R3 WORKSHOP, JUNE 5-7, 2019, CHICAGO, ILLINOIS

NATIONAL SECURITY PROGRAMS

NNOVATIONS IN ECOMMISSIONING:
OW R&D TO REDUCE D&D COSTS NHANCES URBAN RESILIENCE

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Argonne National Laboratory is a U.S. Department of Energy laboratory managed by UChicago Argonne, LLC.

Argonne NATIONAL LABORATORY

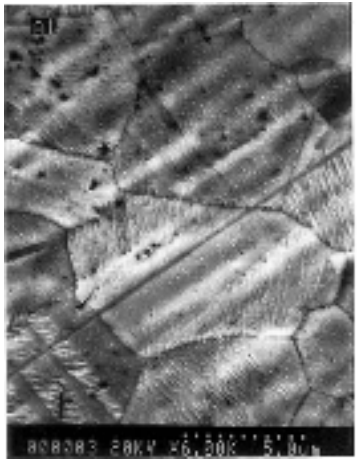
CHEMICAL DECONTAMINATION TECHNOLOGY RESEARCH AT ARGONNE

- Reviewed, tested and recommended chemical decontamination methods
  - Supported DOE-Environmental Management for nuclear decontamination operations at various DOE sites
- Developed worker-friendly chemical decontamination process for metals
- Developed hydrogel for decontaminating porous materials
- Developing wide-area decontamination for nuclear and radiological releases
- Developing methods/protocols for decontamination of NAVAIR craft

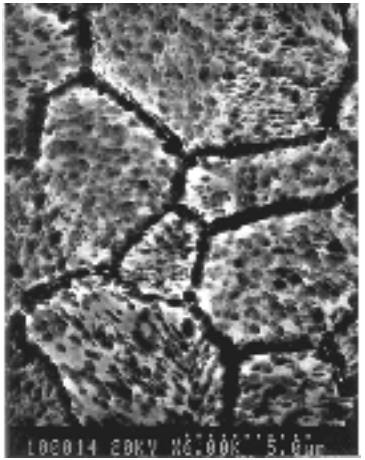
HEDPA wash, Argonne

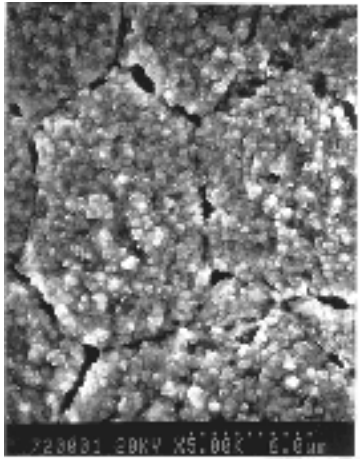
BEST METHOD DEVELOPMENT FOR DOE

- Surveyed techniques
- Developed corrosion coupon surrogates
- Tested processes for comparison
- Provided recommendations to DOE



