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Fact Sheet

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February 2000 (CN 35)

ANAEROBIC, GRANULAR-ACTIVATED FLUIDIZED BED REACTORS FOR TREATMENT OF PROPELLANT WASTEWATERS

The Problem

A major challenge for Army propellant producers is the regulation of dinitrotoluene (DNT) at low concentrations in the outflow of wastewater treatment plants. DNT results from single- and multi-base propellant production and is transferred to the wastewater during wet-screening and water-dry operations. DNT has been included in the National Pollutant Discharge Elimination System permit for one propellant producer, regulating its discharge at 113 micrograms per liter. The current method of treatment is adsorption on activated carbon, which is expensive and is currently being conducted on an interim basis without secondary containment.

The Technology

The U.S. Army Construction Engineering Research Laboratory (CERL) has tested a combined adsorption/biodegradation treatment process. The surface of granular-activated carbon adsorbs non-polar compounds, such as DNT, and acts as a "storage place" to buffer variations in influent concentration. The surface is also an excellent attachment medium for bacteria, allowing the bacteria to thrive in a more uniform aqueous concentration of DNT. The activated carbon adsorbs DNT when the influent concentration peaks, then slowly desorbs it when the concentration drops.

The treatment uses bioreactors that are operated in an up-flow, fluidized bed mode to eliminate clogging problems. They also operate in the anaerobic mode when high strength wastewater is discharged directly from water-dry operations. Research has shown that use of anaerobic transformation is key in degrading DNT, as well as TNT, RDX and HMX.

Benefits/Savings

The development of an efficient biological process to treat high strength DNT will allow the previously mentioned wastewater treatment plant to meet new low-concentration DNT regulations. The process will maintain mission readiness, improve effluent quality, and help meet new environmental regulations.

In addition, the technology produces methane gas which could be used as fuel in place of natural gas. Although the methane requires some cleanup (removal of carbon dioxide, sulfide, and water vapor), it represents a recovery of energy.

Status

Proof of principle at a bench scale in a university setting was completed. CERL demonstrated a bioreactor benchscale at Radford Army Ammunition Plant, VA. The bioreactor successfully treated high strength wastewater directly from a water-dry operation. DNT was reduced by more than 99.9 percent, and the new low concentration limits were met directly at the pretreatment step.

This process has also been applied to wastewater from torpedo propellant production, where the target contaminant was propylene glycol dinitrate (PGDN), and to pesticide manufacturing wastewater, where the target contaminants were dichlorophenol and chloro-phenoxyacetic acid. The latter application was conducted under the Environmental Technology Initiative at Nitrokemia, Inc. in Hungary.

Further testing is ongoing under a Cooperative Research and Development Agreement. It has been applied to deicing fluids collected from the runways at Albany County Airport, NY. The target contaminant there is propylene glycol.

This process has also been tested at the bench and pilot scales for treatment of pinkwater, which contains TNT and RDX. These systems were also operated in an anaerobic mode, using ethanol as a co-substrate. A demonstration scale test is underway at McAlester Army Ammunition Plant with funding from the Environmental Security Technology Certification Program (ESTCP).

Points of Contact

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