New Materials and Techniques for Removal of Actinides from Surfaces*

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Experimental

Samples of stainless steel (AISI 304), mild steel (UNI Aq 42), aluminium alloy (UNI P-A1-Mg 3,5), polymethylmetacrylate, polyvinylchloride, polytetrafluoroethylene, cured by B.S. 4247 specification, have been contaminated with 0.2 ml of 2% solutions of uranyl nitrate and thorium nitrate (pH = 3.0), respectively. The following decontaminating agents have been applied to the samples:

Agent (a): an attapulgus clay aqueous suspension, prepared with 10 wt.% of clay and 15 wt.% of water.

Agent (b): an attapulgus clay suspension in nitric acid solution (5 N), prepared with 10 wt.% of clay and 18 wt.% of nitric solution.

Agent (c): a neoprene aqueous emulsion.

Agent (d): a neoprene aqueous emulsion additivated with nitric acid, prepared with 10 wt.% neoprene emulsion and 1 wt.% of nitric acid solution 0.5 N.

Afterwards some of the described agents have been applied on contaminated materials for routine operations for which material had been employed.

Radioactivity measurements have been executed on standard samples by an alpha scintillator, with a ZnS(Ag) detector, after contamination and after each decontamination process, inserting the samples directly in the shielded well of instrumentation; the efficiency of the instrument was determined with uranyl nitrate and thorium nitrate standards.

Measurements on materials contaminated for routine operations for which material had been employed have been carried out with the same instrumentation, by a smear test technique [1].

Results and Discussion

Results are reported as $\log D_F$, where D_F is the ratio of activity after contamination and after a single decontamination, and as $\log D_{FL}$, where D_{FL} is the maximum D_F obtainable with repeated application of some decontamination process (often three).

Values of $\log D_F$ and $\log D_{FL}$ obtained with the described decontaminating agents on different materials are reported, for uranyl nitrate in Table I and Table III, respectively and for thorium nitrate in Table II and Table IV, respectively.

The values of $\log D_{FL}$ obtained on materials routinely decontaminated are slightly lower than those found on respective standard samples, in Table V routinely processed data are reported.

TABLE I. Values of $\log D_F$ Obtained on Different Materials Contaminated with Uranyl Nitrate

Materials	Agent			
	a	b	c	d
Stainless steel	1.63	2.26	1.31	1.36
Mild steel	0.58	1.10	0.65	0.89
Aluminium alloy	1.33	2.13	1.10	1.35
Polyvinylchloride	2.20	2.62	2.05	2.28
Polymethylmetacrylate	2.32	2.66	2.03	2.34
Polytetrafluoroethylene	1.41	2.30	1.93	2.21

TABLE II. Values of $\log D_F$ Obtained on Different Materials Contaminated with Thorium Nitrate

Materials	Agent			
	a	b	c	d
Stainless steel	2.26	3.05	1.56	1.77
Mild steel	0.62	1.82	0.69	0.89
Aluminium alloy	1.80	2.56	1.20	1.45
Polyvinylchloride	2.00	2.83	2.03	2.17
Polymethylmetacrylate	2.12	2.77	2.02	2.23
Polytetrafluoroethylene	1.57	2.40	1.98	2.19

TABLE III. Values of $\log D_{FL}$ Obtained on Different Materials Contaminated with Uranyl Nitrate

Materials	Agent			
	a	b	c	d
Stainless steel	1.76	2.69	1.45	1.67
Mild steel	0.75	2.02	0.92	1.16
Aluminium alloy	1.72	2.98	1.41	1.70
Polyvinylchloride	2.43	3.01	2.42	2.44
Polymethylmetacrylate	2.50	3.10	2.37	2.56
Polytetrafluoroethylene	1.63	2.60	2.26	2.39

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TABLE IV. Values of log D_{FL} Obtained on Different Materials Contaminated with Thorium Nitrate

Materials	Agent			
	a	b	c	d
Stainless steel	2.53	3.59	2.05	2.24
Mild steel	0.80	2.59	0.94	1.09
Aluminium alloy	1.97	3.29	1.63	1.86
Polyvinylchloride	2.82	3.09	2.47	2.40
Polymethylmetacrylate	2.90	3.10	2.30	2.36
Polytetrafluoroethylene	2.24	2.57	2.25	2.29

Decontaminating agents have shown good efficiency, high radiological safety, ease of application and removal, low cost, resulting wastes are easily handleable and treatable.

TABLE V. Process Data from Routinely Decontamination Experiment at C.R.E.S.A.M.

Process data	Agents a and b	Agents c and d
Application technique	trowel	spray
Applicability on vertical surfaces	yes	no
Amount of basic agent used (kg m^{-2})	4	1
Cost of basic agent ($ m^{-2})	4.8	5.0
Decontamination time (h)	72–96	48–72
Exposure time (h m^{-2} man^{-1})	0.8	0.4
Radioactive solid waste produced (1 m^{-2})	5.0	1.5

Reference

1 'Regulation for the Safe Transport of Radioactive Materials', *IAEA Safety Series No. 6*, IAEA, Vienna, 1973, p. 38.