asme radwaste course

COMPACTION

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ASME RW Systems Committee Radwaste Short Course - 1991
BWR: 1981 PLANT AVERAGE

COMPACTIBLE DAW

Average ft³/Unit: 15.350

PLASTIC 25.0

CLOTH 11.0

FER 6.0

RUBBER 5.0

TOTAL 3.0

OTHERS 6.0

NOC 5.0

Average ft³/Unit: 7.200

NON-COMPACTIBLE DAW

PIPE/PLY 17.0

CONDUIT 8.0

FILT FA 5.0

COM-MLG 3.0

CONCRETE 3.0

GLASS 4.0

LEAD

Figure 4-9

4-25
IN DRUM COMPACTORS
BASIC CONSIDERATIONS

HYDRAULIC MOTOR SIZE (AT FULL LOAD)

\[ HP = \frac{GPM \times PSI}{1714 \times \text{EFF.}}, \text{ NOTE EFF.} +0.85 \]

RAM SPEED

\[ v = \left( \frac{Q}{A} \right) \times 231 \quad v = \text{IN./MIN.} \]

\[ A = \text{IN SQ.} \]

\[ Q = \text{GPM} \]

EXAMPLE: 30 TON DRUM COMPACTOR, 6 INCH CYLINDER
FLOW HI/LO 15 GPM / 7 GPM @ 2100 PSI

\[ HP (HI) = 15 \times 2100 / (1714 \times 0.85) = 22 \text{ HP} \]

\[ HP (LO) = 7 \times 2100 / (1714 \times 0.85) = 10 \text{ HP} \]

\[ v (HI) = 15 \times 231 / 28 = 124 \text{ IN./MIN.} \]

\[ v (LO) = 7 \times 231 / 28 = 58 \text{ IN./MIN.} \]

PLATEN PRESSURE (WITH 55 GALLON DRUM)

30 TONS = 130 PSI

15 TONS = 65 PSI
JOG FUNCTION – REDUCED SPEED AND PRESSURE
EXAMPLE 15 IN/MIN. AT 1 TON PRESSURE

ROD SIZE – DIA. OF PISTON / DIA. OF ROD

NORMAL ROD – 2 TO 1

COMPACTION ROD – 3 TO 1, 6 TO 5

NOTE ADDITION OF ROD STOP IS DESIRABLE

STARTERS AND CONTACTORS – NEMA PREFERRED

EASE OF DRUM LOADING

HEPA FILTRATION DESIGN FOR POSITIVE AIR CONTROL

NORMAL DRUM COMPACTORS PERFORMANCE

30 TO 45 #/CU.FT.
AVERAGE DAW COMPACTION DENSITIES
WITH/WITHOUT ANTI-SPRING BACK DEVICES

LEGEND:
- WITH A580
- WITHOUT A580

PLANTS
Figure 4-9

4-75
GETTING THE MOST OUT OF A DRUM COMPACTOR

1. DEDICATED CREW

2. DETERMINE BEST ANTI-SPRINGBACK SYSTEM

3. SORTING PRIOR TO COMPACTION

4. SEGREGATION OF WASTE
   BOTTOM 1/3 – PLASTIC
   MIDDLE 1/3 – HERCULITE
   TOP 1/3 – MISC. (HEAVY NON-COMP.)

5. GOALS AND COMPETITION
   Make tickets (?) or minimum allocations
DEDICATED VS ROTATING CREWS
WITH/WITHOUT ANTI-SPRING BACK DEVICES

LEGEND:

▌ WITH ASBO
□ WITHOUT ASBO

AVGAGE NET COMPACTED DENSITY

6.0 16,0 24.0 32.0 40.0 48.0 56.0

Figure 4-10
COMPACTOR OPERATIONS

4-76
CUTAWAY VIEW
55 GALLON DRUM WITH ANTI SPRING-BACK DEVICE
COMPACTING DISC SHOWN IN PLACE
BOX COMPACTORS

BASICS

1. COMPACTION FORCE - RANGE 50 TO 250 TONS
2. COMPACTION VOLUME - APPROX. 90 CU. FT.
3. PLATEN PRESSURE - 30 TO 150 PSI

ADVANTAGES

1. LARGE LABOR SAVINGS - DUE TO NO. PACKAGES
2. REDUCTION IN SHIPPING (FACTOR OF 10)
3. SAVINGS IN STORAGE SPACE (SAME DENSITY)

