



**MICROEMULSION**

# Application Instructions



## 3-D Microemulsion (3DME) 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.

<b>Viable application methods</b>	Direct push In wells
<b>Typical dilution factor</b>	1:6 (exact dilution to be discussed with REGENESIS) 1 kg of 3DME concentrate in 6 litres of water
<b>Mixing activities</b>	Homogenize concentrated product before transferring Transfer concentrated product to tank <u>already filled</u> with water
<b>Mixing activities – co-application with S-MicroZVI</b>	Use dilution factor required for 3DME First mix and homogenize 3DME with water Add S-MicroZVI to 3DME solution already formed
<b>Recommended injection pump</b>	Diaphragm pump
<b>Recommended injection pressure</b>	Low pressure injection. Typically 1-5 bar Adjust pressure using pressure regulator Take note of pressure and flow rate for each step
<b>Direct push injection</b>	Retractable screen tip recommended; pressure activated tip as an alternative Typical injection steps every 30 cm <a href="#">More info on direct push applications</a>
<b>In well application</b>	Low pressure injection; <b>DO NOT</b> gravity feed Use single or double packer Flush well with clean water after application <a href="#">More info on well applications</a>
<b>Other recommendations</b>	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
<b>Recommended monitoring</b>	Typically, monthly to quarterly monitoring. Monitoring period typically 9 months to 2/3 years Parameters: contaminants of concern. Supporting evidence: O <sub>2</sub> , redox, pH, electrical conductivity, Fe, Mn, nitrates, sulphates, eventual daughter products (Fe & Mn need to be filtered and acidified in the field)

## 3-D Microemulsion®

3-D Microemulsion® (3DME) is composed of three electron donor sources: free lactate, tetramers of lactic acid (polylactate) and fatty acids (primarily unsaturated C-18 fatty acids), providing a controlled release of electron donors (hydrogen) into the groundwater for up to 5 years.

3DME Safety Data Sheets will be supplied with all delivered products. These should be read carefully prior to 3DME 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

3DME is typically supplied in **181.4kg drums**, which are shipped 4 drums to a pallet on a heavy goods vehicle. Please discuss any site access restrictions with REGENESIS, so an appropriately sized delivery vehicle is used.

Prior to 3DME 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 will accept and will provide valuable flow rate and pressure information to inform the subsequent 3DME injection. 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 3DME volume of 1,000L per point then the water test injection should aim for 1,150L – 1,200L.

## Mixing Instructions

3DME is delivered as a factory emulsified concentrate, which 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. Ensure the mixer makes contact with the bottom of the container to adequately disturb any settled product, particularly in cold conditions.

3DME should only be applied after dilution with water - as a high volume, microemulsion. In this form it offers optimal distribution of the 3DME material throughout the target aquifer from the injection point.



This in turn will result in minimal number of injection points required overall for the project, reducing time and cost. The production of a 3DME injection-ready microemulsion generally involves the on-site, volumetric mixing of **6-parts water with 1-part 3DME concentrate** to form the injection-ready 3DME microemulsion. For example, 700L of injection-ready microemulsion would require 600L of water and 100kg<sup>1</sup> of 3DME concentrate.

As stated above, the 'standard' 3DME dilution ratio is 6:1, but dose, dilution ratio, number of injection points and method will be specified by your REGENESIS point of contact at the project design stage.

The 3DME 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. REGENESIS recommends that mixing proceed in the following order:

1. The required volume of water should be added to the mixing tank.
2. Engage the mixing mechanism prior to adding the 3DME concentrate.
3. 3DME concentrate is a relatively thick substance, particularly in low temperatures, and a drum pump or similar should therefore be used. We would not recommend adding water to the 3DME concentrate as this results in an instable mixture which is more difficult to pump.
4. As the concentrate is added to the water ensure that they are mixed together vigorously to begin with. Please note that continuous gentle mixing is required throughout injection to prevent the emulsion from separating.

Depending on the level of the mixing tank, mixed 3DME in the mixing tank may siphon back into the containers of 3DME concentrate. This can be avoided by installing lever valves on the supply hose or removing the supply hose from the mixing tank after adding 3DME.

## Co-Application with S-MicroZVI

3DME maybe mixed and applied with S-MicroZVI<sup>®</sup>, for this procedure please refer to the S-MicroZVI application instructions.

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<sup>1</sup>For mixing purposes, assume 3DME concentrate has a density of 1kg/L

## Direct Push Applications

A typical 3DME project will only require a single application. As multiple applications are not necessary, and where geological conditions are suitable, direct-push application is the preferred application method (lower costs as compared to injection well installation).

The injection rods should be advanced to the target depth and the 3DME injection-ready microemulsion applied, 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 3DME has been displaced into the 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 and in doing so reduce the risk of 3DME flowing upwards ('daylighting').

If the 3DME application is based on a grid design, the application should ideally be performed by systematically working from the outside to the centre of the injection array to minimise local mounding of groundwater. Where possible, a suitable distance should be maintained between consecutive injection locations to avoid localised overloading of the formation with injected product (e.g. inject at every 3<sup>rd</sup> point in a barrier).

## Well Applications

3DME can be injected via fixed injection wells where direct push is not considered practical. REGENESIS recommends that injection wells should generally be constructed using **≥50mm diameter HDPE**. 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 3DME 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 daylighting. Once the requisite volume has been applied evenly over the target horizon, clean water should be used to flush through the pump, hoses and well to ensure all 3DME has been displaced into the target formation. 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.