Solving Environmental Problems with Innovative Technology: A Midwest Perspective

INNOVATION
Function: noun
Date: 15th century
1 : the introduction of something new
2 : a new idea, method, or device

great ideas for the environment... waiting to happen

U.S. EPA Region 5 Chicago, Illinois

EPA Region 5 believes innovative technologies offer great promise to improve environmental conditions at lower cost or to significantly improve the performance of currently available technologies at no additional cost. This is a snapshot – as of summer 2009 – of current technology developments and needs for both mitigation and measurement of environmental conditions. Contacts are listed for each entry to facilitate further discussion.

visit: epa.gov/region5/business/innovation/

Commercial-ready Technologies

The technologies in this section have undergone or will undergo verification by EPA's Environmental Technology Verification program. Please visit www.epa.gov/etv.

Reducing Endocrine Disruptors in Watersheds
EPA Contact: John McKernan, 513-569-7415, mckernan.john@epa.gov
Situation: Endocrine Disruptor Chemicals, or EDCs, are being discovered in many watersheds at measurable, low levels.
Need: A cost-effective method to locate EDC problem areas within watersheds – a method that provides actual biological evidence of a problem rather than just a number or concentration of EDCs – and a cost-effective method to qualitatively detect the presence of extremely low levels of EDCs in surface water, rather than measuring individual chemical concentrations.
EPA will complete verification this year of four test kits for rapid estrogen detection.

Spray Drift Technology
EPA Contact: Mike Kosusko, 919-541-2734, kosusko.mike@epa.gov and Bruce Wilkinson, 312-886-6002, wilkinson.bruce@epa.gov
Situation: Pesticide spray drift is the movement of spray droplets through the air at the time of application, or soon thereafter, from the target site to any non- or off-target site. Spray drift can expose people, domestic animals and bodies of water to pesticides. Spray drift management technologies are of interest to pesticide and other chemical manufacturers, application equipment manufacturers, pesticide applicators, government agencies and advocacy groups.
Need: Drift reduction technologies that can reduce drift downwind and reduce undesired pesticide exposures.
EPA is completing validation testing this year on a protocol for testing spray drift reduction technology. We plan to use data from these verifications to modify labeling language for pesticides applied with the tested technologies.

Trichloroethylene (TCE) and Perchloroethylene (PCE) Indoor Air Monitoring
EPA Contact: John McKernan, 513-569-7415, mckernan.john@epa.gov
Situation: TCE and PCE are chlorinated compounds commonly found as soil or ground-water contamination. Though originally liquids, they may migrate upward as vapor intrusion from the ground into buildings. Indoor air monitoring for vapor intrusion is now done with summa canisters or Tedlar bags, both of which collect an air sample that must be analyzed off-site. Another method uses EPA's Trace Atmospheric Gas Analyzer, which gives real-time indoor air readings but is so large it is contained in a special bus. Both types of indoor air vapor intrusion analysis are time-consuming and costly, and require multiple entries into a residence.
Need: A real-time, hand-held, direct-reading air monitoring device that can determine vapor intrusion in a structure, measured in parts per billion.
EPA is developing a vapor intrusion monitoring device verification with the Navy.

Real-Time Mycrocystin Measurement Tools
EPA Contact: John McKernan, 513-569-7415, mckernan.john@epa.gov
Situation: Microcystin is a toxin produced by certain types of algal bloom in fresh waters like the Great Lakes. It is toxic to birds, fish and mammals. Recreational water managers need a rapid means of detecting the toxins to warn the public that it is not safe to swim in certain areas. Current methods require sampling and lab analysis that may not produce data for several days.
Need: Real-time microcystin test kits.
EPA is conducting a microcystin verification project. Two vendors with five rapid test kits are planned for testing later this year. Reports should be available by mid 2010.

