

REMEDIATION SOLUTION



Metal Stabilization Technology

PROCESS DESCRIPTION

Atomisol[®] Metal stabilization and encapsulation is an alternative treatment technology for stabilizing toxic heavy metals in soils and production waste streams. The Atomisol[®] proprietary stabilization systems render high levels of lead, chromium, cadmium, arsenic and other heavy metals into non-leachable, safe forms, suitable for onsite deposition or off-site disposal in Subtitle D landfills or construction debris monofills. Atomisol[®] treatment technologies are effective in stabilizing metals in soils, sludge, ashes and sediments.

Members of certain crystalline mineral types (Atomisol[®]) exhibit the property of isomorphism, i.e., a condition present when an ion at high dilution is incorporated by mixing crystal formation into a precipitate, even though such formation would not be predicted on the basis of crystallographic and ionic radii.

The Atomisol[®] product and process initiates the formation of isomorphous minerals that are representative of the reaction-series association existing between a series of stable mineral solids with analogous chemical formulas and crystal forms. When the atoms have similar sizes and similar physical properties (e.g. specific gravity, optical properties, etc.) a stable isomorphous situation exists.

All precipitation/crystallization reactions tend to carry other constituents (ions) from the mother-solution. Actual precipitation/crystallization occurs in a succession of steps as the process seeks equilibrium. The driving force for precipitation/crystallization is coincident crystal nucleation and heat loss. Initial nucleation is characterized by expanded growth-rate, and greater opportunity for substitutions in the crystal's structure. This mechanism leads to the desired formation of co-precipitated isomorphous minerals in a reaction-series. As co-precipitation accelerates, the larger crystals grow at the expense of smaller crystals with the smaller crystals dissolving and re-precipitating within the larger crystals.

The process continues until equilibrium is reached and the mother-solution is depleted by initial nucleation, co-precipitation, and post co-precipitation. Problematic heavy metal ions are effectively rendered stable, insoluble and non-hazardous within distinct new mineral species.

These processes are cost effective, operationally straight forward and reliable.

There are more than 300 Atomisol[®] isomorphs.

APPLICATIONS

The Atomisol[®] technology is field proven and commercialized for stabilizing heavy metals including: lead, cadmium, arsenic, zinc, chromium, selenium, antimony, barium, and copper. Lab scale proof of concept work is underway on a second method to treat mercury. Sites of application include firing ranges, metal laden sediments, mining operations, primary steel manufacturing, ash from thermal destruction, foundry waste, battery plants, electro-plating wastes and military installations.

In an isomorphous mineral, certain ions or molecules will enter into the crystal-lattice of a mineral solid without causing any marked change in crystal morphology or other physical properties. For simplicity, this is accomplished by the two ions having similar but not equal radii and the same charge, with the smaller ion radii being preferentially concentrated in early formed specimens of a crystallizing mineral series. For example, a Pb ion commonly co-precipitates with a Ca ion, where Pb^{+2} substitutes for Ca^{+2} within a defined crystal lattice to form a common mineral solid. The Pb^{+2} substitution for Ca^{+2} usually occurs based on availability of the closest ion to a vacant crystal-lattice site and in the later stages of the crystallization event when available Ca^{+2} has been

ADVANTAGES

Advantages and Effectiveness: Standard stabilization techniques “encapsulate” or bind heavy metals to contaminated media by adding cement with pozzolonic materials. This approach adds to both volume and mass of the treated material, is difficult to apply, costs more, and has uncertain longevity. The Atomisol[®] approach involves converting the physical state of the leachable metallic and oxide forms to an environmentally stable mineral and other chemical forms without adding to volume or mass, and avoiding or minimizing offsite disposal costs. The technique typically results in a cost-savings of 20 to 50% over conventional techniques and treatment results are permanent.

During a site remediation, the key question is whether or not apatite or other mineral formation can be initiated synthetically, under field conditions. Fortunately, Atomisol[®] crystal synthesis at ambient conditions is simple and very rapid. Three factors are required, as follows:

1. The appropriate reagent mixture.
2. Blending - to initiate and accelerate the formation reaction.
3. Nucleation points - to focus initial formation, and then be taken up in the new mineral.

