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**Compaction of Alpha
Contaminated Wastes**

William R. Herald and Don F. Luthy

January 30, 1976

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Miamisburg, Ohio

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INTRODUCTION

Being concerned for the impact of radioactively contaminated wastes upon the environment and since the cost of discarding such waste becomes increasingly more expensive, Mound Laboratory has adopted a policy to reduce the volume of this type of material which requires eventual burial or storage. A successful effort was made to reduce the volume of unnecessary materials, introduced into radioactive processing areas, which will eventually require disposal as contaminated waste.

Wastes generated in areas processing radioactive materials were considered for volume reduction by compaction. A program was instituted at the start of FY1975 to develop compaction techniques for these materials.

INITIAL EQUIPMENT INSTALLATION AND DEVELOPMENT OF PROCEDURES FOR ≤ 10 nCi/GRAM WASTE

Space was made available on the first floor of the Plutonium Processing Building (PP-Building) for the installation of the necessary equipment for the compaction study.

A commercial compactor sold by Consolidated Baling Machine Company (Model DOS-RAW-M) of Brooklyn, New York (Figure 1) was installed in PP-Building (Figure 2).

A temporary enclosure of wood framing covered with 0.005 in. plastic film was constructed around the compactor to lessen the possibility of spreading contamination. The exhaust fan from the compactor was vented into the building "hot" exhaust after filtration through double HEPA filters. Provisions were made to take air samples from the exhaust before and after the filter and from the room enclosure.

The compactor unit is basically a two-column, opensided, downstroke, hydraulic baler, modified to compact within a standard 55 gal. drum. (Figures 3 and 4 show the front and side view respectively of the basic compactor.)

A "drum support plate" is mounted on spring-loaded rollers on the base of the compactor. The plate facilitates movement of the drum from under the hydraulic cylinder for repeated loading and compacting of its contents.

An air exhaust system consisting of a hood, absolute filter, and exhaust fan is incorporated with the movement of the hydraulic cylinder. This system is so arranged that when the platen descends to compress material, the air exhaust system descends until the hood rests on the drum collar. Air from the drum being compacted is then drawn off and filtered. (See Figure 5).

The hydraulic cylinder is operated by a five G.P.M. hydraulic pump driven by a 3 hp motor. This cylinder has a 4 in. bore and a 35 in. stroke. An adjustable relief valve, adjustable pressure operated switch and a solenoid-operated, 4-way control valve are incorporated into the hydraulic system. The relief valve is set for approximately 1700 psi and the hydraulic system pressure set for 1590 psi which provides 10 tons operating force. The controls consist of one "up" button, two "down" buttons, and one "stop" button. The control panel was located several feet away from the compactor, exterior to the enclosure, to insure that the operator cannot be injured and to remove him from a possibly contaminated area. A safety switch on the drum support plate prevents operation of the hydraulic pump motor if the drum is not in the proper position for compaction of waste.

In operating the test unit, a 55-gal drum is placed on the drum support plate and secured with the drum clamp. A hopper is then placed on top of the drum. Waste is loaded and the full drum placed under the ram, compressed, rolled out from under the ram until no space remains to compact additional waste. The hopper is lifted from the drum, the clamp released, the drum placed on the floor where the lid is attached and secured. (See Figure 6.)

Waste was collected from the offices and cafeteria areas for the initial compaction tests giving a varied assortment of materials that may be encountered in the "hot" building operations. This waste consisted mainly of rags, plastic bags, tin cans, paper towels, etc. Compaction of these items presented no risk of contamination and allowed refinement of the equipment, procedures, and techniques. Several drums of this material were compacted using instructions supplied by the manufacturer. The main problem encountered was a too large and heavy hopper to be removed from one drum and reinstalled on another in the confines of the enclosure.

FIGURE 1 - Commercial compactor.

FIGURE 2 - Floor plan of PP Building.

FIGURE 3 - Basic commercial compactor (front view).

FIGURE 4 - Basic commercial compactor (side view).

FIGURE 5 - HEPA filter assembly on basic commercial compactor.

The unit was then modified by the addition of three "dog-ear" clamps to secure the hopper to the ram housing. This enabled the hopper to be lifted from the drum when the ram was in the retracted position, therefore negating the need for manually removing the hopper from the drum when exchanging an empty drum for a full one. While adding waste the "dog-ear" clamps are released and the hopper remains on the drum for holding waste. (See Figure 7).