Economical, User-friendly Lead Test Kit
EPA Contact: Julius Enriquez, 513-569-7285, enriquez.julius@epa.gov
Situation: Dust is a natural result of doing abatement and renovation work, but in older homes and apartment buildings the dust can pose a potentially hazardous exposure to lead.
Need: A reliable, low-cost, user-friendly tool to accurately detect lead in samples of paint or dust, and contribute to more expeditious removal of lead-based paint hazards and the associated risks of exposure.
EPA has developed a test plan for verifying performance of lead test kits, and expects to verify from six to13 test kits this year and next. Vendor meetings have been held and applications are being received for verification.

Conversion of Liquid, Solid, and Gaseous Wastes to Commercial Products and Energy
EPA Contact: Lee Beck, 919-541-0617, beck.lee@epa.gov.
Situation: Conversion of waste to commercial products and energy offers extensive opportunities for researchers looking for profitable technologies, especially those looking for ways to create fuel from biomass and biological wastes.
Need: Cost-effective technologies that can economically convert biosolids and biomass into energy.
By mid-2010, EPA will complete a state-of-the-technology pre-verification assessment of gasification technology as it applies to converting pulp and paper mill waste and municipal solid waste to fuels and commercial products.

Open-Path Ambient Air Monitoring to Characterize Emissions from Landfills and Industrial Sources
EPA Contact: Motria Caudill, 312-886-0267, caudill.motria@epa.gov
Situation: Complex chemical reactions within landfills cause air emissions of a multitude of compounds including benzene, methane and hydrogen sulfide. The ultraviolet differential optical absorption spectrometer, or UV-DOAS, uses a projector fitted with a xenon-vapor lamp, which transmits an ultraviolet light beam to a spectrometer built within a receiver. The spectrum's absorption bands are analyzed, various gases are identified, and the concentrations of these gases are detected simultaneously. EPA has approved this method for routine sampling of sulfur dioxide, nitrogen dioxide and ozone. The agency is now working toward use of UV-DOAS to detect various air toxics at landfills and industrial sources.
Need: A portable monitor that can continuously identify and quantify gaseous pollutants in real time.
EPA has piloted UV-DOAS at multiple sites and found it practical to measure dangerous ammonia, hydrogen sulfide, carbon disulfide, benzene, formaldehyde, xylenes and toluene.

Mitigation, Treatment and Remediation Technologies

Additional Technologies to Attenuate or Prevent H2S Emissions from Landfills
EPA Contact: Paul Ruesch, 312-886-7898, ruesch.paul@epa.gov
Situation: When loads of mixed construction and demolition debris are processed for recycling, a residual product called C&D debris fines is produced. This material is often used as alternative daily cover at landfills. It often contains gypsum, which can – under certain conditions – be reduced to hydrogen sulfide gas, an irritant at low concentrations and potentially deadly at high concentrations.
Need: A technology that will allow C&D fines to be used safely as alternative daily cover, because the C&D recycling industry claims this form of recycling cannot be profitable without this market for C&D fines.

Sustainable Reuse of Great Lakes Sediments
EPA Contact: David Cowgill, 312-353-3576, cowgill.david@epa.gov
Situation: Over the next 20 years, EPA must address contaminated sediment at 75 sites in the Great Lakes. Of those, five sites with approximately 1.5 million cubic yards of sediment are expected to be cleaned up in the next three to eight years. Current technology is a mix of dredging and disposal in commercial landfills or confined disposal facilities at a cost of $20-$40 per cubic yard. Alternative technologies tend to exceed $100-200 per cubic yard.
Need: A portable system that can provide sustainable reuse of sediment at a cost below current dredge-and-disposal options. There is also a need to identify and demonstrate the large-scale effectiveness of innovative technologies for sediment dewatering, soil separation and/or sediment washing.

"Dustless" Lead Abatement and Renovation Technologies
EPA Contact: Maggie Theroux, 617-918-1613, theroux.maggie@epa.gov and David Turpin, 312-886-7836, turpin.david@epa.gov
Situation: Dust is a natural result of doing abatement and renovation work, but in older homes and apartment buildings the dust can pose a potentially hazardous exposure to lead.
Need: More efficient and cost-effective technologies for stabilizing or removing lead-based paint. These technologies would be of interest to environmental pollution abatement companies and anyone – including homeowners and do-it-yourselfers – that may disturb paint during a renovation, remodeling, repair, abatement or painting project.

