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**PROTECTING AND CLEANING HANDS CONTAMINATED BY
SYNTHETIC FALLOUT UNDER FIELD CONDITIONS**

Research and Development Technical Report USNRDL-TR-256
NY 320-001
U.S. Army

27 August 1958

by

R. H. Black

**FC
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U.S. NAVAL RADIOLOGICAL DEFENSE LABORATORY

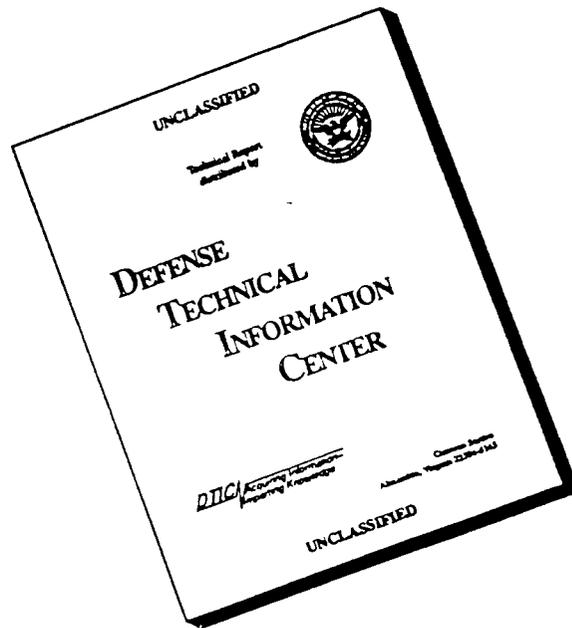
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PROTECTING AND CLEANING HANDS CONTAMINATED BY
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Research and Development Technical Report USNRDL-TR-256
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Health and Safety

Technical Objective
AW-5c

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U N C L A S S I F I E D

ABSTRACT

Hands of field test personnel became radioactively contaminated with (a) dust or slurry synthetic fallout containing La^{140} tracer, and (b) La^{140} in acid solution. Two protective creams and several cleaning materials were used in an attempt to reduce adherence of contaminant and to facilitate decontamination. The protective creams were not found to be advantageous. Three experimental cleaning solutions (isotonic neutral solution of a complexing agent plus a detergent and germicide; an isotonic saline solution at pH 2.0 plus detergent and germicide; and a 3% citric acid solution) were found to decontaminate skin more readily than soap and water. A waterless mechanic's hand cleaner was found to clean hands with the same effectiveness as soap and water.

NONTENTYICAL SUMMARY

The Problem

Radioactive contamination of the skin of personnel following a nuclear weapon detonation or a radiological accident can constitute a serious health problem. However, study of preventing contamination or removing contaminant until now has been limited to laboratory-scale tests of creams and liquids for protecting and cleaning hands. Evaluation under field conditions has been lacking.

Findings

The hands of personnel became contaminated with synthetic fallout during a land reclamation field test. Two protective creams were used in an attempt to reduce adherence of the contaminant, and several cleaning materials to facilitate decontamination.

The protective creams were not found to be advantageous. Three experimental cleaning solutions were found to decontaminate skin more readily than soap and water. A waterless hand cleaner was found to clean hands with the same effectiveness as soap and water.

ADMINISTRATIVE INFORMATION

The work reported was an outgrowth of an investigation conducted by this laboratory under the sponsorship of the Bureau of Yards and Docks and the U. S. Army (OCE). This investigation is described, as Program 6, Problem 3, in this laboratory's Preliminary Presentation of USNRDL Technical Program for FY 1957, dated February 1956.

ACKNOWLEDGMENTS

This test was made possible by the cooperation of Mr. J. D. Sartor, who was conducting a field test in which the synthetic fallout was produced and utilized. He and his entire team were most generous in donating time for the hand-cleaning tests.

The technical assistance of Mr. D. A. Gustafson, of the San Francisco Naval Shipyard Electronics Shop, was invaluable for maintaining continuous instrument operation.

REPORT OF INVESTIGATION

INTRODUCTION

Radioactive contamination of the skin of personnel following a nuclear weapon detonation or a radiological accident can constitute a serious health problem. However, study of preventing contamination or removing contaminant until now has been limited to laboratory tests on the cleaning of contaminated skin. No information is available on the relative merits of cleaning materials used under field conditions. Prevention through the use of rubber gloves is desirable, but under field conditions this may not always be practical or possible. Also, contaminants have been known to penetrate surgeon's gloves.¹ Therefore, it is necessary to have alternate means of protecting or cleaning hands which are vulnerable to contamination under field conditions.

