

## REMEDIAL ALTERNATIVES FOR AGRICULTURAL CONTAMINATION

<sup>1</sup>S.W. Anderson and <sup>1</sup>K.M. Yerraguntla

<sup>1</sup>Black & Veatch Corporation, 101 North Wacker Drive, Suite 1100, Chicago, IL 60606; Phone: (312)346-3775; Fax: (312)346-4781.

### Abstract

Agricultural soils contaminated with chemicals such as pesticides and fertilizers are affecting chemical quality of groundwater in many Midwestern states. A study conducted by the Wisconsin Department of Agriculture randomly investigated 27 agriculture application businesses and found 93% had pesticide-contaminated soils. At least half of the 27 sites had pesticides in the groundwater. Persistent pesticides pose a threat to the well-being of the environment and to human health. Much consideration and research needs to go into the decision-making process for an effective remediation of a particular site. This paper provides information which has been accumulated about remedial technologies for source materials, soils, and water media (surface water and groundwater) at industrial/commercial sites and explains a remedial alternatives evaluation process. Prior to application of a particular remediation technology to a site, the key first step is to develop remedial alternatives that represent a range of feasible actions at the site. The alternatives normally range from no action, where no additional action is taken to reduce the volume, mobility, or toxicity of chemicals of interest at the site, to full treatment. The alternatives are then screened in a subsequent planning step. The screening criteria include implementability of the alternative, effectiveness of the alternative, and total cost. *In situ* bioremediation, monitored natural attenuation, phytoremediation, land farming, and bioventing are promising remediation technologies for agricultural contamination. Soils should contain low moisture content and high permeability for the application of bioventing and *in situ* bioremediation technologies. Phytoremediation requires a large surface area of land and is limited to sites with lower chemical concentrations in shallow, soils. Land farming also requires a large land area for treatment and is relatively simple to design. Application of any of the above remediation technologies to agricultural contamination creates minimal disturbance to site operations, can be used to address inaccessible areas, may not require costly offgas treatment, and can be easily combined with other technologies such as installation of vertical barriers, groundwater extraction, air sparging, etc. Also, application of *in situ* bioremediation and monitored natural attenuation to the contaminated water media remediates chemicals that are absorbed onto or trapped within geological materials, produces no waste products that need to be disposed, and requires continued monitoring and maintenance. Vertical barriers are generally used to retard or restrict the flow of contaminated groundwater or to restrict the flow of clean groundwater into an impacted area. When a vertical barrier is placed upgradient of the agricultural contamination, it acts like an umbrella, keeping the groundwater from flowing through the area. When the barrier is placed downgradient of the agricultural contamination, it acts like a dam, retarding or restricting the groundwater flow. When the barrier is placed around the entire circumference of the impacted zone, it acts to isolate the chemicals from both upgradient and downgradient influences. Therefore, selection and application of a remediation technology or combination of remediation technologies to agricultural contamination will depend on the availability of the site-specific information.

**Key words:** remediation technology, natural attenuation, land farming, bioremediation