

**Table A-18.A. Activated carbon**

|                         |  |  |   |
|-------------------------|--|--|---|
| Technology              | Excavation/injection via drilling (direct push or permanent injection well)  |  | Activated carbon is added to excavations/trenches in granular form, or injected into the subsurface in powdered (slurry) or nano(colloidal)-scale (liquid) form. Virgin, food-grade, coal-based activated carbon is recommended for use. An adequate mass of carbon must be applied to reach goals. Direct contact with contaminants is necessary for sorption to occur, therefore (uniform) distribution of carbon to contact contaminants is necessary to maximize carbon's effects. Chemical or biological amendments may be added to carbon to enhance contaminant degradation. |
| Remediation process     | Physical mass recovery   | No   | N/A   |
|                         | Phase change   | Yes  | Dissolved contaminants sorb to carbon particles. In general, absorption capacity of carbon increases with aqueous concentration of contaminant, but preferential adsorption may interfere with targeting specific compounds (e.g. xylene may sorb at the expense of benzene).   |
|                         | In situ destruction  | Maybe  | Sorbed contaminants, in concept and in some field situations, are destroyed by subsequent biodegradation. Destruction is more likely to occur if favorable environmental conditions for biodegradation are established and maintained.  |
|                         | Stabilization/ binding   | Yes  | Sorption to carbon is reversible and not indefinite. Under certain conditions sorbed contaminants may be re-released to the aqueous phase (dynamic equilibrium).  |
| Objective applicability | LNAPL saturation   | Maybe  | The use of activated carbon to sorb/destroy LNAPL has been tested in the field, but results are not conclusive. Adding an adequate mass, and proper placement, of carbon are critical.  |
|                         |  | Example performance metrics  | LNAPL abatement   |
|                         | LNAPL composition  | Yes  | Abate moderate to low dissolved concentrations by sorption to carbon. Destruction of sorbed hydrocarbons is encouraged by the addition of oxidants, biological nutrients (biostimulation), and/or bioaugmentation during and/or after carbon application.   |
|                         |  | Example performance metrics  | Reduction in dissolved contaminant concentrations. However, care must be taken to ensure that monitoring wells, and samples from them, are not impacted by carbon particles that may negatively bias sample results.  |
| Applicable LNAPL type   | Applicability depends on the composition of the LNAPL or of the LNAPL constituents in groundwater. Larger organic molecules (e.g. PAH) may interfere with and reduce sorption of more volatile compounds (e.g., BTEX). |  |   |
| Geologic factors        | Unsaturated zone   | Activated carbon is well documented to sorb vapor-phase organics. However, installation at shallow depths may be problematic and other technologies may be better suited to address vapor-phase impacts.   |   |
|                         | Saturated zone   | Consolidation, grain size, permeability and heterogeneity effects on carbon distribution vary by the size of the carbon particles. Granular carbon generally does not move once in place in an excavation, and the particle size precludes most injection techniques. Powdered carbon (slurry) tends to filter out in permeable material, resulting in reduced travel distances (ROI) from and concentration around the injection point. Injection of carbon slurry into finer-grained (less permeable/more consolidated) material usually is done by hydraulic fracturing of the soil matrix, resulting in non-uniformly distributed veins and feathers of carbon. Colloidal-scale carbon can be introduced under low pressure and tends to follow permeable pathways in the matrix, as groundwater does. |   |