When tests on the cold waste were completed and the test compactor operational, waste (≤ 10 nCi/g) from the processing area offices was collected and compacted. This material was collected in 30-gal drum liners. A fine talcum powder was mixed into the bag of trash. Bags of trash were then compacted to determine if any of the talcum escaped from the hood enclosure upon rupture of the containment bag.

No talcum or air flow could be measured on any of the test runs escaping from the drum hood into the enclosure. Air flow measurements showed velocity of 190 fpm which gave a total exhaust of 242 cfm on the drum hood.

At this point, compaction of ≤ 10 nCi/g waste was initiated on a routine basis.

DEVELOPMENT OF A PROCEDURE FOR COMPACTION OF ≥ 10 and ≤ 100 nCi/GRAM WASTES

Waste containing > 10 and ≤ 100 nCi/g requires a 20-yr retrievable package known as the TRU container. The difference in this package from that used for ≤ 10 nCi/g

FIGURE 6 - Hopper and hood of basic compactor (top view).

waste is a rigid 0.090 in. plastic liner with a separate lid which fits inside the standard 55-gal drum.

The TRU container was tested to determine if it was compatible with the compaction equipment. The test compactor platen was only $3/8$ in. smaller than the opening in the top of the TRU liner, which made alignment with the platen critical. Because of the design of the liner (the tapered opening is larger at the top), alignment upon entry was relatively easy. The loosely fitting liner inside the drum ($3/8$ in. difference in diameters of the liner and drum) and the differences in density of the materials to be compacted, caused the liner to shift during compaction of the waste. This shift of the liner caused the bottom of the liner lip to catch on the top edge of the platen upon retraction. This was solved by installing an inverted funnel on the top outside diameter of the platen. When the ram lifts the platen out of the liner, this funnel recenters the liner and prevents the platen from deforming the lip at the sealing surface. (See Figures 8 and 9).

Several drums were compacted using ≤ 10 nCi/g waste. These liners were sealed and removed from the drums. The liners were inspected for damage to sides and bottoms from the waste being compacted inside them. The liners were also inspected to determine if the "spring back" pressure would deform the sides or break the seal of the glued-on lid. After compaction and sealing, the first group of approximately 10 drums were observed for a period of one week for verification of

FIGURE 7 - Front view of basic compactor showing "dog-ear" clamp.

FIGURE 8 - Basic compactor platen (bottom view).

FIGURE 9 - Modified compactor platen and hopper doors (front view).

the seal integrity. The liners were then sealed in a 55-gal drum for retrievable storage. One hundred and thirty-six drums were compacted into forty-four for an average 3-to-1 ratio with the test compactor during the first four and one-half months of the fiscal year. All drums compacted contained ≤ 10 nCi/g waste. This ratio could have been higher but several methods and techniques were being developed to test procedures, therefore some drums were sealed when the tests were completed, although not completely full. Most drums were compacted at a 3.5 to 1 ratio but several were as low as 2 to 1, thus lowering the overall average.

The waste was delivered to the compactor in 55-gal drums by the decontamination group who had instructions to fill the drums as they normally would before sealing for burial. This provided an accounting of the number of drums input to the compactor as compared to the output. From

- A COMPACTOR
- B FILTER AND ROOM AIR EXHAUST
- C RADIATION MONITOR
- D AIR MONITOR FOR ROOM 46B
- E AIR MONITOR FOR ROOM 46A
- F PORTABLE ALPHA COUNTER
- G HYDRAULIC PUMP AND MOTOR
- H FLOOR DRAIN
- I TEST COMPACTOR

FIGURE 10 - New compaction facility.

this information, the resulting compaction ratio was calculated. This waste consists mainly of plastic bags, dry rags, paper, cardboard, shoe covers and various plastic articles.

DESIGN AND CONSTRUCTION OF NEW COMPACTION FACILITY

The new compaction area is divided into two rooms (See Figures 2 and 10). Both rooms have stainless steel walls and ceilings with a vinyl-epoxy coated concrete floor. (See Figures 11 and 12). Room 46A is designed for ≥ 10 nCi/g to ≤ 100 nCi/g waste compaction and exits into Room 46B which in turn exits to Corridor 10. The rooms are also designed to have increasingly higher air pressure when moving from Room 46A to Corridor 10. As Room 46A is the area most likely to have a release of radioactivity, this flow of air is designed to keep the contamination from spreading. Room 46A is

FIGURE 11 - Modified compactor in Room 46A.

