TECHNICAL BULLETIN:

Regenesis Products and how they relate to Green Remediation

According to the USEPA 's Technology Primer on Green Remediation published in April 2008, there are 6 core elements of green remediation:

1) Energy Requirements for the Treatment System of Technology
2) Air Emissions
3) Water Requirements or Impacts on Water Resources
4) Land and Ecosystem Impacts
5) Material Consumption and Waste Generation
6) Long-Term Stewardship

For an approach or remediation effort to be deemed a green remediation project it appears that it must incorporate or embrace at least one of the core elements mentioned above, however one can presume that the more core elements that are part of a project the better or "greener".

Energy Requirements of the Treatment System or Technology
Consider use of optimized passive-energy technologies (with little or no demand for external utility power) that enable all remediation objectives to be met, Look for energy efficient equipment and maintain equipment at peak performance to maximize efficiency, Periodically evaluate and optimize energy efficiency of equipment with high energy demands, and consider installing renewable energy systems to replace or offset electricity requirements otherwise met by the utility.

Regenesis products are a natural fit within this core element as their primary design is to provide for the removal of contaminants through the stimulation of natural, biological processes. Simply put, a single injection of a Regenesis product can eliminate the high costs of long-term, operations and maintenance, energy intensive systems. Close to 10 years ago, the Regenesis product Hydrogen Release Compound (HRC®) was proven, through rigorous, independent assessment, to be a highly efficient, passive-energy technology that eliminated the need for long-term consumption of electricity to facilitate the remediation process. This certification process concluded that HRC was shown to require less than 6% of the energy use utilized by pumping and treating or air sparging. In other words it was 94% more efficient relative to traditional technologies when it came to energy use. In a letter from the New Jersey Department of Environmental Protection (NJDEP), HRC was also described as having produced significant reductions in energy use on a typical site of 0.25 acres. In this specific scenario HRC was calculated to have saved between 340,000 to 660,000 kWhs of electricity over typical current proven technologies resulting in approximately 220 to 430 tons of avoided CO_2 emissions.

A similar assessment of other Regenesis technologies would yield similar results.

Air Emissions

Minimize use of heavy equipment requiring high volumes of fuel, Use cleaner fuels and retrofit diesel engines to operate heavy equipment, when possible, Reduce atmospheric release of toxic or priority pollutants (ozone, particulate matter, carbon monoxide, nitrogen dioxide, sulfur dioxide, and lead), and minimize dust export of contaminants.

The application of Regenesis products most often requires the use of portable injection equipment, such as truck mounted direct-push probes, to deliver the material into the subsurface. This equipment is considered light-duty and relative to the remediation timeline, only operates for a short duration. Once a Regenesis product is applied to the subsurface no additional fuel driven equipment is required for successful remediation to take place. An example of the air emissions efficiency provided by a Regenesis product can be illustrated by looking once again at HRC. The use of Hydrogen Release Compound (HRC®) resulted in less than 6% of the energy use required by pumping and treating or air sparging and a net reduction in CO2 emissions over these two techniques of 2 million tons and 3.5 million tons , respectively, per acre treated. HRC was also described as having produced significant reductions in energy use on a typical site of 0.25 acres. In this specific scenario HRC was calculated to have saved between 340,000 to 660,000 kWhs of electricity over typical current proven technologies resulting in approximately 220 to 430 tons of avoided CO_2 emissions.

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Water Requirements and Impacts on Water Resources

Minimize fresh water consumption and maximize water reuse during daily operations and treatment processes, Reclaim treated water for beneficial use such as irrigation, Use native vegetation requiring little or no irrigation,and prevent impacts such as nutrient loading on water quality in nearby water bodies.

Regenesis products are pusposefully designed and used to restore impacted or contaminated water resources, particularly groundwater resources. It is estimated that over the many years of their wide use that millions of gallons of contaminated groundwater have been restored.Also relative to water resources, the use of Regenesis products requires the amendment or addition of water to some of the compounds to create a slurry and/or dilute the material for ease-of-application. The water source can either be site water, which is pumped from the subsurface, then mixed with the compounds and re-injected or a potable water source. Usually the selection of the water source is made by the engineering consultant who is implementing the remediation. Relative to water resources conservation, the obvious, lowest impact choice is the use of site water, however in some cases potable water may be the only option available.

Land and Ecosystem Impacts

Use minimally invasive *in situ* technologies, use passive energy technologies such as bioremediation and phytoremediation as primary remedies or “finishing steps,” where possible and effective, Minimize soil and habitat disturbance, Minimize bioavailability of contaminants through adequate contaminant source and plume controls and reduce noise and lighting disturbance.

Regenesis products are in-situ, bioremediation or chemical oxidation technologies which by design produce minimal above-ground disturbance. Contaminant bioavailability (prior to

treatment) is typically limited to the subsurface and where the subsurface interacts with surface water measures such as permeable reactive bio-barriers can be utilized to minimize off-site migration. Noise and lighting disturbance is typically not an issue unless operations are performed at night,

Material Consumption and Waste Generation

Use technologies designed to minimize waste generation, re-use materials whenever possible, recycle materials generated at or removed from the site whenever possible, minimize natural resource extraction and disposal, and use passive sampling devices producing minimal waste, where feasible.

The use of Regenesis products does not generate any waste beyond the material packaging. Current packaging options include recyclable pails, drums and totes. The raw materials used in the manufacturing of Regenesis products are mined from the ground then systematically returned to the ground through their application in remediation.

Long-Term Stewardship Actions

Reduce emission of CO_2, N_2O, CH_4, and other greenhouse gases contributing to climate change, integrate an adaptive management approach into long-term controls for a site, install renewable energy systems to power long-term cleanup and future activities on redeveloped land, use passive sampling devices for long-term monitoring, where feasible, and solicit community involvement to increase public acceptance and awareness of long-term activities and restrictions.

The use of Regenesis products relative to long-term stewardship include the previously mentioned minimal production of greenhouse gases as a result of the in-situ, biologically driven, controlled-release technology approach. When looking at long-term remediation, Regenesis products can be deployed in a manner that requires the addition of the compounds to the subsurface once every year or in some cases once every couple of years to provide for the control of a migrating plume or cutting it off from a sensitive receptor. This process is much more efficient and environmentally acceptable than other traditional long-term remediation approaches. Additionally the use of Regenesis products can be successful in decreasing long-term remediation timelines (as in the case of monitored natural attenuation) to speed up remediation and avoid the prolonged costs associated with the monitoring process. In many cases the use of controlled-release, injectable compounds may be looked at more favorably by a community as the process is minimally invasive and does not cause any significant above-ground disturbance.

