



Injection Techniques and Applications

The injection of colloidal suspensions of metallic peroxides has been used as a component in the successful remediation of dissolved phase TPH and BTEX compounds. It is most frequently used to address dissolved phase contamination in the ground water plus sorbed material in the saturated capillary fringe and smear zones. It is these latter areas that if not addressed at the same time the ground water is addressed, re-contamination of the water will continue to occur.

How Is It Applied?

When first introduced into the remediation market in the early 1990s, metallic peroxides form for use in accelerating the bio-remediation of dissolved phase petroleum compounds in ground water was in "filter socks" or it was tilled into soils. The "socks" consisted of peroxides, mixed in a ratio with a carrier matrix, encased in a fabric pouch which was wrapped in protective plastic webbing. The "socks", which measured approx. 3" x 12" for use in 4" dia. monitoring wells, with grommets on both ends, were laced together to form a chain, which was then lowered into the well. The number of "socks" used in each well depended on the length of the water column. Optimum effectiveness was obtained when the total saturated area was filled.

What was observed was that although the effect of the metallic peroxide on the ground water in the well could be measured, it was difficult to measure the effect outside of the well. The combination of ground water moving into the casing to replace the displaced volume of the peroxide when it is removed for sampling combined with the effect of purging 3 to 5 casing volumes prior to ground water sampling resulted in oxygen depleted upgradient ground water being introduced into the well. The sample results reflected this condition.

In addition, the introduction of metallic peroxides in well released either high concentrations of calcium or magnesium hydroxide, lastly unless a significant number of packed wells were installed throughout the affected area, especially upgradient of the

Another of the limitations, to date, of the ORC slurry injection process has been the expendable point and adapter that is being used by bore-hole installers. Both the adapter and expendable point used on the end of either 1" or 1.25" rods were originally designed to inject grout when backfilling a bore-hole. They were designed to inject the mixture in a vertical direction, which served the purpose well.

area of initial release, you weren't remediating the whole affected area, only the water immediately in and passing through, the original monitoring wells. A combination of barrier wells installed just downgradient of the area of initial release and at the downgradient property boundary, helped to treat and contain some of the contamination but there needed to be another method developed for delivering remedial materials throughout an affected area.

SLURRY INJECTION

A more cost-effective and efficient method for placing viscous liquids, colloidal suspensions and other remedial materials throughout an affected area of a site has evolved. A leader in this evolution has been Innovative Environmental Technologies, Inc. The slurries may be injected directly into the saturated zone, at locations predetermined to facilitate accelerated attenuation, through the use of direct-push bore-holes utilizing specialized tooling and delivery equipment.

Until recently, the pump most often used to inject the slurry has been the Geoprobe GS-1000. Although it is rated at 1000 psi, the true injection pressure in-situ has been an order of magnitude less than that in most instances. Most often, the slurry is found to escape under these pressures from around the probe point (the annular space). Thus it was necessary to install bore holes close in order to be able to affect the impacted groundwater and soils.

Recently made available to the remediation industry, designed specifically for injecting remedial liquids of various specific gravities, suspensions with high solids, oxidizers and reducing agents is Innovative Environmental Technologies, Inc. patent pending injection process. Using compressed gases and a variety of feed systems air as driving forces rather than pumps offers flexibility to the remedial contractor, pathway development in-situ and a safer cleaner and faster injection process offering prefracturing, post fracturing and high volume injections. The benefits of this increased injection flexibility are:

1. The ability to affect a much larger radius of influence per injection point,
2. The injection points can be spaced farther apart without sacrificing subsurface area coverage, hence fewer bore-holes will need to be installed to affect the same area,
3. More even distribution of the injected slurry insures pH excursions are minimized due to localized pockets of delivered materials,
4. Using our newly designed horizontal injection point, in conjunction with the injection process enables contaminated areas under previously inaccessible areas i.e.; buildings, small river or stream beds, to be accessed and treated.

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The problem with using these same tools to inject slurries materials is the inability to control the horizontal extent of slurry distribution. The engineer has to rely on the existing pathways of the geologic formation to disburse the slurry. Even in an optimum matrix, such as medium/fine grained sand, the mixture will seek preferential pathways rather than equal distribution (similar to "air channeling" that occurs in sparging systems). When you factor in the additional possibility of silt or clay lenses or an entire matrix composed of silts or clays, the problem is exacerbated.

We have designed an injection point and adapter that can be used with existing, industry standard 1" and 1.25" direct push rods that will inject the all remedial fluids and suspensions in a reliable and highly effective horizontal pattern. This distribution of the remedial solutions will be much more predictable when combined with novel and patented injection process, fewer bore-holes are necessary to completely affect treatment in all areas.