Lower-cost Wastewater Treatment and Nutrient Control
EPA Contact: Peter Swenson, 312-886-0236, swenson.peter@epa.gov
Situation: As wastewater treatment facilities are pushed to achieve tighter limits on total phosphorus and total nitrogen, they are examining technologies in use in coastal states. But the 3,600 facilities in the Midwest region note that many of these technologies require a significant investment in capital and also utilize much more energy and chemicals than existing operations.
Need: Lower-cost solutions and technological solutions that utilize less energy and fewer chemicals than existing technologies.

Improved Industrial Wastewater Treatment for Mercury Control
EPA Contact: Peter Swenson, 312-886-0236, swenson.peter@epa.gov
Situation: The Great Lakes guidance established strict limitations for the control of mercury in wastewater discharges to the Great Lakes. The ability to meet water quality limits for mercury is in question. Because of this, many states are allowing for variances. A number of emerging technologies have the potential to meet more stringent standards (nanograms per liter range), but the viability, dependability and cost-effectiveness of these processes has not been tested, particularly for large industrial applications such as coal mines, coal-fired power plants, steel mills, paper mills and refineries.
Need: Efficient new technologies for improved mercury control.

Improved Bedbug Pesticides
EPA Contact: Dan Hopkins, 312-886-5994, hopkins.dan@epa.gov and Don Baumgartner, 312-886-7835, baumgartner.donald@epa.gov
Situation: Infestations of bedbugs have increased recently in numerous metropolitan areas, particularly in Ohio where bedbug infestations have been reported in hospitals, nursing homes, police stations, apartment buildings and residences. A major problem is resistance to registered pesticides, notably pyrethroid insecticides, commonly used for bedbug control. Treatment for bedbug infestations is often complicated, expensive and requires multiple visits by professional pest control specialists.
Need: New pesticide products – such as insect growth regulators – that will control bedbugs but which are not susceptible to the development of insect resistance, and are relatively less toxic to mammals.

Measurement, Monitoring and Sampling Challenges

Development of a Cost-effective Rapid Assessment Technique to Quantify Type E Botulism (Clostridium botulinium) Toxin
EPA Contact: David Cowgill, 312-353-3576, cowgill.david@epa.gov
Situation: Botulism is a neuromuscular disease caused by several different strains of the bacterium Clostridium botulinium. The bacterium is classified into seven types by characteristics of the neurotoxins that are produced. Four of these types (A, B, E and rarely F) cause human botulism, while types C, D and E cause illness in mammals, birds and fish. Type C botulism and Type E botulism are responsible for extensive waterfowl and some fish kills in North America. Type C and E botulism poisonings are elicited by the consumption of the botulinium toxin through food web interactions. Type C botulism mostly affects waterfowl and is typically restricted to marshes and wetlands in prairie regions, primarily found west of the Mississippi River. Type E botulism is more prevalent in the Great Lakes, and has also been documented in California.
Need: A cost-effective, rapid-assessment field technique to quantify the botulism toxin in various environmental media (sediments, invertebrates, macroalgae, birds, fish). This would help to understand the mechanism by which botulism is transferred through the food chain, and ultimately help state managers potentially mitigate the impacts of these outbreaks by providing an environmental monitoring tool for rapidly detecting the presence of the botulism toxin.

Wireless Sensor Technology
EPA Contact: Andrew Tschampa, 312-886-6136, tschampa.andrew@epa.gov
Situation: Significant advances in wireless sensor technology have helped create wireless field monitoring networks over wide areas. This improving technology is creating new possibilities for continuous field monitoring of environmental conditions.
Need: Wireless surface-water monitoring networks that would monitor for water quality, water chemistry and associated measurements, sediment enzymes, chlorophyll-a and fecal indicators.

