REMEDIATING SUBSURFACE CONTAMINATION WITH ACTIVATED CARBON INJECTATES

QUESTIONS AND ANSWERS

Q. ***How does activated carbon work to remediate my site?***

A. After the activated carbon is injected into the subsurface, contaminants are concentrated and sequestered (immobilized) very tightly onto the surface of the activated carbon. Since activated carbon also provides a very hospitable environment for microorganisms to grow, any native (indigenous) microbes will populate the carbon. These microorganisms then degrade the contaminants sorbed to the activated carbon, continuously recharging it. Activated carbon provides such a favorable environment for microorganisms to grow that in other applications the activated carbon has to be impregnated with silver to prevent their growth! Of course, in the case of subsurface remediation, we want the microorganisms to grow. This process of sorption and natural degradation is a widely accepted practice generally referred to as Monitored Natural Attenuation (MNA). Injecting activated carbon simply enhances the MNA process, helping to slow the contaminant migration and provide a more favorable environment for the natural processes to work.

Q. ***Could the contaminants be released back into the aquifer over time?***

A. Activated carbon tightly binds contaminants. Desorption of the contaminants from the activated carbon is unlikely if sufficient quantities of the correct type of activated carbon are properly injected in the first place. If desorption were to occur, the contaminants would be released at such a slight rate that they would be eliminated by the native, indigenous microbes. The ability of activated carbon to tightly and permanently bind contaminants is one reason most "spent" carbon (carbon that can no longer hold additional contaminants) is routinely approved for disposal at landfills.

Q. ***Do I need to add engineered, exogenous microbes to the activated carbon before injecting?***

A. Not typically. It is generally best to rely on native microorganisms rather than introduce engineered, exogenous microorganisms. Native microorganisms have already adapted to the subsurface conditions and contaminants at the site and will typically out-compete introduced organisms. Since the native microorganisms will come to predominate the subsurface microbial population, there is no need to introduce expensive, exogenous microbes. More often than not to do so would be a waste of money. In rare cases, where the subsurface is devoid of indigenous microbes capable of degrading the contaminant of concern, the addition of engineered microbes may be necessary.

Q. ***Does it matter what activated carbon I use?***

A. Absolutely. When using activated carbon to remediate sites there are many properties of the activated carbon that must be considered. For example, microorganisms tend to grow most efficiently on carbon with large and numerous macro-pores. Sorption of the contaminants, on the other hand, may be enhanced with smaller pore sizes. The CleanInject® system manufactured by Enviro-Equipment, Inc. is optimized (calibrated) to work with a specific type and gradation of activated carbon. This optimization provides the best dust suppression during mixing and maximizes the injection rates and flow characteristics. Other carbon properties that must be considered include decisions between hydrophyllic and hydrophobic properties, suspension characteristics, types of binders, acid washed or non-acid washed, carbon source, etc. GR-320-IRC™, available through Enviro-Equipment, Inc., is activated carbon with no additives which has carefully selected properties found to work well in quickly cleaning up sites and at the same time provides the properties needed to take full advantage of CleanInject® technology.

Q. ***Is the activated carbon itself safe?***

A. Activated carbon has long been used for treating liquid and vapor-phase contaminants. Chances are the water you drink has been at least partially purified through the use of activated carbon. Activated carbon is inert and non-biodegradable and will not dissolve in its reaction with contaminants nor mobilize in most aquifers. Unlike many remediation technologies, the use of injected activated carbon does not simply transfer contaminants to another medium or location (air, landfill, etc.) Dust generated during the handling and mixing process prior to injecting can be unsafe, however, and could affect the workers installing the activated carbon or individuals in the area. The dust could also enter nearby building ventilation systems. The CleanInject® system is designed to minimize the dust generated during handling and mixing of the activated carbon when used with GR-320-IRC™.

Q. ***Do I need to do anything after the activated carbon is injected?***

A. Generally, no. Since the activated carbon attracts, concentrates and immobilizes the contaminants while the microorganisms degrade the contaminants, monitoring of the groundwater contaminant concentrations over time is generally all that's necessary. After the activated carbon is injected, the project is like any other site where Monitored Natural Attenuation (MNA) is performed. In certain cases, the injection of activated carbon can be used to enhance the performance of conventional remediation systems such as air-sparging, ChemOx, ozone, oxygen and hydrogen release materials and push-pull systems. Care should be used, however, if adding oxygen to an aquifer as the addition of oxygen can shift the geochemical equilibriums and cause fouling of the aquifer and wells.

Q. ***Does activated carbon work at all sites?***

A. No. As with any remediation program it is critical to properly evaluate the site to thoroughly identify the subsurface soil, groundwater and contaminant conditions. Any sources of free-product (non-aqueous phase liquids - NAPL) must be identified as the NAPL will continue to be a source of contamination and could overload the sorption capacity of the activated carbon or the ability of microorganisms to degrade the contaminants in a reasonable time period. It's also not always possible to properly penetrate very tight formations, making this – and most other technologies - impractical. And with even the best of sites, improper injection methods will doom any project!

Q. ***Is remediation by using activated carbon injection accepted by regulators?***

A. Activated carbon injection relies on sorption and naturally occurring biodegradation to attenuate contaminants. This is the exact same principal as Monitored Natural Attenuation (MNA) which is a widely accepted, and generally preferred, remedial option. MNA by itself doesn't work at all sites as the existing subsurface environment may not provide a favorable environment for the growth of microorganisms or the contaminant migration may not be slowed significantly by the sorption reaction of the aquifer. The injection of activated carbon helps to correct these deficiencies by slowing the movement of the contaminants, allowing for naturally occurring processes to degrade the contaminants. We've found that remediation using injected activated carbon is quickly gaining wide acceptance by regulators. It's generally faster, more cost-effective and more environmentally friendly than other current remediation technologies.

Q. ***Is activated carbon expensive?***

A. By itself, common activated carbon is the most inexpensive injectate on the market. Other injectates - carbon-based or otherwise - often rely on patented ingredients or additives that, due to their proprietary nature, may cost significantly more. Also, because activated carbon is used in so many processes throughout the world, it's readily available commercially.

Q. ***Are there other advantages to using activated carbon over other types of commercially available injectates or technologies?***

A. Many. Some of the advantages of using activated carbon include:

1. Once activated carbon is injected it remains in-place and is not subject to degradation. Most injectates work through a chemical reaction. Once the chemical reaction is finished, the injectate is useless. Activated carbon, on the other hand, works through sorption and is continually recharged by microorganisms co-located with the contaminants on the surface of the carbon.
2. Activated carbon is very effective for polishing low concentration sites or sites with residual contaminants remaining after active remediation.
3. Activated carbon can be placed easily into a smear zone and will remain in place endlessly, ready to work, waiting to sequester and degrade contaminants during subsequent groundwater elevation changes.
4. On sites where chemical oxidation has been used but found to be ineffective, a die-off of microorganisms is often observed. Activated carbon can provide an optimal environment for the remaining microorganisms to collect, regrow and repopulate.
5. Since many injectates rely on a chemical reaction to work, any surfacing of the injectate during placement can be dangerous. Activated carbon, on the other hand, is innocuous.