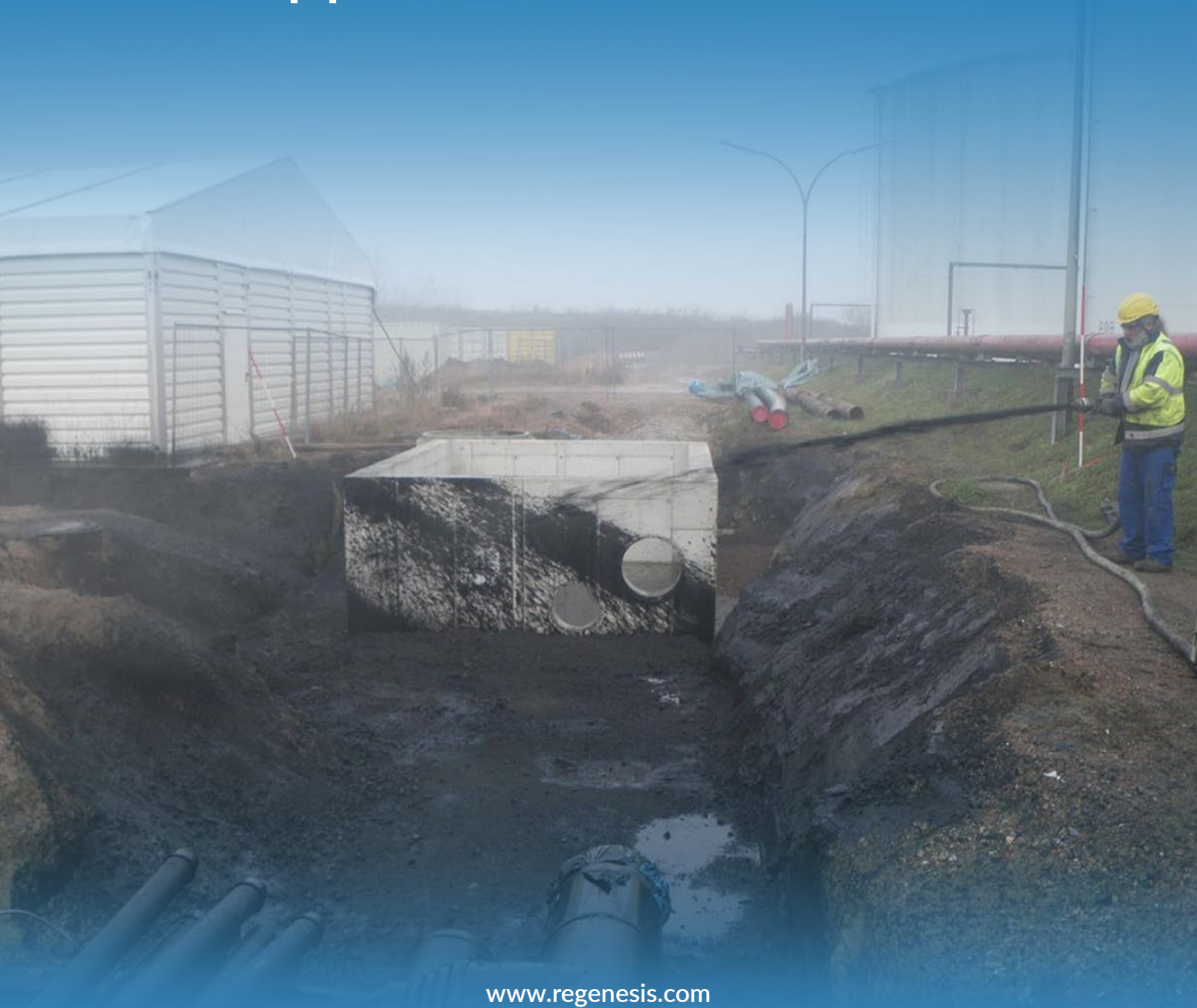




PetroFix Oil Spill Response Application Instructions



PetroFix Oil Spill Response 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.