Various laboratories that utilize radioisotopes in research have published the results of case studies in which the skin of personnel which had become accidentally contaminated were decontaminated. Most of these decontaminations were performed with strong chemical reagents which are generally not applicable to field work inasmuch as they require careful supervision to prevent serious skin irritation.

Mild chemical skin decontamination methods were studied at USNRDL in 1949.² Two types of solutions that appeared suitable were developed: one type consisted of isotonic neutral solutions of complexing agents, plus a detergent and germicide; the other was an isotonic saline solution at pH 2.0, plus a detergent and germicide. The toxicity of these solutions was studied in 1950;³ both were found slightly irritating, probably due to the germicide. This study also showed that these solutions tended to increase the absorption into the body of a soluble $Sr^{89}Cl_2$ contaminant.

At Operation CASTLE the hands of technical personnel and decontamination crews often became contaminated. Usually the contaminant was removable by scrubbing with soap and water or scrubbing with a mixture of

corrosive and detergent, but on one particular individual such treatment did not remove the contaminant. An ammoniacal petroleum-based waterless hand cleaner was found to be effective in cleaning this individual's hands.

Barrier creams, advertised as reducing dermatitis caused by contact agents, such as solvents, grimes, pollens, and irritating plants, are a possible preventive. The use of barrier creams has reduced the problem of skin contamination in one atomic energy plant;¹ but tests using barrier creams to reduce the effect of other contact agents have not been conclusive.

Barrier creams may actually interpose a physical barrier between the skin and potential contaminating agents. The cream, if applied heavily enough, might even act as a shield against alpha and low-energy beta radiation. Personnel from this laboratory who have used various barrier creams found them generally useful for reducing the effect required to clean hands after working with ordinary industrial greases, paints, and grimes, and the creams caused no skin irritation. It was upon these bases that a test of the value of barrier creams was proposed for Operation KEATING as part of Project 2.8. Only limited data were obtained due to the effectiveness of the Radiological Safety Program.⁵

OSMUND conducted a lead target recovery field test at Camp Stoneman, Pittsburg, California, in September 1956. Full-scale decontamination procedures were used on limited areas contaminated with synthetic fallout; this provided an excellent opportunity to test methods and procedures of hand decontamination. This report describes the experiment which was undertaken. The objectives were to determine the effectiveness of barrier creams in preventing contamination from adhering to hands and to determine the effectiveness of a waterless cleaner and three experimental solutions in removing radiological contamination from the skin of the hands.

EXPERIMENTAL PLAN

During the lead target recovery tests the normal field operation duties included: Ia^{140} solution preparation; mixing the Ia^{140} solution with soil to make the synthetic fallout; dispersing the synthetic fallout; radiation survey; and decontamination operations. Selected test personnel were given the experimental protection of a barrier cream prior to entering the contaminated area. Any person returning from the contaminated area with over 500 c/min on his hands, as determined by the Radiological Safety Monitor, was directed by the monitor to the hand cleaning center where a sequence of count-clean-count was performed on the palms of his hands using the experimental procedures described below in the section headed "Cleaning." When the experimental hand cleaning sequence for an individual was completed, he was released to the Radiological Safety Group for routine personnel decontamination.

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Contaminant

Three types of contaminant were used in this experiment. Most of the data on which this report is based came from contamination by synthetic fallout traced with La^{140} ; other data came from contamination by acid La^{140} solution used in preparing the synthetic fallouts. The La^{140} is a β - and γ -emitting radioisotope with a 40-hr half-life.

The two types of synthetic fallout were: dry, using ambrose clay loam, and slurry, using San Francisco Bay harbor bottom material. The La^{140} tracer concentrations for these synthetic fallouts were 7.5 $\mu\text{c/g}$ and 0.75 $\mu\text{c/g}$, giving a total of four combinations.⁶ Previous experiments had indicated that the La^{140} was firmly adsorbed to the synthetic fallout and that cleaning operations did not desorb the La^{140} from the bulk carrier material; in other words, the detection of La^{140} radiation was a good indication of the presence of synthetic fallout.⁷

The third contaminant type was the acid La^{140} solution. The La^{140} in this solution was in a chemical form suitable for absorbing onto most solids. The La^{140} in this form was not a tracer for a bulk carrier material; it was the contaminant.

Protection

The routine rad-safe procedure for protecting the hands of those performing the La^{140} solution preparation included the wearing of surgeon's gloves, while cotton gloves were worn when manual work was being performed. Additional experimental protection was provided to randomly selected personnel by the application of a barrier cream prior to working in the contaminated areas.