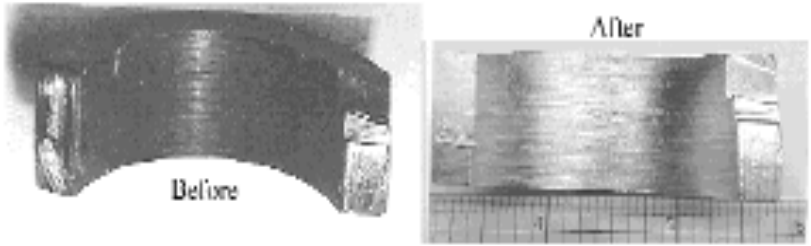
Original



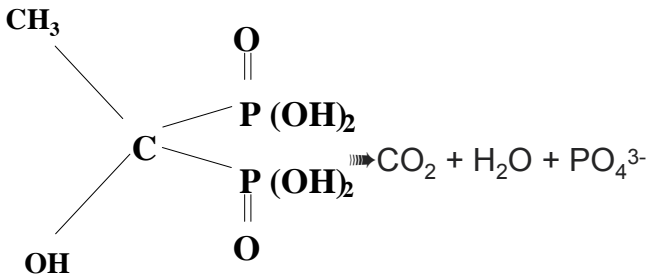


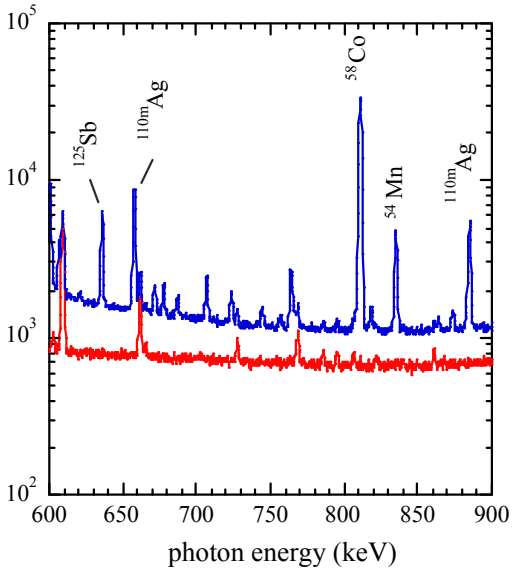
Etched and heat treated to expose grain boundaries

THE HEDPA DECON PROCESS



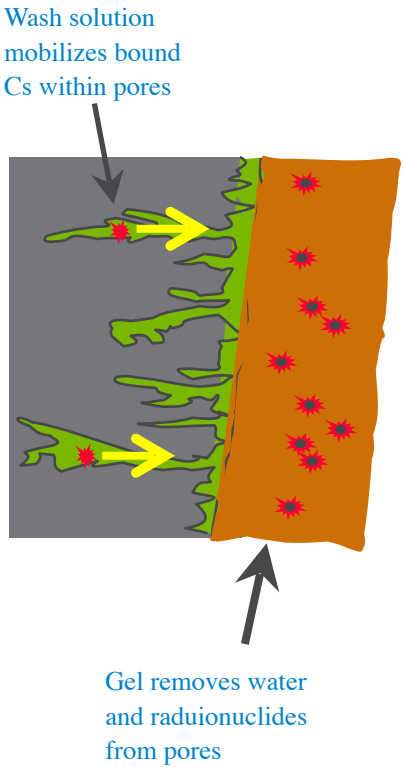
- Argonne patented process
- Uses strong organic acid
- Soluble in water, low odor
- Phosphonic acid groups bond strongly to polyvalent metal cations but less so to alkali, alkaline earth cations
- Dissolves ferrous and some nonferrous oxides very well
- Degrades to CO_2, H_2O, and H_3PO_4
- Kinetics faster than mineral acids
- Innocuous byproducts





DF >110 (BDL)