Application methods	Into excavations, trenches, utilities corridors, backfill material, boreholes, wells. Can also be applied by direct push but this method is not detailed in this guidance
Typical dilution factor	At least 1:1 (1 kg of concentrate PetroFix in 1 litre of water). To optimise in situ distribution, consider higher dilutions when possible (up to 1:10 – 1 kg PetroFix in 10 litres of water) High dilutions for wells and boreholes applications (1:6 to 1:10)
Mixing activities	Open drum, and thoroughly mix concentrated product with a paddle-mixer or equivalent, to homogenize. Transfer concentrated product to mix-tank, <u>already</u> filled with water Pour Electron Acceptors only after complete homogenization
Spray application	Use centrifugal pump or high volume diaphragm pump Cover base and walls as needed Consider mix product with soil with an excavator if contamination is deep
Excavator application	Mixing directly in excavator bucket is possible Mix carefully with contaminated soil
Manual application	Perform only after having assessed is a safe method. Pour product into excavation Consider mix product with soil with a shovel if contamination is deep
Application in utilities corridors and backfill	Pour product into the corridor or backfill material. Adjust volume rate to avoid product surfacing
Application in wells and boreholes	Low pressure injection using inflatable packer or valved well cap. Consider gravity feed only if pressure injection is not available Flush well with clean water after application
Other recommendations	Always wash and flush all equipment used with clean water
Recommended monitoring	For groundwater, refer to PetroFix Application and Management Instructions For soils usually no monitoring is performed. Please contact REGENESIS Technical Support for more info

PetroFix Oil Spill Response application instructions

This document includes application instructions for PetroFix® as used in the most common spill response applications: inside excavations, trenches, utilities corridors, in backfill material and in boreholes or existing wells.

PetroFix can be also injected under pressure using direct push equipment, but this application method will not be described in this guidance. Please refer to the [PetroFix Application and Management Instructions](#) document for information on injection under pressure, and also for details on groundwater monitoring and monitoring wells cleaning activities, in case of execution of such activities.

PetroFix

PetroFix is a two part product:

1. a high-concentration water-based suspension of micron-scale activated carbon; and
2. Bio-stimulating Electron Acceptor Blend (EAB).

It provides a dual functioning treatment of in-situ sorption combined with enhanced biodegradation of petroleum hydrocarbons (diesel, gasoline, heating oil, etc), providing immediate and long-lasting results through one single application without need for repeated application over time.

It can manage any dissolved phase contamination in water and can be also applied in unsaturated soil or backfill material, where it provides treatment of residual contamination and inhibition of environmental risk pathways. It is not expected to be efficient on measurable quantities of free product, as the mass of contaminant would be too high to be sorbed by the activated carbon. 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. PetroFix is usually shipped in **181.4kg (155L)** drums, the EAB is supplied in separate, small 9.07 kg tubs. PetroFix is generally delivered to destination on pallets via a heavy goods vehicle. Please discuss any site access restrictions with REGENESIS, so an appropriately sized delivery vehicle is used.



Fig. 1: PetroFix 181.4 kg drums and PetroFix Electron Acceptors blend 9.07 kg tubs

Mixing instructions

PetroFix must always be diluted with water and mixed prior to application. For application into excavation, trenches and utilities corridors, consider a minimum of 1:1 dilution factor (1 kg of PetroFix concentrate in 1 Litre of water). If the logistics and conditions of the site allow, aim to increase dilution up to a maximum of 1:10 (or 1 kg of PetroFix concentrate in 10 Litres of water); a higher volume and lower viscosity solution will allow improved distribution.

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 electric 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. Please note, manual mixing is not recommended, as this will unlikely create sufficient mechanical force to adequately homogenize the product. 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, add the required volume of water 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. Transfer of concentrate PetroFix can be done also manually using tubs or any small container in case drum pump or diaphragm pump are not available. In case the product contained in the drum is not entirely used at the end of the working day or at the end of the site activities, seal tightly in the original containers and store in a safe place avoiding extreme weather conditions (especially avoid freezing and low temperatures).

