Energy Systems Division

Wastewater Treatment and Productive Environmental Restoration

Argonne is helping industry and government agencies develop solutions for advanced wastewater treatment and sustainable environmental restoration

Advanced trace metals removal from industrial wastewater

The implementation of the U.S. "Great Lakes Initiative" is bringing water-quality based limits, in the vicinity of 1 part per trillion, for point-source discharges of mercury to surface water within the Great Lakes basin. Meeting these new limits, close to the analytical detection limit, represents a challenge because existing technologies either are not capable of removing mercury to such low levels, or require adaptation to do so, or have not been tested at these low concentrations. Importantly, obtaining quality data while testing technologies at these low concentrations requires the adoption of measures to prevent background concentrations from interfering with experimental results. Argonne National laboratory has evaluated technologies for the advanced removal of mercury, vanadium, selenium and arsenic in industrial wastewater. For this study, funded privately, after an extensive search on existing technologies at different stages of maturation, Argonne has tested the most promising technologies on a comparative basis for their ability to meet near-zero mercury discharge limits, and for the abatement of arsenic, vanadium and selenium. Comparable, transparent and quality driven results are the deliverable from this activity, as well as an assessment of implications for technology scale up and implementation.

For this testing, Argonne worked closely with technology vendors to design test protocols that, while considering vendor-preferred test conditions, provide possible implementers with a larger range of data suitable for scale up to pilot scale, or, on a technology-specific case, to full scale. Additionally, Argonne has implemented a thorough analytical program that has helped tailor treatment approaches to the specific forms and species of metals present in the wastewater.

By testing multiple technologies using horizontally harmonized test conditions to provide comparable endpoint metrics, Argonne is providing an independent technology evaluation approach that can save industry costs and time, and regulators and policy-makers an insight on the successes and challenges of removing mercury to meet the Great Lakes Initiative limits, as well as other trace elements. By operating in a Class 5 Clean Room laboratory, Argonne is providing quality data that minimize the interaction with ambient background and thus improve the understanding of the effectiveness of the technologies tested.

Clean room testing allows for clear, transparent results at trace concentrations

Degraded land resources for transitional, productive ecosystem restoration

In order to achieve environmental restoration of degraded land, a succession of plant species is necessary where the initial "colonizers" are adapted to the environmental toxin and effect the remedial action, while final, native ecosystems are later introduced as soon as the environmental conditions are conducive to their growth. Funding from both the U.S. Department of Energy and major oil companies has allowed us to work with scientists in Russia to develop expertise and field techniques for the biological treatment of oilfield contamination, both in temperate and arctic regions. This project identified a number of plants, native or acclimated to arctic regions, that have increased tolerance of oil hydrocarbons and that have the potential for increasing hydrocarbon degradation rates in soil. In a different project, Argonne, funded by the Department of Energy, is investigating a "systems approach" that combines environmental non-point source pollution control with productive land use to meet the renewable energy mandate of the Energy Independence and Security Act of 2007. In this approach, we apply bioremediation and vegetative remedial strategies (phytoremediation) to recover land resources and reclaim water for the large scale production of biofuel feedstock in marginal or environmentally challenging land. This approach is important because land and water are perhaps the most limiting resources to the sustainable production of biofuel feedstock. There is interest in combining the knowledge from these two activities to the productive remediation and restoration of land and water impacted by tar sands extraction.

There is a sizable opportunity to turn this environmental liability into an opportunity to transitionally produce biofuel crops (biodiesel and lignocellulosic feedstock) and at the same time to reduce the environmental footprint of tar sands extraction.

Russian scientists, in collaboration with Argonne, study plant systems for oil degradation in soil in the Kola Peninsula in Russia

Argonne has tested and deployed phytotechnologies for environmental restoration and remediation

Selected references

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Argonne National Laboratory is certified to ISO 9001 and ISO 14001 international standards.

The Argonne team is comprised of agronomists, environmental engineers, ecologists, chemical engineers, geologists, microbiologists, hydrogeologists and groundwater modelers, and has extensive capabilities in site characterization, technology development, experimental and process design, and field deployment of phytotechnologies.

Facilities include:

- Phytotechnology laboratory
- Pilot-scale High bay facility
- Wastewater chemistry and engineering lab in Clean room ISO-5

CONTACT> M. Cristina Negri| 630 252-9662 | negri@anl.gov| Energy Systems Division | www.anl.gov