

MENDS

Modular electrochemical nuclear decontamination system

Partnership Opportunities

Los Alamos scientists validated the core principles and engineered a demonstrated proof of concept prototype of the innovative decontamination system. Several MENDS configurations have been tested on both radioactive and non-radioactive equipment and components, and the target decontamination or surface pre-treatment has been effectively realized and demonstrated in these tests. Los Alamos National Laboratory is seeking input from potential users or interested parties regarding the development of the technology.

IP Information

Patents pending. Internal reference numbers S133812.001, S133877.001, S167619.000, S167637.000, and S133812.002.

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Overview

Researchers at Los Alamos National Laboratory (LANL) have developed a novel electrochemical decontamination technology in a self-contained, semi-autonomous system. The Modular Electrochemical Nuclear Decontamination System (MENDS) can be adapted for a myriad of uses and configurations, such as a closed loop system with bespoke suction heads for decontaminating large parts or surfaces or a recirculating bath for decontaminating small parts and equipment. MENDS is integrated with both proprietary flow cell that reactivates and recycles the circulating decontamination solution and a reservoir for containing the decontamination solution bearing the removed radioactive material. MENDS may also be used to etch metal surfaces for increased adhesion of coatings—even nanoparticle-embedded coatings. LANL is seeking input from potential users or interested parties regarding the development and use of the technology.

Advantages

The system and co-developed technologies allow for real-time, onboard monitoring of contamination as a function of substrate material removed, waste reduction, and lower radiation dose rates due to its unique design features and automation options. The liquid solution flows continuously and is recirculated rapidly through the electrochemical cell and over the contaminated surface. The surface etching provides better adhesion for coatings, including polymers and nano-materials. Versatile electrochemical flow cell

- Integral onboard measurement system
- Closed system for contaminant removal
- Vacuum-capable delivery system
- Positive pressure-capable delivery system
- Semi-automated design
- Fully autonomous system under development
- Cleaning solution can be re-used many times
- Etched surface enhances bonding for coatings
- Dissolves most oxides and alloys

Technology Description

The Los Alamos system utilizes an in-house designed electrochemical cell capable of oxidizing ions in aqueous solution at a rapid rate sufficient to provide a continuous/stable supply of the oxidizing ion; the flow of the solution is directed toward fixtures, vessel, or surfaces to achieve decontamination of metals and metal alloys. The oxidizing ion can oxidize and subsequently dissolve a variety of metals, alloys, and oxides. When used for the targeted etching of surfaces, the resulting surface is ideal for coating adhesion.

The rapid oxidation of MENDS is faster than current decontamination methods. The electrochemical system can oxidize a wide variety of oxides and alloys to render them soluble in the aqueous solution, thus removing contamination from equipment and/or surfaces quickly and completely. The reduced ion is re-oxidized in the electrochemical cell. In this way, the cleaning solution containing the oxidizing ion can be reused many times. An ultrasonic probe can be used to increase agitation and decrease cleaning time. The resulting etched surface has a higher surface area and is better suited to adhere coatings.

Market Applications

The MENDS technology can support a broad range of industries. MENDS may be sized and scaled up or down as needed for different applications—from tiny RTGs (radioisotope thermoelectric generators) to massive containment tanks and enclosures in industrial facilities (e.g., nuclear, oil, and gas). MENDS can be used for regular maintenance, decommissioning, or reuse of selected equipment. Alternative decontamination systems exist, but Los Alamos–developed MENDS is faster, more efficient, and ideal for equipment with unique geometries or difficult surfaces and spaces—reducing costs and worker exposure to radiation dose. MENDS may also support the coatings industry with methods of surface preparation that enhance adhesion on difficult-to-coat surfaces. Current developed coatings may be used to protect against corrosion, biofouling, and other wear-intensive applications.

Selected Publications

- Karmioli B, et al. Electrochemical Approach to Metal Decontamination. American Chemical Society—Southwest & Rocky Regional Meeting. 2019 November 11. El Paso, TX.
- Karmioli B, et al. Corrosion and Biofouling Solutions. DisrupTECH. 2020 October 15. Los Alamos, NM.
- Karmioli B, et al. Electrochemical Decontamination of Gloveboxes. American Glovebox Society. 2021 August 9. Santa Fe, NM.