PERFORMANCE

NORMAL OPERATING RANGE 30 TO 37 $/# CU.FT.
**TABLE I**

EPRI 1981 BWR PLANT Average Waste Composition

<table>
<thead>
<tr>
<th>Compactible - 68% of total</th>
<th>Noncompactible - 32% of total</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Rubber</strong> - (insulation off wire)</td>
<td><strong>Wood</strong> - (larger boards, wood frames, pallets)</td>
</tr>
<tr>
<td><strong>Plastic</strong> - (sheets, rolls, buckets)</td>
<td><strong>Lead</strong> - (lead sheets, bricks)</td>
</tr>
<tr>
<td><strong>Paper</strong> - (sheets, tarpaulin, sheetrock)</td>
<td><strong>Tools</strong> - unable to process through shredder</td>
</tr>
<tr>
<td><strong>PVC</strong> - (pipes, tubes)</td>
<td><strong>Conduit</strong> - (long metal pipes)</td>
</tr>
<tr>
<td><strong>Metal</strong> - (small pipes, sheets)</td>
<td><strong>Concrete</strong> - (blocks, asphalt)</td>
</tr>
<tr>
<td><strong>Wood</strong> - (small pieces of boards, plywood)</td>
<td><strong>Glass</strong> - (broken fluorescent tubes)</td>
</tr>
<tr>
<td><strong>Cloth</strong> - (canvas, threaded plastic)</td>
<td><strong>Dirt</strong> - (soil placed in bags)</td>
</tr>
<tr>
<td><strong>Others &amp; Misc.</strong> - (tins, barrels, wiring, trailer underpinning)</td>
<td><strong>Filters</strong> - (unused HEPA filter)</td>
</tr>
<tr>
<td></td>
<td><strong>Filter Frames</strong> - (AC unit, metal/paper units)</td>
</tr>
<tr>
<td></td>
<td><strong>Composite Materials</strong> - (chairs, cushions)</td>
</tr>
<tr>
<td></td>
<td><strong>Pipe</strong> - (large/long metal pipes)</td>
</tr>
<tr>
<td></td>
<td><strong>Misc.</strong> - (3-ply copper tubing/rubber, ladders)</td>
</tr>
</tbody>
</table>

**Fig. 1.** Shredded Material Density Versus Compactor Ram Pressure.
<table>
<thead>
<tr>
<th>Material</th>
<th>Waste Only</th>
<th>Waste/Drums and Overpack</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wood - Soft Pine*</td>
<td>80</td>
<td>93</td>
</tr>
<tr>
<td>Silica Sand*</td>
<td>114</td>
<td>123</td>
</tr>
<tr>
<td>Steel Chips*</td>
<td>231</td>
<td>270</td>
</tr>
<tr>
<td>Onionskin Paper</td>
<td>85</td>
<td>98</td>
</tr>
<tr>
<td>PVC Sheet</td>
<td>59</td>
<td>74</td>
</tr>
<tr>
<td>Check Paper #24, Type 2</td>
<td>78</td>
<td>91</td>
</tr>
<tr>
<td>Clay Paper, Type 1</td>
<td>58</td>
<td>73</td>
</tr>
<tr>
<td>Tagboard</td>
<td>77</td>
<td>90</td>
</tr>
<tr>
<td>Shop Rags</td>
<td>88</td>
<td>100</td>
</tr>
<tr>
<td>Computer Paper</td>
<td>82</td>
<td>94</td>
</tr>
<tr>
<td>Glass</td>
<td>131</td>
<td>138</td>
</tr>
<tr>
<td>Concrete Rubble*</td>
<td>119</td>
<td>127</td>
</tr>
<tr>
<td>Average of the Above</td>
<td>104</td>
<td>115</td>
</tr>
</tbody>
</table>