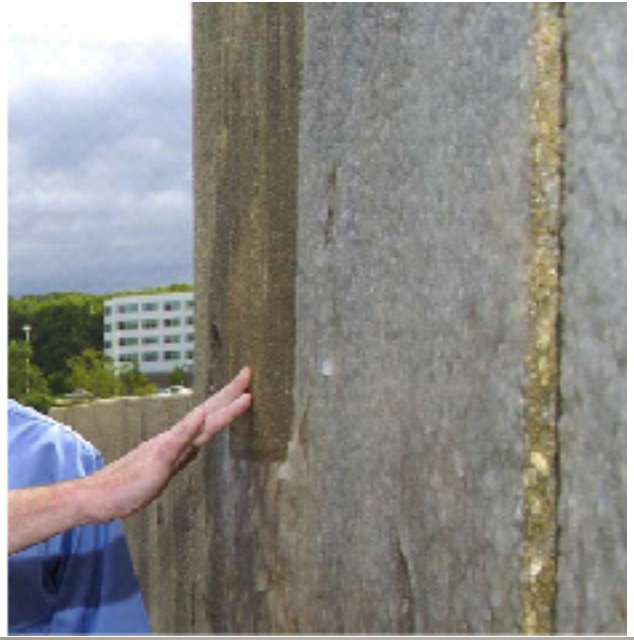
SUPERABSORBING GEL – ARGONNE SUPERGEL



- Ionic superabsorbing hydrogel mixed in field
- Spray onto surface and hold for >~20 min
- Mechanism
  - Hydrogel removes surface bound species and solution penetrates the pore structure
  - Solution releases the bound radionuclide ions into the pore water where it will exist in free ionic form
  - Hydrogel pulls water from the pore structure thereby removing the radionuclides from the surface
  - Hydrogel stabilizes the radionuclides to mitigate environmental release and re-adsorption of the radionuclides to the surface
  - Sequestering agents for additional sink
- Remove the hydrogel from the surface leaving a non-destructively treated surface containing residual radioactivity.
- Dehydrate and dispose of hydrogel

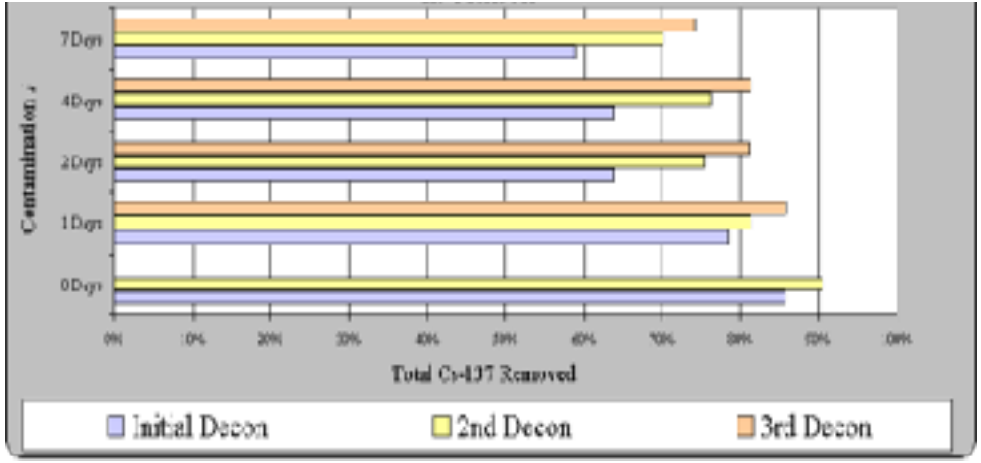
SUPERGEL R&D

- Concept to Pilot-Scale demonstration in 18 months
- Developed optimal polymer formulation
  - Long chemical shelf life
  - Common reagents
  - Cost effective
  - Sprayable
- Developed optimal wash solution
  - Tested >50 combinations of best candidates in the laboratory
- Systems integration
  - Spray and vacuum technology is off-the-shelf
  - Compatible with low level radioactive waste regulations



SUPERGEL R&D (CONT.)

- Current formulation effective for cesium plus actinide/fission product decon
- Licensed to EAI in 2012
- New patent granted in 2014
- Demonstrated by foreign allies in FY14-current
- Continued field testing in FY15-19
  - Foreign allies, Argonne hot cell floor, D&D of Pu Glovebox facility, hot spots on concrete



Americium Decontamination from Concrete

	Pre-Decon Activity (nCi/Coupon)	Post-Decon Activity (nCi/Coupon)	%R
	52	10	80%
	56	21	62%
	51	18	65%
	42	16	62%
Avg	**50**	**17**	**67%**
SD	**6**	**5**	**9%**

MUNICIPAL AND COMMERCIAL EQUIPMENT FOR RADIOLOGICAL RESPONSE AND RECOVERY

- Considers a wide area release of nuclear or radiological material such as nuclear plant accident, RDD, IND.
- Compressing the recovery timeline through the use of municipal and commercial equipment.
- In order to facilitate the development of ideas and methods for the use of such equipment, we developed example scenarios for five “Support Goals.”
- All scenarios under the Support Goals ask the same question –

  What types of municipal and commercial equipment can be used to complete the scenario activity and do we have sufficient data to recommend their use and predicted efficacy?

http://cambusinesssolutions.com/best-practices/disaster-recovery-is-not-optional-anymore/

MUNICIPAL AND COMMERCIAL EQUIPMENT FOR RADIOLOGICAL RESPONSE AND RECOVERY (CONT.)

