

Apex Innovation Test Development of Aerob-A-Jet¹ Aerator for Remediation of Petroleum Contaminated Sites - A Case Study

Introduction

Vacuum Bubble[®] Technology (VBT[™]) creates micro bubbles of air that are neutrally buoyant. The bubbles are created under a partial vacuum and, as a result, the internal pressure of the bubbles is lower than that of the surrounding water. Consequently, the bubbles collapse to an average dimension of 0.25 mm in diameter. Because of their small size and neutral buoyancy, the bubbles remain in the water for many minutes. These micro bubbles increase the oxygen transfer potential in the water which, in turn, enables aerobic bacteria to consume the organic waste in the water.

The Study

Apex's Iowa Division in Des Moines, Iowa has developed an oxygen delivery system to aerobically degrade, in-situ, organic compounds in groundwater systems. The device was inspired by the prohibitive costs and questionable performance of ORC that has been injected at sites to enhance biological degradation of BTEX constituents and aerobically degradable compounds. The device uses proven technology from the sewage treatment and livestock waste lagoon treatment business.

¹ In 2003 the trade name 'Aerob-A-Jet' was discontinued and replaced with Vacuum Bubble[®] Technology (VBT[™]). As this paper preceded that change, the integrity of the paper as originally written is preserved in this version.

Model 100P Aerob-A-Jet Aerator



The motor that drives the unit in this study is pneumatic (runs on compressed air) such that the unit is intrinsically safe (no electrical components). The bubbles are generated through a patented process and do not utilize the compressed air as the source of the air transferred into the saturated formation, but rather fresh atmospheric air.

The prototype system was put to the work during a pilot test at a petroleum (mostly gasoline) contaminated site in Iowa. The site is located where clay-rich glacial drift was deposited 10-15,000 years ago. The deposits have small discontinuous sand lenses. Depth to water is approximately 8-9 feet BGS. The site had undergone source excavation in May 1999 as part of a UST removal project. The excavation was backfilled with a coarse grained sand. An eight-inch diameter well was installed on the upgradient side of the excavated area, as well as several monitoring points to monitor the progress of the pilot test.

The pilot test began in June 1999 and ran for 9 weeks. Pre-test groundwater data as well as bacterial plate counts, DO, and CO₂ readings were collected. After the aeration unit was started, the groundwater system was monitored weekly (DO, CO₂ and water levels) to determine area of influence. As expected, and as an advantage over conventional sparging, no water level increases were detected from "mounding," as the aeration is not applied under pressure.

Therefore, fear of pushing contamination to undesirable areas is not a concern. A mid-test sampling and post-test sampling round was performed. The results are very promising with an area of influence reaching out 20 feet from the edge of the excavated area. In fact many of the

wells that exceeded the SSTL's established for the site (under Iowa's RBCA program) are now below the SSTL's from the pilot testing benefits. This will likely result in a reduced area requiring treatment and a substantial cost savings to the client. The results are currently being written into a Corrective Action Design Report that will be submitted to the IDNR in November 1999.

The cost of setting up a system includes a compressor (equipped with an oiler and dryer and sized for each site's application), and the number of Aerob-A-Jet units needed for the specific site. The cost of the aerator unit itself is nominal. We expect to deliver 5.5 pounds of dissolved oxygen per day per unit. Each unit requires approximately 2.0 SCFM of compressed air. We anticipate a one aerator unit system to cost about \$10-14K installed. Maintenance of the system requires a periodic cleaning of precipitates from the aerator unit with muriatic acid and maintaining the compressor as required by its manufacturer.