* *Non-Compactible in Conventional Equipment*

<table>
<thead>
<tr>
<th>Material</th>
<th>Waste Only</th>
<th>Waste/Drums and Overpack</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compactible</td>
<td>82 lb/cu. ft.</td>
<td>95 lb/cu. ft.</td>
</tr>
<tr>
<td>Non-Compactible</td>
<td>148 lb/cu. ft.</td>
<td>153 lb/cu. ft.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Material</th>
<th>Conventional Lb/Cu. Ft.</th>
<th>1500 Ton Lb./Cu. Ft.</th>
<th>Volume/Reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compactible</td>
<td>20 to 40</td>
<td>74</td>
<td>1.85 to 3.7</td>
</tr>
<tr>
<td>Non-Compactible</td>
<td>30</td>
<td>133</td>
<td>4.8</td>
</tr>
</tbody>
</table>
SUPERCOMPACTORS

RANGE OF FORCE - 1,000 TO 2,200 TONS
(5,000 TONS) SEG

DIMENSIONS (PRESS) HEIGHT 11 TO 15 FT.
BASE 5 TO 8 FT.

WEIGHT 30 TO 50 TONS

HYDRAULIC SYSTEM PRESSURE - 3,000 TO 4000 PSI
PUMPS - GEAR, GEAR + PIST

DIMENSIONS - 8 X 8X 8 FT.