FIGURE 12 - Room 46A, stainless steel ceiling.

FIGURE 13 - Modified compactor.

equipped with a remotely controlled sprinkler system to wash down the compactor, walls, ceiling and floor. With an injector, solution can be introduced into the sprinkler system to clean the room of any surface contamination before personnel enter the room. This cleaning solution is drained by floor outlets to the low-level contamination solution storage tank. The injector system permits more efficient and safer decontamination of the area which reduces down time following a release of contamination. To prevent electrical shorts during sprinkler operation,

FIGURE 14 - Caisson HEPA filter on modified compactor (46A).

Room 46A has sealed lighting fixtures and two watertight switches on the compactor. All other electrical equipment has been removed to Room 46B or Corridor 10. Room 46B does not have the same degree of protection because a lower level (≤ 10 nCi/g) of waste will be compacted. Each room is equipped with two continuous air samplers and an air monitor. The HEPA filter is also equipped with a before and after remote air sampling system. With the air sampling system and a differential pressure gauge, the efficiency of the filtration system is being monitored.

FIGURE 15 - Drum and HDPE liner which make up TRU package.

FIGURE 16 - Loading waste into (46A) compactor.

A compactor of the same type and model number as used in the tests was installed in Room 46A (Figure 13). Several modifications were made to this compactor to improve its operational capability. (See Figure 9). First, the drum hopper was welded to the drum hood. This takes the place of the "dog-ear" clamps on the test compactor. An opening was cut in the side of the drum hopper, and two outside-hinged doors added. An integral part of the door latch is a magnetic switch which cuts off power to the compactor hydraulic pump when the doors are opened. Second, the improved platen developed for use with the TRU package was installed on the Room 46A compactor. The air exhaust system as originally supplied with the compactor was discarded and the drum hood was altered to accept a Caisson HEPA filter. (See Figure 14). This filter measures 2 x 2 x 1 ft and is easily changed. The air flow measures 600 cfm. All air from Room 46A and 46B is exhausted through this filter to the building "hot" air filtration system. A damping device was installed on the Caisson prefilter housing to insure that the room air balance is independent of the compactor operation.

In operating the compactor the drum support plate is pulled out from under the hood. A 55-gal drum or TRU package (See Figure 15) is secured in position by the drum support clamp. The drum is positioned under the drum hood. The drum hood is opened and waste, checked for radiation and noncompactables, is placed in the drum until full. (See Figure 16). The doors are closed and the operator leaves Room 46A and enters Room 46B to the controls by the entrance. (See Figure 17). The two

"down" buttons are pressed simultaneously and held in until the pressure operated switch turns the hydraulic pump off and stops downward movement of the ram. The "up" button is pressed to return the platen and ram to the loading position. The loading position is indicated by a pointer which is activated by the platen. The operator reenters Room 46A and opens the hood doors. Additional waste is loaded until the drum and drum hood are full. The doors are closed and the controls are activated again. This process is repeated until the drum is full. The drum is considered full when the waste, after spring-back, is approximately 2 in. from the top of the drum or drum liner. When the drum is full the "up" button is pressed until the drum hood lifts off the drum. The drum is rolled out from under the hood on the drum support plate and the drum support clamp is removed. The drum is placed on the floor, checked for contamination and moved to the drum lid securing area. In the last 7.5 months of FY-1975, the new compactor has compacted 269 drums of ≤ 10 nCi/g waste into 71 drums for a ratio of 3.8. This waste was similar to the drums compacted with the test compactor. For the entire FY-1975, 405 ≤ 10 nCi/g drums were compacted into 115 drums, yielding a compaction ratio of 3.5. This ratio would be higher, however, several test runs were included in the data. After the first month of operation, higher level ≥ 10 - ≤ 100 nCi/g waste was compacted. During the last 6 months of the first year of operation, 140 drums of waste were compacted into 37 drums for a ratio of 3.8 for ≥ 10 - ≤ 100 nCi/g waste.