The creams tested were Cream A, a hard, wax-like cream,⁸ and Cream B, a soft, easily smoothed cream similar to common cleansing cream.* Both were proprietary preparations selected as suitable for wet work.

Cleaning

The hand cleaning was performed by test personnel under supervision. A vigorous 1- to 2-min wash was prescribed, but not timed. Drying was done with paper towels. The formulations of the different washes tested and application procedures are given in Table 1.

Soap and water washing was chosen as a control. The EDTA and saline solutions were selected as a result of previous work at USNRDL.² The waterless cleaner was selected because of favorable experience at Operation CASTLE. The citric acid was recommended by the Radiological Safety Representative for the field tests.

* "Kerodex 71," manufactured by Ayrst Laboratories, New York, New York.

TABLE 1

Cleaning Formulations and Procedures

Wash	Formulation	% Wt	Approximate Amount per Application	Cleaning Sequence(d)
Soap and water	Stearate Soap, G51-S-1870		Not Limited	Wet hand , lather, rinse, wipe dry
Waterless Hand Cleaner	Ammoniacal Petroleum-based proprietary formulation		15 cc	Rub into skin, wipe clean with 2 towels
RTGA	4%a-EDTA(a) Disinfectant(b) Wetting Agent(c) Water HCl (to adjust pH to 7)	3.0 0.1 0.4 96.5	50 ml	Rub during application, rinse, wipe dry
Saline	NaCl (isotonic) Disinfectant(b) Wetting agent(c) Water HCl (to adjust pH to 2)	0.9 0.1 0.4 98.6	50 ml	Rub during application, rinse, wipe dry
Citric Acid	Citric acid Water	3 97	50 ml	Rub during application, rinse, wipe dry

(a) Tetra sodium ethylenediaminetetraacetic acid.

(b) Di-isobutylphenoxylethoxyethyl dimethylbenzylammonium-chloride monohydrate.

(c) Alkylaryl polyether alcohol.

(d) All rinses were with tap water, all drying was with one paper towel unless otherwise noted.

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Two washings by the same method were performed in each case, unless one wash brought the count very close to the background count. More than two washings using the same method were performed when activity levels permitted.

In some instances of unusually high beta readings, more than one cleaning method was prescribed.

Instrumentation

The instrument for routine initial radiological safety monitoring was a Geiger-Muller end-window count rate meter.* The instrument used in this study for assessing contamination on the palms of the hands was the USNRDL Large Area Beta Detector. This instrument, designed and built by the Nucleonics Division of USNRDL, consists of a modified AN/UDR-9 radiac set, a pre-amplifier, and a detector. A 5-min timer** replaces the normal switching and timing circuits of the AN/UDR-9 to simplify the operation of the instrument. The pre-amplifier is a 3-tube device with a voltage gain of approximately 1,000. The detector uses an 8 x 10 x 1/8-in. sheet of plastic scintillant.*** The scintillant is coupled with 10⁶ centistoke DC-200 silicone oil to a segmented plexiglas light-pipe, which is coupled to a 5-in. diameter photomultiplier tube.**** The detector pre-amplifier combination is contained in a light-tight box with a removable cover. The instrument was set to give a 15-sec count. The physical relationship between a person with his hands in position for counting and the elements of the beta counter preamplifier is shown in Fig. 1.

Two 12- μ c samples of synthetic fallout were prepared for instrument standardization. Sample 1 was 0.75 μ c/g San Francisco Bay mud (dried). Sample 2 was 7.5 μ c/g San Francisco Bay mud (dried). The averaged 15-sec count was used as the standardization factor to convert from counts per 15 sec (c/15 sec) to microcuries (μ c).

RESULTS AND DISCUSSION

The effectiveness of the various methods tested is expressed as a residual fraction, the beta radiation reading of the palms of the hands taken immediately after a washing divided by the beta reading taken

-
- * Model 2150, Berkeley Scientific Div., Beckman Instruments Corp., Richmond, Calif.
 - ** "Microflex" Timer, Eagle Signal Corp., Moline, Ill.
 - *** "Scintilon B", National Radiac, Newark, N. J.
 - **** Type 6304, A.E. Dumont Inc., Clifton, New Jersey.

