Editor’s Note: This article on pallet disposal and Municipal Solid Waste sites includes material presented by Dr. Bush at the recent NWPCA Recycling Meeting. This is the first in a two-part series; the second will discuss pallet disposal in construction and demolition sites.

Summary

We estimate that 185 million pallets went through Municipal Solid Waste landfill gates in 1995. About 17 percent of these were recovered, but to low or no revenue uses. About 1/3 would not accept pallets as-is.

Many Want to Know

How many pallets are ending up in landfills? Are any being recovered? This is the first of two articles on landfill disposal of wood pallets in the United States to answer these and other questions dealing with the fate of pallets. In this article we will focus on municipal solid waste (MSW) landfills, and in the second article we will describe the situation at construction and demolition (C&D) landfills.

The study was conducted by the Center for Forest Products Marketing at Virginia Tech in cooperation with the USDA Forest Service Southern Research Station unit at Virginia Tech. This is one of several industrial tracking studies conducted by the Center for Forest Products Marketing. This study is also part of an overall pallet repair and recycling research program for the Southern Research Station and in conjunction with Virginia Tech’s Department of Wood Science and Forest Products.

A History of Surveying

Industry surveys are a specialty of the Center for Forest Products Marketing. Recent surveys include material use by pallet, furniture and cabinet manufacturers, along with pallet repair and recycling. The Center has been estimating the volumes of wood materials used and quantities of wood pallets repaired and recycled by the pallet and container industry in the US since 1992.

Each year a large number of new wood pallets are manufactured using approximately 40% of the hardwood lumber produced in the US. Each year the pallet and container industry receives a significant quantity of wood pallets for recycling.

In addition, many pallets end up in landfills, rendering this resource useless. Prior to our study no information was available regarding the number of pallets reaching US landfills for landfilling as-is and for recycling.

In this paper we focus on pallet waste received and recovered at MSW landfills. However, we do estimate the total quantity of all types of waste and the quantity of wood waste received at these landfills in 1995. In addition, we estimate the amount of yard/wood waste and pallet waste received for recycling in 1995 and the various uses of recovered pallets.

Response Rate Was Good

Following a thorough pre-test and pilot-test, a questionnaire was mailed in March 1996 to 1,690 randomly selected MSW facilities in the US (excluding Alaska and Hawaii). The response rate for the study was 40 percent.

Figure 1 illustrates the number and percentage of responses received from each region. The number of responses received from the Midwest, Northeast, South, and West regions was 107 (20.8% of the total), 68 (13.2%), 198 (38.5%), and 141 (27.4%), respectively. The number of responses received from each region corresponds well to the number of licensed MSW landfills in each region. We estimated that there were approximately 2,829 state licensed MSW landfills in operation when the survey was conducted and that 19.5% were located in the Midwest, 13.3% in the Northeast, 38.8% in the South, and 28.4% in the West.

Total Waste at MSW Landfills

On average 103.3 thousand tons of waste were received at each MSW landfill in 1995. Landfills in the South accepted more waste, on average, than landfills in any other region. An average landfill in the South accepted 118.6 thousand tons of waste, while those in the West accepted 84.2 thousand tons. Landfills in the South also accepted the highest proportion of yard/wood waste, at 38.4%, compared to 27.3% in the West and 26.7% in the Northeast.

Figure 1. Number of usable responses received from each region
thousand tons of waste where as an average landfill in the West, Northeast, and Midwest regions accepted 107.1, 97.5, and 73.2 thousand tons of waste in 1995, respectively.

We estimate that approximately 293 million tons of waste were received at MSW facilities in the US. Figure 2 provides the breakdown by each region. The South received the greatest amount of waste, approximately 130 million tons or 44.4% of the total waste received in 1995.

