MAXUM'S MAGNETO-HYDRODYNAMICS (MHD) TECHNOLOGY WHITE PAPER

Maxum Resources, LLC

Maxum Resources, LLC (Maxum) is the inventor and developer for Maxum's Magneto-Hydrodynamics (MHD) remediation process. Maxum personnel have been involved in the soil and groundwater remediation business for over 27 years. Maxum's Principal Geologist has gained valuable experience during his employment with several major environmental consulting firms, including Cardno ATC, Tetra Tech EM, Inc., and Arcadis Geraghty & Miller.

The Science

The treatment system employs Maxum's MHD Reactor originally developed as a mobile onsite method for remediation of hazardous and non-hazardous soil and water pollutants at brownfields sites. Contaminants are either 1) treated in-situ with our proprietary MHD process, or 2) excavated at the site, separated, treated, and placed back into the same area or transported to a designated landfill.

The MHD system destroys contaminants by converting them into harmless carbon dioxide, water, and elemental salts. This process is a form of MHD that uses a water reactor to create charged fluids through a process that introduces lattice energy. This process causes localized temperature and pressure increases that drive numerous chemical reactions (resulting in a reduction in pollutants) that are substantially greater than other methods of remediation currently available. The process supercharges the fluids, converting the contaminants and leaving by-products of water, CO_2, and elemental salts. The MHD Reactor's power lies in the supercharged fluids and the chemical formulas that are uniquely tailored to sites based on the characteristics of the soil/groundwater matrix, contaminants, and local conditions.

Depending on the requirements of a particular site, the MHD process may be delivered by one of two methods: In-situ or Ex-situ or remediation.

In-situ remediation is offered in two forms: (1) treatment of surface soil and/or groundwater to a pre-determined depth, which can provide a 'contact-barrier' for protection against direct contact; and (2) injected by deep earth probe into the soil and/or groundwater to pre-determined depths – accomplishing complete remediation.

Ex-situ remediation is offered as a remediation option for sites requiring treatment of surface soil, or if the ex-situ technique is determined to be more feasible. Contaminated soil is excavated, separated, treated, and can be placed back in the site as clean soil – thus eliminating transportation and any future liability associated with using landfills.

Maxum's Magneto-Hydrodynamics (MHD) Treatment Process Technology

The treatment system is an in-situ or ex-situ method for remediation of pollutants. This innovative MHD method destroys contaminants by converting them into carbon dioxide and

water. Our device, referred to as the "MHD Reactor", subjects treatment fluid to a proprietary enhancement process. This enhanced water has the characteristic of a surfactant; therefore, when the enhanced water is combined with other oxidizers it acts as a carrier to penetrate a soil/groundwater matrix more effectively. The MHD treatment system is extremely effective treating contaminated groundwater, soil (including sand, silt, and clay), dredge spoils, sediment and sludge.

Maxum's Magneto-Hydrodynamics (MHD) Technology Reactor

The technology employed in the MHD Reactor has capabilities well beyond the specific application of treating soil, water, sludge, etc. The MHD technology has the ability to destroy double bond organics (such as PCE, TCE, DCE, vinyl chloride, etc.), petroleum hydrocarbons (including gasoline, diesel, jet fuel, oil, etc.), orthophosphoric pesticides, cyanide, PCB's, explosives, and dioxin. The Reactor is a device & technology that both affects the molecular structure and influences the molecular charge of organic fluids, gases and liquids. The effects include:

- Separation of dissimilar components
- Reduction or elimination of non-homogenous materials entrained or emulsified in the medium
- Greater oxidation efficiencies
- Enhanced molecular homogeneity

Chemistry of the System

Hot Spot Chemistry

MHD treatment causes localized temperature and pressure increases, which drive numerous chemical reactions. These reactions cause the water to disassociate into hydrogen atoms and hydroxyl radicals. These radicals react in a variety of ways, depending on the concentration and chemical composition of the contaminants in the water. An extensive reaction is the formation of hydrogen peroxide from the re-combination of two hydroxyl radicals. The peroxide, as well as the heat and pressure, serve to crack higher-molecular weight species to smaller fragments.

Surfactant Chemistry

In addition to forming peroxide, the hydroxyl radicals react with the hydrocarbons forming a hydrocarbon free radical. The hydrocarbon free radical can react with other hydrocarbons to form polymeric materials, forming chains terminated with a hydroxyl group. The hydrocarbon radicals can also react with dissolved oxygen forming an alkylperoxy radical. These act as surfactants, which in turn can act to liberate hydrocarbon material from solid or semi-solid matrices as well as facilitate both additional chemical reactions and separation of the solids from the liquid matrix.

Catalytic Chemistry

Locally high temperatures and pressures associated with MHD treatment also induce an electrical discharge from the metal surface of the "The Reactor". The metal radical acts as a

catalytic surface facilitating the "hydrocarbon cracking" effect of surfactants, high temperature and pressure, and hydroxylation reactions.

Propagation of Acoustical Waves

Both "hot spot" chemistry and electrical discharges will be confined to relatively small fractions of the fluid volume. The pressure waves induced by the MHD treatment, however, can propagate throughout the fluid. One result of these pressure waves will be the growth and sedimentation of particles in the fluid. The pressure waves cause sinusoidal variations in particle velocities. Driven by these time varying velocities, particle collision and agglomeration rates increase and the resulting larger particles can more effectively separate from the fluid.

Technology Validation

Numerous independent laboratories and research organizations have tested the technology. Case studies are available upon request.

Applications

The MHD technology can be cost effectively used for treatments in the following primary areas of remediation:

- In-Situ and Ex-Situ Soil Remediation
- In-Situ and Ex-Situ Groundwater Remediation
- Pit Remediation
- River / Ocean Dredge Remediation
- Sludge Dewatering and Remediation
- Water and Wastewater Treatments