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**RADIOACTIVE DECONTAMINATION TESTS ON SURGEON'S GLOVES  
CONTAMINATED WITH PLUTONIUM**



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HEALTH AND SAFETY

LOS ALAMOS SCIENTIFIC LABORATORY  
OF THE UNIVERSITY OF CALIFORNIA LOS ALAMOS NEW MEXICO

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RADIOACTIVE DECONTAMINATION TESTS ON SURGEON'S  
GLOVES CONTAMINATED WITH PLUTONIUM

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## 1. SUMMARY

A technique was devised for applying plutonium activity to gloves, washing them in various decontamination solutions, and evaluating the relative effectiveness of these solutions for removing the activity.

When the most efficient solution for decontamination was determined, decontamination of various lots of gloves from a laboratory handling plutonium was attempted. For a run-of-the-lab lot of gloves, 80% were decontaminated and recovered for re-use. For gloves from an extremely "hot" laboratory, recovery efficiency depended upon whether or not the lot had been cross-contaminated by one or two highly contaminated gloves.

The cost of decontaminating gloves was approximately three times the cost of new gloves. While on a routine, large lot basis, this cost could be lowered considerably, it appears to be uneconomical to decontaminate gloves unless new gloves should become unavailable.

"Consumer resistance" to washed gloves was found to be present among users.

## 2. TEST OF RELATIVE EFFECTIVENESS OF DECONTAMINATION SOLUTIONS

New size 10 Wilson Rubber Company "Wiltex Latex Surgeon's Gloves" were used. Each glove was slipped over a piece of 1/4 in. plywood,

5 by 7 in., which gives a slight tension to the rubber. The assembly is relatively flat and can be easily handled and alpha-counted. A plutonium solution (HCl solution, pH 1 or less) was applied to the palm of each glove and allowed to dry. Approximately  $10^6$  d/m in 0.2 ml solution was used on each glove. After drying for a minimum of 16 hr, each glove was counted using an air-filled probe operating in the proportional region and feeding through a preamplifier into a scale of 256 scaler. The over-all geometry of the counting equipment was 5.5%.

Gloves so prepared were washed in the decontamination solution being tested in the following manner: Each glove was agitated in the solution at 70°F for a period of 3 min, a soaking piece of gauze was swiped lightly across the contaminated spot, and the glove was rinsed in warm tap water for 1 min, using the same agitation. The glove was then allowed to air dry a minimum of 16 hr and again counted on the proportional alpha counter. Efficiency of decontamination was expressed as  $(1.00 - \frac{d/m \text{ after}}{d/m \text{ before}}) \times 100\%$ .

Twenty-four commercial detergent solutions were tested in duplicate in the above manner. In each case, solution concentration was that recommended by the manufacturer for general cleaning. Efficiencies computed by the above expression varied from minus 30% to plus 89%. The negative values were found in the cases where a wetting agent was used alone, the result being to spread the activity on the glove and reduce self-absorption during alpha counting.

Two other solutions in general use in the laboratory for decontamination purposes were also tested. The compositions per liter are as follows:

Solution A (acid decontamination solution - pH approximately 2)

4.8 gm (0.025F) citric acid  
2 ml Versene Fe-3 specific (liquid)  
2 ml Igepal - CA Extra

Make up to 1 liter with water.

Solution B (basic decontamination solution - pH 10)

4.8 gm (0.025F) citric acid  
1 gm Versene regular powder  
5 ml Igepal - CA Extra  
7 gm NaOH (sufficient to raise pH to 10)

Make up to 1 liter with water.

Testing of these solutions gave efficiencies of 98% and 94%, respectively.

Table I is a tabulation of all solutions in the order of their effectiveness.

### 3. DECONTAMINATION OF USED GLOVES

A lot of gloves from the glove disposal bin in a laboratory using plutonium was secured. One hundred pairs of gloves (200) were taken at random. They were placed in an enclosed pot in 30 gal of the acidic chelating solution, and sufficient saturated steam was applied through

TABLE I

## TABULATION OF DECONTAMINATION EFFICIENCIES OF DETERGENT SOLUTIONS

<u>Product</u>	<u>% Efficiency</u>	<u>% Concentration by volume</u>	<u>Remarks</u>
Igepal - CA Extra	30	2	
Zoleo	20	3	
Dreft	18	3	
Hales Toilet Soap	23	3	
SBS-50	26	3	
SBS-11	27	3	
Ivory Snow	33	3	
Sana Sass	33	3	
Dysept	39	3	
Hale-Shine	41	3	
Franklin Cleaner	41	33	
Majestic Soap	42	2	
Actusol	42	3	
Wedaco	43	5	
Neutralave	47	3	
Servis Ammonisan	50	6	
Versene Fe-3	54	2	
Temp	56	--	Cream, used direct and rinsed
Versene - Regular	56	2	
Oakite	57	0.4	
Bryte	67	3	
Versene Fe-3 Specific	76	2	
Radiac Wash	81	12	
Alconox	89	3	
Solution B	94	--	Basic chelation solution
Solution A	98	--	Acidic chelation solution

the bottom to give agitation for a period of 30 min. They were then rinsed twice in lukewarm water and dried. After drying 16 hr in room air, the gloves were turned inside out and allowed to dry a second 16 hr or longer. The gloves were then monitored inside and out for alpha radiation using a Pee Wee (a proportional, battery operated, portable, alpha count rate meter), were tested for leaks and were powdered, sized and paired. Eighty pairs were found free of all activity, paint, or leaks, and were in good usable condition.

A second lot was collected in one laboratory where high levels of activity were known to be present. Collection was made by having the users dispose of the gloves into a closed pot containing about two gallons of the decontamination solution. Of 54 pairs washed, none was free of activity after the first washing. Fourteen pairs were found free of activity after a second washing, 13 pairs of which were usable. Of the 40 pairs washed a third time, 22 pairs were free of activity; but all were discarded because of holes or loss of elasticity in the gloves. A check of the container used for collection was made, and it was found to be highly contaminated. The condition of the container indicates that one or more highly contaminated gloves in the lot cross-contaminated the entire lot.

A third lot was collected in the same manner as the second and in the same room, but the time of collection was shortened from several days to one day. Of 24 pairs washed once, 21 pairs were recovered as usable, one pair was free of activity but with leaks, and two pairs



with activity were discarded.

Table II is a tabulation of results of decontamination of the various lots of gloves.

TABLE II  
RESULTS OF CLEANING EFFORTS ON GLOVE LOTS

<u>Lot</u>	<u>Pairs</u>	<u>Pairs Recovered</u>	<u>% Recovered</u>	<u>Remarks</u>
1. Run-of-lab	100	80	80	
2. "Hot" room (3 day)	54	13	24	After second wash
3. "Hot" room (1 day)	24	21	88	

The recovered gloves were put out for use in the laboratories. There was a certain reluctance on the part of the users to take these gloves when new gloves were available. There were also some complaints that the recovered gloves had lost some of their elasticity and tore easily. This complaint was not borne out upon examination of the remaining gloves.

The entire operation of washing, monitoring, leak testing, powdering, sizing, and pairing a batch of 100 pairs of gloves required approximately two man days. Drying time is neglected. Using a figure of \$25.00 per man day, including overhead, the cost is \$50.00 per 100 pairs of gloves, and if only 80% is recovered, the cost is \$50.00 per 80 pairs of gloves, or \$0.625 per pair. With gloves selling at 15 to 20 cents per pair, the recovery of used gloves appears uneconomical at this time.