

Environmental Geotechniques – Engi 7718  
In Class Assignment – 18 May 2009  
Typical answers

- A) high pH conditions, reducing conditions and “competitive sorption”
  
- B) Iron oxides that contain arsenic exist under oxic conditions. If conditions become reducing the iron oxides are dissolved and the arsenic is released. Oxidation and reduction reactions work together. What causes the conditions to become reducing is the introduction of organic matter (in the form of dissolved organic matter, peat or organic pollutants) which when consumed by the microorganisms in the soil uses up the oxygen.
  
- C) pH, temperature, redox potential, conductivity, dissolved oxygen, contaminant concentrations and concentrations of other elements, well locations, water levels, and well elevations
  
- D) 20 ng/L detection is possible
  
- E) The results suggest that arsenic is being dissolved from the clay layer just underlying the landfill. The clay mixture (of illite and chlorite) contains the amorphous iron oxide ferrihydrite that bonds strongly with arsenic. Benzene existed as a pollutant within the landfill and leachate containing benzene migrated into the clay prior to capping. In this layer under the landfill decreasing benzene concentrations occurred with increasing arsenic concentrations. Most probably microbial reduction of the iron oxides occurred with oxidation of benzene and this released arsenic from the iron oxide. Since the process consumes oxygen and capping of the site limits oxygen replenishment, this contributes to the reducing conditions and allows them to be maintained. Other organic materials at the site are also providing energy for the redox reactions since the benzene alone cannot explain the quantities of reduced iron that were measured.
  
- F) MNA is monitored natural attenuation and it involves monitoring a contaminated site while allowing natural processes to provide remediation and it can also include capping the region of contamination to keep the site dry and limit migration of leachate. Capping a waste site may not be a good idea if organic pollutants and/or other organic materials and arsenic are present at the site. Microbial oxidation of organic pollutants consumes oxygen and can cause oxygen depletion and reducing conditions if the site is capped and oxygen flow is prevented. These conditions can release arsenic taken up by iron oxides especially. Groundwater arsenic concentrations may be increased by 50% at contaminated sites where MNA with capping is employed.