Soil-Based Use of Residuals, Wastewater & Reclaimed Water

W-2170 (2009-2014)

Reusing Waste Addresses Many Issues, but Major Obstacles Exist

Biosolids can be applied to farmland as a substitute for fertilizer. City of Geneva photo.

Aerial view of Stickney Wastewater Treatment Plant. US Army Corps of Engineers photo.

Millions of tons of municipal, agricultural, and industrial solid waste are discarded each year in the U.S. Often, these solid wastes are disposed of in landfills or incinerated, which is costly to the industries and the public. Reusing solid wastes as soil substitutes, soil additives, or fertilizers could cut disposal costs and reduce landfill volume as well as help restore disturbed land and boost crop productivity. Wastewater (degraded water, stormwater, irrigation return flow, graywater, and effluents from livestock operations) can be reused in lieu of freshwater extractions—a popular option as water shortages loom. Soil can help treat reclaimed water by absorbing some of the nutrients before they have a chance to runoff into nearby bodies of water. Still, in 2009, less than 10% of treated wastewaters were reused.

The lack of standardized regulations for reusing wastes has been a major obstacle, particularly with concerns that wastes contain potential contaminants, including excess nitrogen, phosphorous, pesticides, industrial chemicals, and trace pharmaceuticals. More research is needed to determine the persistence of these compounds after waste is applied to soil and the potential threats they pose to air, water, and soil quality, or exposed plants, livestock, wildlife, and humans. The bioavailability of potential contaminants varies with different waste processing technologies, soil types, climates, and land management practices. In order to reuse wastes safely, practical scientific knowledge is needed to determine if and how waste can be used in a cost-effective and environmentally friendly manner in certain areas.

Multistate Research & Extension Project Yields Safer Waste Reuse Policies and Practices

Multistate Research Project W-2170 has made considerable advancements in understanding how to safely and economically reuse wastes. Over the last five years, researchers conducted field experiments, greenhouse studies, and laboratory tests with different wastes in varying conditions and developed new methods and tools to help evaluate the short- and long-term effects of applying wastes to soils.

W-2170 researchers identified processes that reduce contaminants in wastes, so that they can be reused safely.

- Pre-tilling soil prior to applying liquid wastes or manure reduces runoff of many contaminants into nearby surface and groundwater.
- Adding compost and biosolids (treated sewage sludge) to soils reduces potential of transferring contaminants like lead and arsenic to humans via vegetable consumption and soil ingestion.
- A new process for composting biosolids has resulted in an odor-free product that will have greater public acceptance for urban use.

Waste reuse policies and practices can lower waste disposal costs, reduce freshwater extraction, improve soil quality, and scale back use of agrochemicals. Reusing waste allows existing industries and agriculture to be more sustainable and opens the door for new industries and jobs.

W-2170's research has made it possible to develop science-based regulations and policies for reusing wastes.

- These regulations and policies have been used by a range of stakeholders, including municipal wastewater treatment plant operators, farmers, industries in charge of site remediation, and project managers from US EPA, Natural Resources Conservation Service, the Virginia Department of Environmental Quality, and Minnesota Pollution Control Agency, among others.
- New rules for setting limits on contaminants now require bioavailability assessments, which allows safer, more accurate limits.
- Regulations and standards have made it easier for industries to get the proper permitting and safely institute reuse processes that make them more competitive and sustainable.
- A testing program for soil amendments made from industrial by-products resulted in eight new materials being recommended for labeling by the Virginia Department of Agriculture and Consumer Services in 2012. Receiving an official state label has economic and public relations benefits for industries. The testing program has also rejected products that pose risks to soil and water quality.

Increased adoption of waste reuse policies influenced by W-2170 has reduced landfill waste and saved on disposal costs.