At this stage, we expect the following activities in the impacted area:

1. People, vehicles, and objects have moved and are moving in and out of the contaminated areas,
2. Precipitation has occurred, increasing the spread of contaminants beyond the original release points,
3. Urgent remediation is needed for critical infrastructure (e.g., water utility, energy utility, transportation, medical, fire stations, government facilities, etc.),
4. Regular activities (e.g., business, school, etc.) in the non-evacuated but potentially contaminated area,
5. Identification and remediation of hotspots, and
6. Development of remediation strategies for the evacuated area.

SUPPORT GOALS

- **Survey and monitoring:** Monitor the contamination levels in affected areas for an extended period.
- **Mitigation of received dose to first responders:** Reduce the radiation dose burden to response and recovery personnel.

SUPPORT GOALS

- **Decontamination (gross and final):** Decontamination methods can be more effective if implemented within days of a release rather than waiting months or years.
- **Waste management:** Large amount of contaminated, solid waste will be generated over a wide area from businesses and residences.

SUPPORT GOALS

- **Containment of wastewater:** Water will likely be used by first responders to extinguish fires that may be generated during a radioactive release. It may also be used to reduce radiation levels to early responders and by subsequent recovery teams.

Scenario 3: Hard, horizontal surfaces such as roads, walkways, and parking lots can trap radioactive contamination. Prior studies and experience show that the contamination resides at or very near the surface of such hard materials (less than 1 cm or less than 0.5 inches). What equipment would be useful for removing contamination at the surface? What equipment would be useful in removing a **very shallow depth of paving material**? How does the choice of equipment and method change if many linear miles of surfaces need such treatment?	EQUIPMENT	Asphalt Milling Machine.	Floor scabblers, scarifiers	Heavy equipment	Pressure washing.	Water jetting vehicles.	Other specialty equipment for concrete removal.	Washing, wiping by hand or machine.
	DESCRIPTION	Asphalt milling machines are typically used for removing tarmac surfaces or pavement. 	Multiple-tipped heads pound surface for very shallow removal. 	Could strip the surface of long linear areas 	At highest pressures, can ablate hard porous surfaces (e.g., asphalt, concrete, ceramics, natural stone) 	Cuts the top layers of hard surfaces for removal. 	Specialty equipment in road and nuclear industry (e.g., Concrete Shaving by CoreCut removes 1–10 mm per pass).	DIY methods using towels, mops, scrub brushes; mechanical floor cleaners may be used on interior surfaces to remove contaminated dust. 
	ADVANTAGES	Variable >50 mm, small to medium 500 to 1200 mm.	5-mm surface removal, 20–30 square meters per hour.	Larger coverage rate than hand units, shallow removal depth.	Large quantities available COTS, DIY, Fukushima experience. Minimizes water use.	Very effective, Fukushima experience, water collection on some units. Removes surface with depth control.	Specialized equipment, very effective.	Can be effective on hard, smooth surfaces, large quantities available COTS, DIY, variety of techniques.
	LIMITATIONS	Availability.	Coverage rate, dust control, availability in the numbers needed. Defines structures.	Dust control, availability.	Water collection, manpower, aerosol exposure, best practice procedure.	Very specialized, availability, water collection.	Availability, types and variety needs inventory.	No guidance available, best practices undefined.
	R&D NEEDS	Survey of inventory (LR).	Survey of inventory (LR). Compatible dust control options (LR).	Survey of inventory (LR). Compatible dust control options (LR).	Data from Fukushima experience (LR). Best practice guidance (LR).	Survey of inventory (LR). Compatible dust control options (LR). Best practice guidance (LR).	Survey of inventory (LR).	Best practice guidance (LR).