Rapid in-situ Monitoring Technologies for Sediments
EPA Contact: David Cowgill, 312-353-3576, cowgill.david@epa.gov
Situation: It is very costly to survey Great Lakes Areas of Concern, located primarily at river mouths and harbors around the Great Lakes. Typically a series of sediment sampling surveys involving chemical and toxicological analyses in laboratories are performed to identify hot spots that require cleanup. Volume estimates are made based upon the data provided by sediment coring and chemical analysis.
Need: Cost-effective monitoring technologies that can quickly characterize concentrations of heavy metals and organic chemicals to help define the dimensions of an excavation or cleanup. This technology could also be used for sediment sampling after a cleanup to verify that project goals had been achieved or document ecological recovery.

Smart Sampling Technology for Water and Air
EPA Contact: Dennis Wesolowski, 312-353-9084, wesolowski.dennis@epa.gov
Situation: The Chicago Regional Laboratory did a record number of analyses in 2007. However, many of the samples analyzed show contaminant amounts less than the established reporting limit for that analysis. Depending on the monitoring objective or project objective, such information may be of little or no value.
Need: A way to take samples of water or air only if there is reasonable likelihood that the compounds of concern will be found at some detectable level. The savings in time and resources could help increase the lab's capacity to provide more useful information for many more projects.

Sampling of Porous Surfaces
EPA Contact: Dennis Wesolowski, 312-353-9084, wesolowski.dennis@epa.gov
Situation: Responding to a chemical attack on an inhabited area presents significant sampling difficulties. To assess the extent of contamination and the effectiveness of cleanup efforts, chemicals must be sampled from a variety of surfaces. Current sampling techniques work well on non-porous surfaces, but porous surfaces such as concrete, wood, fabric and carpet may allow the agent to penetrate and avoid initial detection. The porous surface may allow off-gassing of the agent for some time, which could re-contaminate the area or building, thus delaying repopulation.
Need: A device or system to extract chemical agents that may penetrate porous surfaces for analysis either in the field or the laboratory in a fast and effective manner, thus verifying that an area is safe for repopulation.

GPS Technology to Measure Stream Slope to cm Level
EPA Contact: Andrew Tschampa, 312-886-6136, tschampa.andrew@epa.gov
Situation: During field monitoring work, it is critical to obtain the slope or drop of a stream or river. All current methods rely on a form of surveying, which involves line of sight. So as a stream meanders around bends, continued measurements are necessary. This is very labor intensive. Improvements to current GPS technology would be of great value.
Need: A cost-effective GPS survey device, sensitive to the level of centimeters or less, that could be exposed to water.

Improved Bedbug Monitors
EPA Contact: Dan Hopkins, 312-886-5994, hopkins.daniel@epa.gov and Don Baumgartner, 312-886-7835, baumgartner.donald@epa.gov
Situation: Infestations of bedbugs have increased recently in numerous metropolitan areas, particularly in Ohio where bedbug infestations have been reported in hospitals, nursing homes, police stations, apartment buildings and residences.
Need: Simple, cost-effective monitoring traps that can be used to assess the presence and abundance of bedbugs, before and after control efforts.

Continuous Portable Ambient Monitoring of Hydrogen Sulfide at Landfills, Concentrated Animal Feeding Operations and Oil Facilities
EPA Contact: Marta Fuoco, 312-886-6243, fuoco.marta@epa.gov
Situation: Hydrogen sulfide is a colorless gas with a characteristic rotten-egg odor that can be detected at low levels. It occurs naturally in crude petroleum, results from the breakdown of organic matter and is produced by human and animal waste. It is also produced in certain industrial processes. Exposure at low concentrations can result in irritation, while high concentrations could result in death. Region 5 receives complaints dealing with nuisance odors and adverse health effects from people who live near facilities that emit hydrogen sulfide, mainly concentrated animal feeding operations, landfills and oil facilities.
Need: A portable continuous instrument that can be deployed in the field with minimal maintenance and calibration.