Application of Novel Electron Beam Accelerator for Treatment of Military Contaminants

Slavica Grdanovska, PhD, & Charlie Cooper, PhD – Illinois Accelerator Research Center, Fermi National Accelerator Laboratory

E-beam Treatment Provides a Solution to Multiple Military Needs

The E-beam Process – An Established Industry Tool

- Electron beams have shown promise across a range of industrial applications from wastewater treatment to materials processing to advanced manufacturing.
- Electron beam processing can be used to either break down unwanted contaminants or to link together different materials
- The overall process is cost effective, environmentally friendly and has short processing times.

Perfluorinated Compounds

- E-beam degradation of Perfluorinated compounds is the only successful reduction method.
- PFCs are found in firefighting foam. These chemicals have seeped into the ground and waterways near military sites, and in turn contaminated ground and drinking water.
- Exposure to these chemicals is associated with a range of detrimental health effects including kidney and testicular cancer, liver damage, and decreased immunological response.

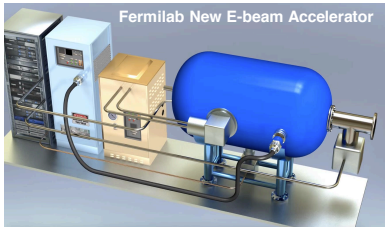
Surface Curing

- Radiation curing is a term used to describe the rapid conversion of liquids to solids by high energy electrons.
- Benefits over thermal curing include cost, improved material properties, elimination of toxic solvents and byproducts, and the ability to combine several different resin systems in the same curing cycle.
- Some examples include flight control surfaces, fairing panels, engine cowls, duct work and interior passenger and cargo compartment floor panels.

Biological & Chemical Agents

- Currently used to destroy microorganisms in postal envelopes
- Could potentially be used to destroy other biological & chemical agents like mustard gas, ricin.

Fermilab Technology Mitigates Barriers to E-beam Field Use



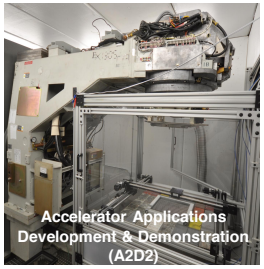
- The cost and capabilities of conventional technology largely make e-beam utilization not technically and/or economically viable.
- We have developed new accelerator technologies which hold a number of advantages over conventional technologies.

➢ **Less expensive**
  ✓ 50% more energy-efficient, 30% less operational expenses

➢ **High-throughput**
  ✓ Can treat more product, 5X more than conventional technologies

➢ **Compact & Portable**
  ✓ Decrease in size from 3-story building to 5x7x13 ft
  ✓ Integrates in existing infrastructure and can be mounted on a truck

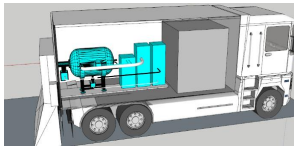
Fermilab Demonstration Facility Validates E-beam Applications



- Warfighter readiness in today's world requires a unique combination of innovative capabilities and new production approaches, all with a keen eye towards environmental management and stewardship.
- Fermilab brings 50-years of accelerator excellence to bear on modeling and testing new military applications that address these priorities through the Illinois Accelerator Research Center.

➢ **Creating New Methods to Treat Environmental Contaminants**
➢ **Establishing New Approaches to Build & Improve Materials**
➢ **Developing New Scanning & Detection Solutions for Military Threats**

Example Work: Field Deployable E-beam Tool



✓ Enhancing material properties of bitumen by means of electron beam induced polymer modification could reduce or prevent crack initiation and propagation in pavements due to various weather conditions and heavy loads.
✓ We are exploring the use of this platform technology to breakdown environmental contaminants and bio/chemical agents.

Ways to Partner with Us

Fermilab is America's particle physics and accelerator lab funded by the Department of Energy. Fermi National Accelerator Laboratory is operated by Fermi Research Alliance, LLC under Contract No. DE-AC02-07CH11359 with the United States Department of Energy.

To catalyze accelerator-based solutions to military pain points we seek:

- **Use cases for new accelerator applications**
- **Collaborators to provide sample and facility access to test novel military applications**
- **Funding partners to help build our next-generation E-beam accelerator prototype**

This manuscript has been authored by Fermi Research Alliance, LLC under Contract No. DE-AC02-07CH11359 with the U.S. Department of Energy, Office of Science, Office of High Energy Physics