- Annually diverting one million tons of spent foundry sand from landfills would realize annual savings of $30,000,000 by the foundry industry.
- Workshops and demonstrations promoted diversion of unusable food to animal feed or compost, thus reducing the disposal of such waste to landfills or incinerators.
- The Virginia Department of Environmental Quality accepted a new screening system developed by Virginia Tech researchers to identify reusable dredge sediments. This system is unique to the US and should lead to a major expansion of beneficial reuse of dredge sediments, which will decrease the cost of sediment management for the public taxpayer and lead to substantial income streams and improved soil productivity for receiving landowners.

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Increased adoption of waste reused as substitute fertilizers and soil amendments has improved soil quality and improved plant yields, especially in drought.

- Farming communities have successfully adopted the use of biosolids and food waste compost to alleviate soil acidity. Adding these wastes to soils to solve soil acidity problems that plague many regions in the developing world.
- Biosolids wastewater contains a lot of phosphorous—an essential nutrient for crops, and reusing it on farmland can help farmers improve phosphorous-poor soils and provide wastewater treatment plant operators with a viable option for recycling phosphorous.
- Applying biosolids to fields can increase crop yields more than synthetic fertilizers because they promote microorganisms that help protect plants against drought stress.

Reusing waste as substitute fertilizers and soil amendments has also reduced phosphorous leaching and runoff.

- Using drinking water treatment residuals (DWTR) to absorb excess phosphorous reduces leaching and runoff from agricultural land. DWTR with high iron and aluminum concentrations especially reduce the solubility of phosphorous—more than either commercial fertilizers or animal manures. Methods generated by W-2170 for applying DWTR make this promising water quality protection technology a practical option.

W-2170 developed management practices for minimizing greenhouse gas emissions when reusing wastes to amend soils.

- Long-term application—or one high application—of compost or biosolids to soils in the Mid-Atlantic region can accelerate soil carbon accumulation and increase soil carbon concentrations while also improving soil physical properties that enhance plant productivity.

W-2170 has provided options for cost-effective land reclamation through reuse of wastes.

- Use of biosolids to rehabilitate contaminated ecosystems has been included as an option for a number of EPA Superfund National Priority List sites.
- W-2170 developed gardening initiatives for brownfields that involve amending soils with wastes to reduce contaminants in the soil. This work is allowing brownfields to be turned into community gardens that produce crops without potentially adverse health effects to the grower or the consumer.
- Commonly used, inexpensive, and widely available agricultural soil tests can be used to screen lead-enriched urban soil. Rapid and affordable lead assessment will allow city planners, communities, and other groups to convert vacant land into urban farms, gardens, parks, playgrounds, and other common areas.
- Virginia's adoption of the W-2170's proposed practices for using biosolids to restore mined land has resulted in changes in mine operations and closure procedures and lower cost options for disturbed land reclamation.
- Using high amounts of biosolids and compost to reconstruct and restore prime farmland following mineral sands mining decreases the cost of mining, increases landowner royalty return, and provides optimal soil productivity for future crops with minimal risks of nitrogen leaching to groundwater.
- Using W-2170 research, Virginia Tech and Iluka Resources, Inc. successfully petitioned their state regulatory agency for a waiver of requirements to save and return topsoil on their mineral sands mines in eastern Virginia. This permit amendment will add millions of dollars to the company, landowners via royalty return, local counties via severance tax, and the state via increased corporate tax base. Iluka Resources, Inc. was awarded the National Mined Land Reclamation Award by the Interstate Mining Compact Commission, and W-2170 was credited as the underpinning source of technology.
- The first use of trading credits to pay for poultry manure transport from farm to mine reclamation site occurred in Pennsylvania as a result of W-2170's research on mine land reclamation.

W-2170 advancements have led to emerging markets, industries, and jobs.

- Spent foundry sand in Ohio can be used as a component of manufactured soils, allowing foundries to create start-up industries and jobs focused on production and marketing of spent foundry sand soil blend materials to the public.

Want to know more?

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Metropolitan Water Reclamation District of Greater Chicago
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This Impact Summary was compiled and designed by Sara Delheimer.

Research plots for the Maryland Port Administration Cox Creek dredge study will determine if dredge sediment is suitable for reuse.