In some instances, each of these requirements were met with a single reagent. In some cases, additional reagents will improve economic and technical performance. Treatment involves distributing the required amount of reagent(s) within the contaminated media. The natural penetration characteristics of liquid/solid reagents reduce the necessity for very aggressive mixing. The reagent immediately initiates chemical reactions, which form microscopic Atomisol[®] crystals, and the Atomisol[®] crystals isomorphically substitute heavy metal contaminants within their structure, eliminating or reducing leachability drastically.

ENVIRONMENTAL BENEFITS

- Reduction in metal contaminant leachability for a broad range of heavy metals including their various forms (i.e., pure, inorganic, organo-metallic, etc.);
- Reduction in environmental risks to soil, groundwater, and ecological receptors after treatment;
- Easily applied at most commercial, industrial and/or mining sites;
- Application is both rapid and cost effective; and
- Does not negatively affect soil properties (i.e., structure and stability) after application

COSTS

Typical Atomisol® application costs will vary depending on soil type, heavy metal type and concentration, form of the heavy metal (i.e., pure, inorganic, oxide, organo-metallic, etc.), site conditions, available resources, location, and regulatory clean-up objectives. Certain specialized metal stabilization applications for, specific troublesome heavy metals, are usually priced on a case by case basis.

When compared to hazardous landfill disposal, Atomisol® applications are typically 30-50% less in cost. Larger projects may benefit from economies of scale where small volume projects typically do not.

Bench scale testing can determine optimal treatment application measures, and help achieve greater project cost control.

EFFECTIVENESS

- Very effective at stabilizing the metal contaminant and reducing the TCLP leachability by as much as 99% or more.
- Metals that the technology can treat include: lead, cadmium, arsenic, zinc, chromium, selenium, antimony, barium, copper, among others.
- Lab scale proof of concept work is underway on mercury.
- Currently evaluating potential applications for NORMs (Naturally Occurring Radioactive Materials).

LOGO



COMPANY PROFILE

Ivey International Inc. is an international award winning environmental technology company that specializes in the development and provision of innovative air, soil, sediment, water and groundwater remediation technology to environmental consultants, environmental contractors and oil and gas companies to restore impacted air, soil and water quality to applicable regulatory standards.

Technical innovations (products and processes) developed for the environment market include:

- **Atomisol**[®] Metal Encapsulation Technology;
- **Ivey-sol**[®] Surfactant Technology (103, 106, 108, and 109 formulations);
- **Ivey-sol**[®] **SER**[®] (Surfactant Enhanced Remediation) In-situ and Ex-situ Processes;
- **Ivey-sol**[®] **SEB**[®] (Surfactant Enhanced Bioremediation) In-situ and Ex-situ Processes;
- **Ivey-sol**[®] **SEC**[®] (Surfactant Enhanced Chemicalization) In-situ and Ex-situ Processes;
- **DeconIt**[®] A biodegradable decontamination product developed to eliminate cross-contamination issues at environmental sites. DeconIt can easily remove petroleum and chlorinated solvent contamination off surfaces of field measuring equipment (i.e., water level/product Meters, DO Probes, Well Loggers, etc.), field tools, pumps, hosing etc.
- **I-ROX**[®] Chemical REDOX Technology can chemically degrade petroleum and chlorinated contaminants, and can be applied during in-situ or ex-situ site remediation.

The Ivey International Inc. products and processes have established a strong international reputation for rapid site remediation and reclamation with significant cost and time savings for our project partners and clients.

Our corporate mission is to be ***“Today’s Environmental Solutions For A Better Tomorrow”***[®].

Recent National and International Awards include:

2011:

- The Roy F. Weston Award. In recognition to contributions to the field of solid waste technology and management.
- MYSTIC Environmental Excellence Award For Technology

2008:

- The 2007 Environmental Business Journal Achievement Award Bronze Medal;

2007:

- The 2006 North American Frost & Sullivan Award for Technology Innovation;
- The 2006 Environmental Business Journal Remediation Technology Merit Award; and

2006:

- The 2006 Globe Award for Environmental Innovation & Application.

For more information, please visit our website www.iveyinternational.com, call our corporate office at + 1 604 538 1168 or toll free at 1-800-246-2744.