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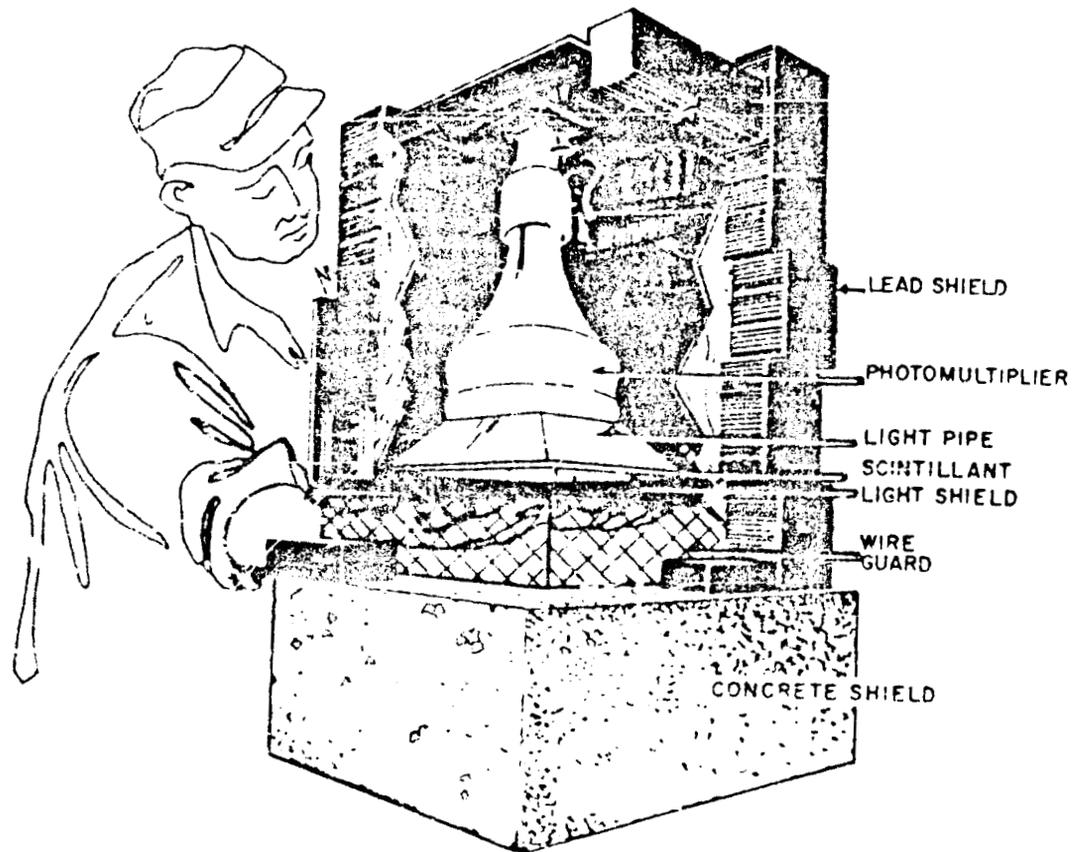


Fig. 1 Large-area Beta Detector in Use

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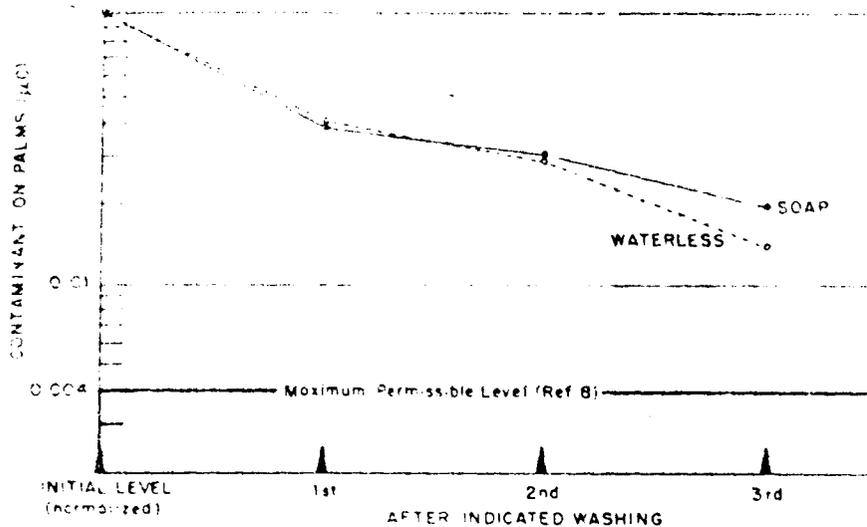


Fig. 2 Comparison of Waterless Cleaner With Soap and Water

immediately before the washing (that is, the readings taken before and after any one of several washings). All types of contaminant are included in the evaluation of a cleaning method, unless otherwise noted.

Protection Methods

The two barrier creams tested, when used in conjunction with a soap and water wash, gave approximately the same results as a soap and water wash with no special protection (Table 2).