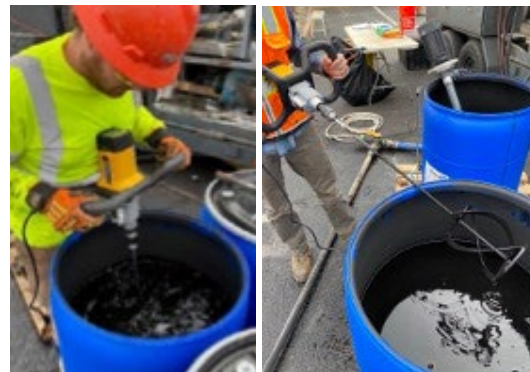


Fig. 2: Homogenization of PetroFix using a hand-held paddle mixer



Fig. 3: Drum pump for transfer of PetroFix from drum to mixing tank

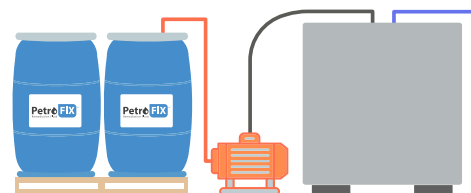


Fig. 4: Alternative system for PetroFix transfer with high volume pump and mixing setup

Application in excavation and in trenches

The diluted PetroFix mixture can be applied directly to open excavation sides and base and in trenches via different methods:

Method	Equipment	Activities	Notes
Spraying	Centrifugal pump or high-volume pump. Example: diaphragm pump producing a flow rate 10-40L/minute and pressure 2-6 bar	Spray-apply mixed solution from the mixing tank. Depending on the expected depth of the contamination, vertical distribution of the product can be enhanced after spray-application mixing the treated soil with an excavator	This method will allow for quick application and favours homogeneous distribution, and is the easiest option for vertical or sub-vertical walls. It is the method to be preferred for large size areas
Mechanically	Excavator attachment Example: rotary tool, auger, or toothed bucket	Possible to consider to mix the concentrate product with water directly inside the bucket of the excavator, instead of using a mixing tank. For big excavations, divide ideally the area in portions that will receive a known dose of product	Mix carefully the product with the soil until the depth where residual contamination is expected, in order to allow for contact
Manually	Manual equipment Example: shovel	After having poured the product, in case deep contamination is envisaged, mix it with the soil until the depth where residual contamination is expected, in order to allow for contact	Only for very limited excavation areas and after having specifically assessed that this is a safe method

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.

Backfill of excavation is possible immediately after application.

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



Fig. 5: PetroFix spray application

Application in utilities corridors and backfill material

Utilities corridors and in general backfill material of existing tanks, pipelines, manholes, etc. are usually constituted by coarse grained material and often become a preferential pathway for contamination. Being selected coarser material compared to surrounding natural soil, a PetroFix application in these areas will easily allow a preferential distribution through the material of interest.

Pour the PetroFix (already mixed with water) into the material taking care about the flow rate, in order to allow the matrix to accept the product and avoid product surfacing. Use a high-volume diaphragm pump, a centrifugal pump or gravity feed from the mixing tank.

Observe the distribution of the product through the black colouration of the backfill material. When applied in utilities corridors, opening all manholes in the vicinity is recommended, in order to observe product reaching the desired distance. If needed, block the utility corridor (using for example bentonite) where it is necessary to avoid product to exit the property boundaries.

If PetroFix is to be applied through an existing soakaway, fill out the area of the soakaway with product and let it infiltrate in the surroundings.

Application in boreholes and existing wells

PetroFix can be applied via fixed injection wells and in boreholes. It is recommended injection via pump, pressurised hose and inflatable packer or valved well caps. Pumping under low pressure (1 to 4 bars) is recommended to optimise in situ distribution.

A high dilution factor is to be considered for this type of application (consider 1:6 to 1:10 as a general guide – 1 kg of product in 6 to 10 Litres of water).

Gravity fed applications can be undertaken if pressurised injection is not possible. In this instance, it is recommended to flush with high quantities of clean water immediately after application in order to enhance product exiting the well/borehole.

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

It is to be expected that any water remaining inside the well/borehole will be black for a long time (weeks to months) after application because of colloidal activated carbon in suspension. Refer to the [PetroFix Application and Management Instructions](#) document for information on how to manage it.

Monitoring and expected results

Refer to the [PetroFix Application and Management Instructions](#) document for information on monitoring of groundwater.

A rapid reduction in dissolved phase contaminant concentrations can be expected (within a few months). It is not recommended treatment validation via soil analysis because the lab analysis is not able to differentiate between the contaminant sorbed to the activated carbon and that bound directly to the soil. Please contact REGENESIS Technical Support for more info.