After one month of operation, it became necessary to increase the opening in the drum hopper. Each week several bags of waste were received which could not easily be inserted into this opening. Upon evaluation of the drum hopper and door structure, a 2 in. section of support behind the door was removed. This allowed about 50 in.² more of usable opening without weakening the drum hopper.

A method to increase the ratio of >10 to ≤ 100 nCi/g waste was developed. Initially, due to the liner used with this type of waste, the operation was limited to 3 drums in for every 1 out. The liner has a glued-on top and a large spring-back pressure made it difficult to properly secure the lid. Higher compaction ratios were achieved using the following technique.

A lid from a rejected liner was cut in approximately 8 places around the sealing edges, enabling the lid to be pushed inside the liner by the platen. More waste could then be added and the liner lid placed on top. When the waste enters the liner, the lid follows, and upon removal of the ram the spring-back of the waste forces the lid to catch on the back side of the liner sealing area (Figure 18). The regular lid can then be secured with no internal force from the spring-back of the waste. This allowed $\sim 3/4$ of a drum more to be put into each liner. An additional benefit is that this arrangement gives a stronger package because a larger internal force is needed to break the liner-lid seal.

Another method found to achieve a greater compaction ratio for ≥ 10 nCi/g waste was to lengthen the duration of the compression stroke by leaving the ram down longer. Waste is compacted in the normal

manner until the drum is full, then the ram is lowered, forcing the waste into the drum. When the ram is withdrawn this waste will expand and be above the top of the drum. The hood is filled again and the ram is lowered. When the back pressure shuts down the hydraulic pump, the doors are opened to see if the platen is below the top of the drum. The ram is raised and more waste added until the platen is approximately 5 in. below the top of the drum on the compression stroke. The ram is then lowered again and left in this position for approximately 24 hours. With this extended pressure on the waste, the spring-back is reduced and the drum lid can easily be secured. This procedure allows an extra $1/3$ to $3/4$ drums of waste to be compacted into a drum. The extended pressure is used only for ≤ 10 nCi/g waste for two reasons. First, ≥ 10 nCi/g to ≤ 100 nCi/g waste does not have as much spring-back because of the large amounts of damp rags in this category. The second reason is the greater possibility for contamination of the compactor.

In the future, more development needs to be completed in several areas to increase the efficiency of the compactor. Some plastic materials such as bags and bottles

FIGURE 17 - Operating compactor (46A) from Room 46B.

A - Lid Used To Control Spring Back
B - Final Lid For Sealing

FIGURE 18 - TRU liner system for compaction.

have a greater spring-back than average waste. The spring-back in a drum of ≤ 10 nCi/g waste is 1 to 1-1/2 ft, plastic may be 1 to 2 ft. This may be reduced by shredding all < 10 nCi/g waste before compaction. Another area of investigation would be the segregation and heating of plastic to or near the melting point prior to compaction. A different method could be the use of a tight fitting disk to hold

the material inside the drum, not allowing the expansion after the platen is withdrawn from the drum. These methods would not be advisable on ≥ 10 - ≤ 100 nCi/g waste because of the higher levels of radiation encountered and the possible damage to the liner.

See Table 1 for compactor summary data.

Table 1
COMPACTOR SUMMARY DATA SHEET

	≤ 10 nCi/g				> 10 - ≤ 100 nCi/g			
	Drums Received	Drums Out	Avg. Wt. (lbs)	Ratio	Drums Received	Drums Out	Avg. Wt. (lbs)	Ratio
<u>1974</u>								
July	27.8	10	233	2.78				
August	24.75	8	251	3.09				
September	41.5	13	230	3.19				
October	30	9	241	3.33				
November	30	10	218	3.0				
December	29.5	9	229	3.28	7.5	2	313	3.75
<u>1975</u>								
January	48	14	220	3.43	25.5	7	268	3.64
February	32.5	9	211	3.61	24.5	7	282	3.5
March	50.5	10	234	5.05	15	4	286	3.75
April	42	11	243	3.8	16	4	332	4.0
May	20	5	262	4.0	28	7	305	4.0
June	28	7	260	4.0	24	6	323	4.0
July	12	3	261	4.0	16	4	310	4.0
August	24	6	256	4.0	24	6	299	4.0
September	16	4	268	4.0	24	6	295	4.0

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