Cleaning Methods

The residual fractions for the soap, EDTA, and waterless cleaning methods were divided into three groups to determine gross effects due to initial contamination level. These group divisions were based on initial level: less than 0.03 µc, 0.03 to 0.3 µc, and greater than 0.3 µc. The logarithmic mean residual fractions are presented in Table 2. They were normalized to 1 µc, 0.1 µc and 0.01 µc for convenience of comparison (Figs. 2 and 3). The results presented are for all three contaminant types combined. The British maximum permissible level⁹ of fixed radioactivity on the skin is 10^{-5} µc/cm², which is equal to 0.004 µc uniformly distributed on the palms of both hands.*

* The U. S. has no comparable maximum permissible level.

TABLE 2

Residual Fractions From the Various Cleaning and Protective Agents (a)

Agent	Initial Level Range (µc)	Residual Fraction and Standard Deviation for Each Wash					
		First Wash		Second Wash		Third Wash	
		2nd count	No. of Subjects	2nd count	No. of Subjects	4th count	No. of Subjects
		1st count	Dev. (%)	3rd count	Dev. (%)	3rd count	Dev. (%)
Cream A, Soap wash 5.2 to 0.53		0.17	3	0.32	3	0.71	2
Cream B, Soap wash 2.4 to 0.01		0.40	10	0.74	32	0.91	3
<u>Cleaning</u>							
Soap	> 0.3	0.15	12	0.54	52	0.69	4
	0.01 to 0.3	0.39	30	0.80	23	0.63	7
	< 0.03	0.35	16	0.79	23	0.19	1
Water-	> 0.3	0.35	7	0.68	23	0.62	4
less	0.03 to 0.3	0.41	10	0.72	18	0.47	2
	< 0.03	0.35	12	0.55	2		
EDTA	> 0.3	0.053	10	0.51	120	0.56	4
	0.03 to 0.3	0.06	24	0.59	4		
	< 0.03	0.15	7				
<u>Protective</u>							
Saline, Perc. Citric Acid Soap EDTA Soap Saline	2.4 to 0.01	0.12	146	0.55	29	0.28	5
	1.0 to 0.01	0.074	13	0.49	38	0.70	2
	4.0 to 0.15	0.37	6	0.28	26	0.28	5
	0.5 to 0.38	0.45	5	0.89	7	0.28	70

(a) Computed as logarithmic means. Standard deviation was calculated from the log standard deviation and is expressed as (antilog (log std. dev.) 1.00) x 100%.

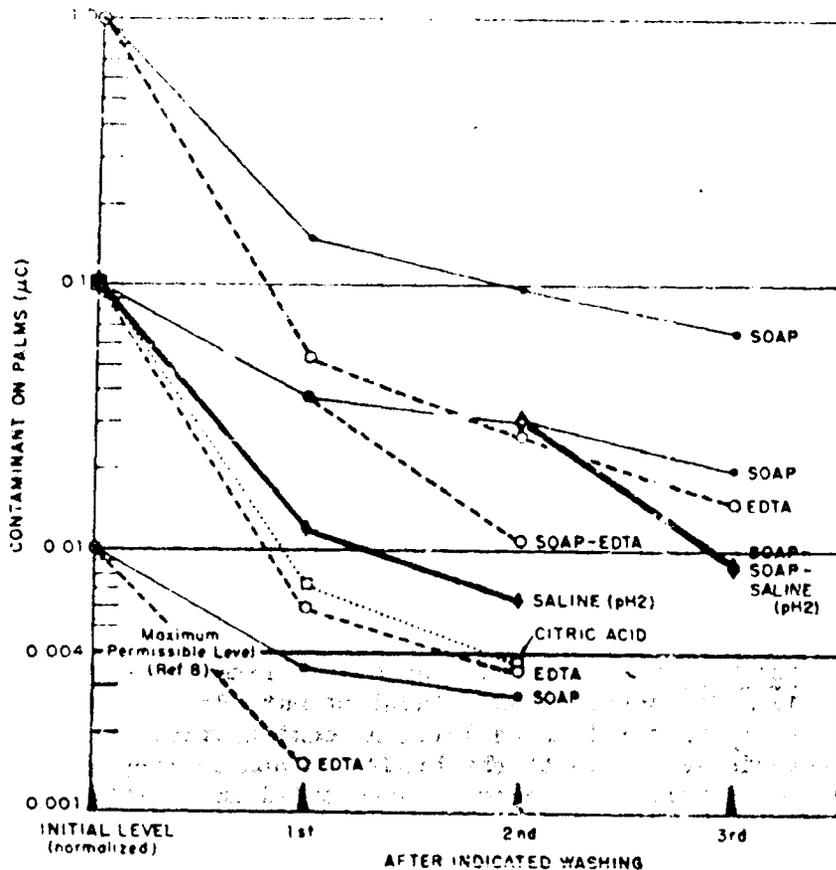


Fig. 3 Comparison of Aqueous Cleaning Methods

Waterless Hand Cleaner. The averages of the first washings with waterless cleaner were approximately as effective as the equivalent soap washings (Table 2, Fig. 2). A review of the washing procedure will show that while the soap and water washing method was not limited by the amount of water that could be used, the waterless method used only 15 cc of cleaner for one washing.