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PUBLISHED DOCUMENTS

- Published two reports on the data gathered at each of the workshops in Chicago and New York.
- Published report summarizing our findings and first order recommendations for use of specific municipal and commercial equipment.
- Published development of surrogate fall-out for decon-type contaminations
  - and strippable paint vs soap and tap wash for military vehicles


Argonne

Subject Matter Expert Workshop for the Use of Municipal and Commercial Equipment for Radiological Response and Recovery: Argonne National Laboratory Workshop Summary Report


Argonne

Subject Matter Expert Workshop for the Use of Municipal and Commercial Equipment for Radiological Response and Recovery: National Urban Security Technology Laboratory Workshop Summary Report


Argonne

Municipal and Commercial Equipment for Radiological Response and Recovery in an Urban Environment: State of Science, Research Needs, and Evaluation of Implementation towards Critical Infrastructure Resilience


Chemosphere

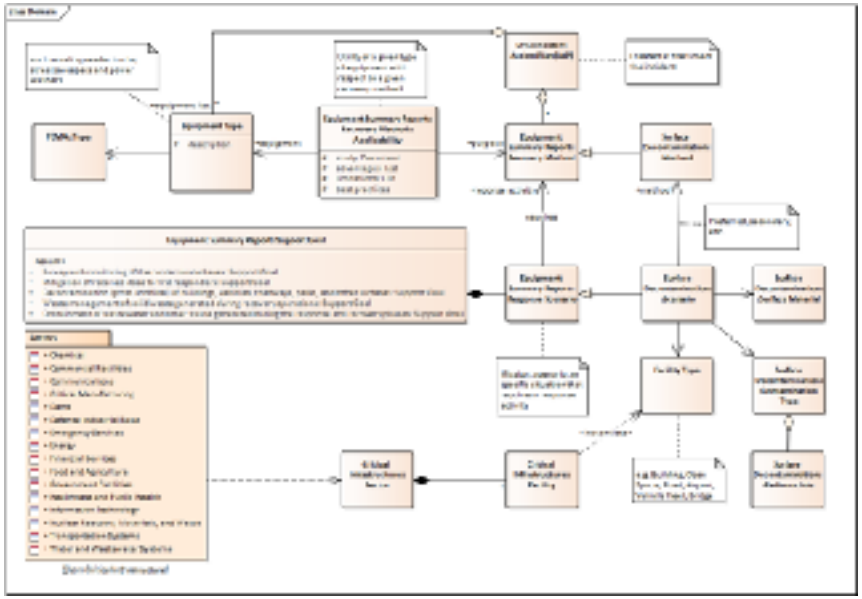
Silicate coating to prevent leaching from radiolabeled surrogate far-field fallout in aqueous environments

William C. Jolly, Christopher Orme, Michael D. Kaminski

UPCOMING PRODUCTS

- Publishing look-up tables of ad hoc filtration beds for radioactive contamination.
  - Also suitable for chemical agents.
- Best Practices documents for use of municipal equipment favored by responders.
- Searchable decision making tool for responders and hazard specialists.

Wash Water: 0.1 M KCl Sand:Clay	Hours	mCl	Gallons	Gal/min
50:50	5.1	3.005	7965	25.8
60:40	3.6	2.534	6726	31.0
70:30	2.4	2.001	5322	36.3
80:20	1.5	1.408	3762	41.6
90:10	0.7	0.768	2075	47.0



WOULD YOU LIKE TO PARTICIPATE ?

WE SEEK EXPERT INPUT ON POTENTIAL METHODS, EQUIPMENT OPTIONS, AND BEST PRACTICES PLUS TECHNICAL REVIEWERS.

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