CONTROL SYSTEM - PLC CONTROLLED, MANUAL

PROCESS RATE - MACHINE RATE APPROX 2.5 MIN.
PER DRUM
NORMAL OP. APPROX 5 MIN.
PER DRUM

PLANT SERVICES - ELECTRICAL 200 AMPS

PLATEN PRESSURE - 5 TO 10,000 PSI

PERFORMANCE RANGE - 60 TO 120 #/CU.FT.
<table>
<thead>
<tr>
<th>CAMPAIGN</th>
<th>FACILITY</th>
</tr>
</thead>
</table>
| 1        | National laboratory test program  
Waste: range of test drums containing various materials, e.g. metal, plastic, rubble, etc. |
| 2        | Nuclear fuel facility operating waste material  
Waste: mixed waste material, e.g. plastic, paper, etc. |
| 3        | U.S. BWR nuclear power plant  
Waste: mixed waste, e.g. high plastic, paper, etc. |
| 4        | Waste broker facility  
Waste: mixed waste from institutional and smaller nuclear waste generators |
| 5        | U.S. BWR-1 nuclear power plant waste first campaign.  
Waste: mixed waste, e.g. high plastic, paper, etc. |
| 6        | Spanish BWR power plant - inefficient overpacking  
Waste: mixed, waste, e.g. plastic, paper, small fraction of metallic waste material |
| 7        | Italian BWR power plant  
Waste: mixed waste, e.g. plastic, paper, and a significant fraction of metallic waste material which was mixed into the other waste material being compacted. |
| 8        | U.S. BWR-1 nuclear power plant waste second campaign.  
Waste: see Item 5. |
| 9        | U.S. BWR-1 nuclear power plant waste third campaign  
Waste: see Item 5; input drums 52 gallon |
| 10       | U.S. PWR-1 nuclear power plant first campaign  
Waste: mixed waste, e.g. plastic and paper |
| 11       | National laboratory test program utilizing grout  
Waste: mixed waste, e.g. plastic, paper. Crushed drums were grouted into large overpacks. |
| 12       | German BWR power plant  
Waste: mixed, waste; however, this plant incinerates paper, plastic, etc. and the waste material supercompacted has significant fraction of metallic waste material. |
| 13       | Waste broker facility  
Waste: mixed waste from institutional and smaller nuclear waste generators. |
| 14       | U.S. PWR-1 nuclear power plant second campaign  
Waste: see Item 10 |
| 15       | U.S. DOE fuel facility first campaign  
Waste: mixed waste |
| 16       | U.S. DOE fuel facility second campaign  
Waste: high fraction of scrap metal |
<table>
<thead>
<tr>
<th>Campaign</th>
<th>No. Of Drums</th>
<th>Input Drums (Gals.)</th>
<th>Average Waste Density Start (Lb/Ft(^3))</th>
<th>Average Gross Weight (Pounds)</th>
<th>Average Waste Density Final (Lb/Ft(^3))</th>
<th>VRF Pucks</th>
<th>VRF Burial</th>
<th>Over-Pack (Gals.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>23</td>
<td>55</td>
<td>21</td>
<td>207</td>
<td>141</td>
<td>6.7:1</td>
<td>3.7:1</td>
<td>83</td>
</tr>
<tr>
<td>2</td>
<td>40</td>
<td>55</td>
<td>20</td>
<td>144</td>
<td>112</td>
<td>5.6:1</td>
<td>3.4:1</td>
<td>83</td>
</tr>
<tr>
<td>3</td>
<td>552</td>
<td>52</td>
<td>24</td>
<td>194</td>
<td>67</td>
<td>2.8:1</td>
<td>2.1</td>
<td>55 &amp; 46</td>
</tr>
<tr>
<td>4</td>
<td>637</td>
<td>55</td>
<td>28</td>
<td>262</td>
<td>92</td>
<td>3.3:1</td>
<td>2.2:1</td>
<td>89</td>
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<td>5</td>
<td>1053</td>
<td>55</td>
<td>28</td>
<td>258</td>
<td>73</td>
<td>2.6:1</td>
<td>1.9:1</td>
<td>80 &amp; 95</td>
</tr>
<tr>
<td>6</td>
<td>1383</td>
<td>58</td>
<td>40</td>
<td>348</td>
<td>96</td>
<td>2.4:1</td>
<td>2.2:1</td>
<td>83</td>
</tr>
<tr>
<td>7</td>
<td>1000</td>
<td>58</td>
<td>18</td>
<td>185</td>
<td>70</td>
<td>3.88:1</td>
<td>2.9:1</td>
<td>83</td>
</tr>
<tr>
<td>8</td>
<td>475</td>
<td>55</td>
<td>28</td>
<td>261</td>
<td>76</td>
<td>2.7:1</td>
<td>*</td>
<td>80 &amp; 95</td>
</tr>
<tr>
<td>9</td>
<td>207</td>
<td>52</td>
<td>30</td>
<td>250</td>
<td>62</td>
<td>2.1:1</td>
<td>*</td>
<td>55</td>
</tr>
<tr>
<td>10</td>
<td>674</td>
<td>52</td>
<td>25</td>
<td>207</td>
<td>60</td>
<td>2.4:1</td>
<td>2.1:1</td>
<td>55</td>
</tr>
<tr>
<td>11</td>
<td>300</td>
<td>55</td>
<td>12</td>
<td>143</td>
<td>66</td>
<td>5.5:1</td>
<td>2.9:1</td>
<td>125 Gross</td>
</tr>
<tr>
<td>12</td>
<td>5000</td>
<td>52</td>
<td>25</td>
<td>206</td>
<td>110</td>
<td>-</td>
<td>3.65:1</td>
<td>55</td>
</tr>
<tr>
<td>13</td>
<td>349</td>
<td>55</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>2.6:1</td>
<td>79</td>
</tr>
<tr>
<td>14</td>
<td>713</td>
<td>52</td>
<td>24</td>
<td>199</td>
<td>55</td>
<td>-</td>
<td>2.1:1</td>
<td>55</td>
</tr>
<tr>
<td>15</td>
<td>4000</td>
<td>55</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>3.19:1</td>
<td>79</td>
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<tr>
<td>16</td>
<td>1200</td>
<td>55</td>
<td>57</td>
<td>475**</td>
<td>142</td>
<td>-</td>
<td>2.5:1</td>
<td>79</td>
</tr>
</tbody>
</table>

*Over-pack Filled with Contaminated Dirt.

**All Metal.

***Density Without Waste Container Weight.

1/19/88
MOBILE SUPERPACK® SYSTEM
Fig. 1 High Force Compactor (HIFOC)
Figure 4-3

4-13