EDTA. The average residual contamination from washing with EDTA was considerably lower than that of soap and water (Table 2, Fig. 3).

To further test the effectiveness of EDTA, we deviated from the original plan of using a single washing method; the initial washing was with soap, the second with EDTA. The result of this test showed that the

residual fraction for the EDTA wash was smaller than residual fraction for the soap wash. Also, two EDTA washings removed more contamination than the one soap wash plus one EDTA wash.

Saline Solution, pH-2. The average residual contamination from washing with the acidic saline solution was considerably lower than that of soap and somewhat higher than that of the EDTA (Table 2, Fig. 3).

A test, similar to the special test for EDTA, was performed using the saline solution (Table 2, Fig. 3). The first two washings were with soap. The third was with saline solution. The residual fraction from the saline solution washing averaged about half the residual fraction for the equivalent soap wash, showing that the saline solution removed the contaminant to a greater degree than soap.

Citric Acid Solution. The citric acid solution was given a cursory test (Table 2, Fig. 3). The average residual from the citric acid washing was approximately the same as that of the EDTA and saline solutions.

Miscellaneous Cleaning Methods. Three individual case studies are reported (Fig. 4). In these, an assortment of methods was used on each subject to remove a relatively high level of contamination from the hands. Conventional methods were used at the beginning and as they appeared to lose effectiveness experimental methods were tried in an attempt to reduce contamination of the hands as much as possible. In two of these cases it appeared as though contamination were "fixed" at approximately 0.1 μc but upon changing to EDTA wash the hands were cleaned to less than 0.01 μc .

Near the conclusion of the test series, two individuals' hands became contaminated to approximately 5 μc , presumably from the acid La¹⁴⁰ solution. One sequence of soap scrub, water rinse, EDTA scrub, water rinse (using a nylon scrub brush and warm solutions, including rinse) was used as a washing procedure. The final levels were approximately 0.05 μc , or overall residual fraction of 0.01. The cleaning sequence used in these two cases may be of interest if further investigative work is to be performed.

In another instance a man mistakenly used the waste water from the day's hand decontamination work (containing a combination of all cleaning solutions) as the wash for his hands. His hands had an initial contamination level of .006 μc , which was considerable lower than the average for the day; but the waste solution cleaned his hands to .002 μc , nearly background. This one case indicates that in the event of water shortage, cleaning solutions can, perhaps, be reused. Naturally, more data would be required to substantiate the idea and to explore possible adverse side effects.

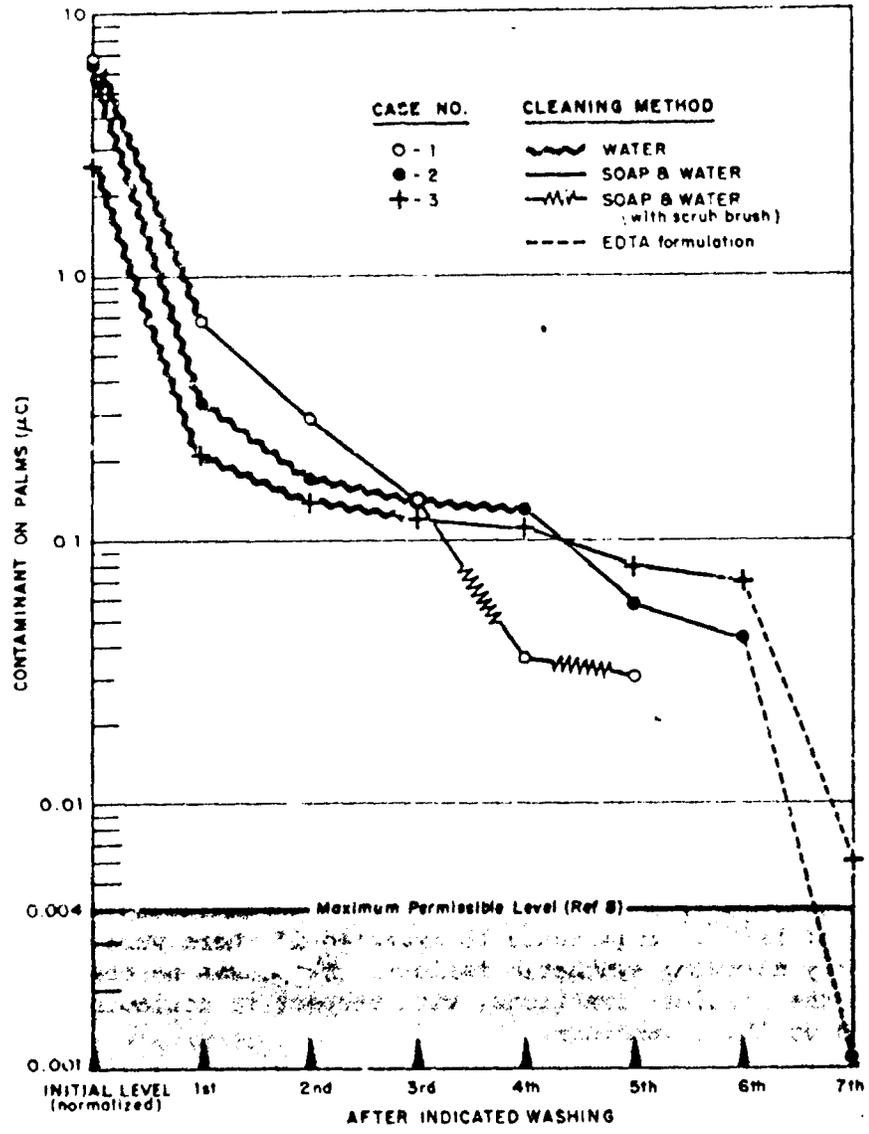


Fig. 4 Three Case Studies

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A nylon brush was used to a very limited degree against resistant contaminant, as the Health Physics Representative had warned us that the contaminant would be driven into the skin by brushing. No adverse effects were observed. The results of one case where a nylon brush was used are presented (Fig. 4). Further investigation could be applied to re-evaluating the effect of scrubbing the skin with a nylon brush, perhaps after an initial wash without brushing.

Miscellaneous Observations

Physiological Effects. No attempt was made to determine toxic effects of the cleaning preparation or barrier creams. Each person used several materials over the period of the field operation; therefore effects could not be isolated. Several persons, who did not regularly use the soft cream emollient which was available, complained of chapped skin. Previous work³ indicated a slight toxicity of two cleaning solutions traceable primarily to the disinfectant.

Comparison of Contaminant Types. In a parallel analysis the data for soap washing were separated by contaminant type and compared, i.e., acid La¹⁴⁰ solution, slurry 0.75 $\mu\text{c/g}$, slurry 7.5 $\mu\text{c/g}$, loam 0.75 $\mu\text{c/g}$, loam 7.5 $\mu\text{c/g}$. Slurry contaminant with 7.5 $\mu\text{c/g}$ was the only one that showed a noticeably different residual fraction; it apparently was easier to remove than other contaminants. As there were only four data points showing this effect no definite conclusions can be drawn concerning the effect of contaminant type.

Initial Level Effect. The effectiveness of the first washing was related to the initial contamination level. In general, a lower residual fraction was obtained from the washing of hands contaminated to a higher initial level of La¹⁴⁰. This would be expected if there were a maximum level of tightly adhering synthetic fallout. There was no observable difference in the residual fractions, with respect to contamination level, for the second or third washings.

Comparison With Previous Laboratory Study. Comparison of some of the findings from this field test and a laboratory experiment performed in 1949,² upon which a portion of the field test work was based, show that in both cases EDTA and saline solutions were more effective decontamination agents than soap, leaving a residual fraction of approximately half that of soap. Laboratory experiments using rats gave much lower residual fractions than those observed at the field test; however, the second washings at the field test gave residual fractions numerically almost the same as the second washing on the skin from a cadaver in laboratory tests. An additional factor, which lends further interest to the correspondence of

the findings, is that the contaminating agents were quite different: synthetic fallout (and La^{140} in acid solution, in a few instances) was used for field work, while a neutral solution of Sr^{90} was used in the laboratory experiments.

Laboratory-scale decontamination tests were performed with the cooperation of human volunteer subjects¹⁰ at approximately the same time as the field tests. A synthetic fallout, composed of Ambrose clay-loam traced with La^{140} , was dry-sprayed onto a 10-cm² area of the underside of the forearm, then rubbed into the skin with a rounded glass rod.

The residual fractions resulting from the cleaning operations were much lower for the laboratory tests than for the field tests, indicating that the methods were more effective in removing the synthetic fallout under the laboratory conditions. This may have been a result of a combination of effects, among which are the type of skin studied (i.e., palms vs underside of forearm), the total area contaminated, the mechanical action grinding the synthetic fallout into skin and mechanical action of scrubbing, the degree of supervision, the synthetic fallout contact time, etc.

However, the qualitative findings of both tests were essentially the same: barrier creams offered no large decontamination advantage, the first wash was the most effective wash (when a single cleaning agent was used), waterless mechanic's hand cleaner was at least as effective a decontamination agent as soap and water, and EDTA and citric acid were more effective than soap as decontamination agents.

Potential Decontamination Methods. Some cleaning formulations have been suspected of increasing the absorption of $\text{Sr}^{90}\text{Cl}_2$ solution into the body.³ However, before any cleaner is disqualified for this reason, all its properties should be weighed in the light of anticipated field conditions. It may be that after the contaminant has been in contact with skin for several hours, the additional absorption caused by the use of a special cleaner would be negligible. Furthermore, it may be possible that for some instances of high level contamination, a two-part wash (such as described in the second paragraph under "Miscellaneous Cleaning Methods," would be desirable in an effort to maximize removal and minimize absorption.

The wetting agent, used alone in 0.5-percent solution has been shown to be a good decontamination agent.² It may be advantageous to further evaluate this agent for absorption, toxicity, and decontamination effectiveness under field conditions.

U N C L A S S I F I E D

CONCLUSIONS

The barrier cream pre-treatments did not detectably alter the effort required to remove the contaminants by soap and water washing.

The waterless hand cleaner showed the same effectiveness as soap and water in removing contaminant from the hands, but required the least total material volume of all cleaners tested.

The EDTA, saline, and citric acid solutions (as formulated) were more effective than soap and water in removing the contaminant.

There was no observable difference in decontamination effectiveness traceable to contaminant type.

There is no method yet which has shown itself to be reliable enough in cleaning contaminated hands to be used without the necessity of a radiation check after washing, to comply with peace-time maximum permissible levels.

Approved by:

E. R. Tompkins

E. R. TOMPKINS

Head, Chemical Technology Division

For the Scientific Director

REFERENCES

1. Towler, G. S. Utilization of Barrier Creams in Atomic Energy Plants. Atomics Eng. Technol., Vol. 1, No. 3, p. 88.
2. Mayer, S. W., Britton, J. B. The Removal of Radioactive Contaminants From Skin by Solutions of Complexing Agents, Keratolytics and Detergents. U. S. Naval Radiological Defense Laboratory Report AD-118(C), 29 April 1949.
3. Loeffler, R. K., Thomas, V. A Quantitative Study of Percutaneous Absorption. II. Toxicity and Effect Upon Absorption of Two Decontamination Solutions. U. S. Naval Radiological Defense Laboratory Report AD-254(B), 2 October 1950.
4. Madson, A. Patch Tests on Skin Prepared With Kerodex. Acta Dermato Venereologica, Vol. 32, Supplementum 29 (1952), p. 213.
5. Heiskell, R. H. Shipboard Radiological Counter-Measure Methods. Project 2.8, Operation REDWING, Interim Test Report ITR-1322, U. S. Naval Radiological Defense Laboratory, July 1956 (Classified).
6. Weisbecker, L. W., Lane, W. B. "Hot Laboratory for Producing Synthetic Radioactive Fallout." Advances and Problems in Nuclear Engineering. Pergamon Press, Inc., London, 1957.
7. Wiltshire, L. L., et al. The Adsorption of La^{140} on Ambrose Clay Loam. U. S. Naval Radiological Defense Laboratory Technical Memorandum No. 67, 3 January 1957.
8. Private Communication, Dr. G. H. Hiatt, Eastman Kodak Co., and Pat. No. 2,221,139 and 2,249,523.
9. Dunster, H. J. The Derivation of Maximum Permissible Levels of Contamination of Surfaces by Radioactive Materials. Atomic Energy Research Establishment (Great Britain), AERE EF/R 1495, 5 July 1954.
10. Friedman, W. F. Decontamination of Synthetic Radioactive Fallout From the Intact Human Skin. Am. Ind. Hyg. J., Vol. 19, No. 1, p. 15, February 1958.

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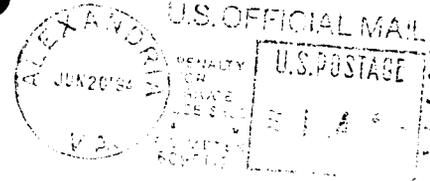
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