**Tipping Fees**

Nationwide, the average tipping fee at MSW landfills was $32.22 per ton. However, tipping fees are quite variable between and even within regions. Landfills in the Northeast region assessed a higher
Table 1. Percentage of MSW landfills accepting wood pallets for landfilling as-is and percentage operating a wood/yard waste processing facility: 1995

<table>
<thead>
<tr>
<th>Region</th>
<th>Percentage accepting wood pallets for landfilling as-is (%)</th>
<th>Percentage operating a wood or yard waste processing facility (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Midwest</td>
<td>71.0</td>
<td>30.8</td>
</tr>
<tr>
<td>Northeast</td>
<td>55.9</td>
<td>38.2</td>
</tr>
<tr>
<td>South</td>
<td>63.6</td>
<td>49.5</td>
</tr>
<tr>
<td>West</td>
<td>77.3</td>
<td>27.0</td>
</tr>
<tr>
<td>United States</td>
<td>67.9</td>
<td>37.9</td>
</tr>
</tbody>
</table>

Some tipping fees were lower for pallets received to be recycled at the landfill.

Wood Waste

In 1995 wood waste accounted for 7.3% of the total waste received at MSW landfills in the US. In other words, 21.4 million tons of wood waste went to MSW landfills in 1995. Wood waste includes not only pallets but boxes, dunnage, packaging, yard trimmings and other non-industrial wood discards. Landfills in the South received approximately 48% of the estimated 21.4 million tons of wood waste. The Western region accounted for approximately 29% of the total wood waste received in 1995. The Northeast region received the least amount of wood waste, 11.4% of the total. However, there was not much difference between the regions in terms of the percentage of waste that was wood. That is, the wood content of MSW was relatively constant, regardless of the total volume of waste received in the region. Approximately 8% of the waste received in the South and 6% of waste in the Midwest was wood. In the West and Northeast regions wood waste accounted for 7.3% and 6.6% of the total waste received, respectively.

Wood Pallet Waste

Are wood pallets accepted at MSW landfills for landfilling as-is (i.e., without processing such as grinding)? If so, what percentage of landfills accept wood pallets for landfilling as-is? How many wood pallets were landfilled in 1995?

Currently some 32% of MSW facilities do not accept wood pallets for landfilling. However, more than one-third of MSW landfills have a wood or yard waste facility where pallet waste can be processed and/or recycled. Table 1 provides the percentage of landfills that accept wood pallets for landfilling. In the Northeast, only 56% of MSW landfills accepted wood pallets for landfilling. In contrast, 77% of landfills in the West accepted wood pallets for landfilling.

We were also interested in knowing the quantity of wood pallets received at landfills that were actually landfilled without processing. We estimate that, in 1995, approximately 4.2 million tons of pallet material were landfilled in the US.

tipping fee ($53.30/ton) than landfills in any other region. The average tipping fee in the West ($26.40/ton) was lower than that of any other region. The tipping fees in the Midwest and South were $31.40 and $29.30 per ton of waste, respectively.
Table 2. Estimated quantity of wood pallet material landfilled at MSW facilities in the contiguous United States by region: 1995

<table>
<thead>
<tr>
<th>Region</th>
<th>Estimated quantity of wood pallet material landfilled (thousand tons)</th>
<th>Pallet material as a percentage of total waste landfilled (%)</th>
<th>Pallet material as a percentage of the total wood waste landfilled (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Midwest</td>
<td>725.6</td>
<td>1.8</td>
<td>29.3</td>
</tr>
<tr>
<td>Northeast</td>
<td>290.3</td>
<td>0.8</td>
<td>11.9</td>
</tr>
<tr>
<td>South</td>
<td>2,480.6</td>
<td>1.9</td>
<td>24.2</td>
</tr>
<tr>
<td>West</td>
<td>700.6</td>
<td>0.8</td>
<td>11.1</td>
</tr>
<tr>
<td>United States</td>
<td>4,197.2</td>
<td>1.4</td>
<td>19.6</td>
</tr>
</tbody>
</table>

(Table 2). This equals 1.4% of the total waste and 19.6% of total wood waste landfilled at MSW facilities in the US. If we assume that each pallet weighs 55 lb., approximately 153 million wood pallets were landfilled in the US in 1995.

Municipal solid waste facilities in the South landfilled the largest quantity of wood pallet material, 2.4 million tons or 59% of the total wood pallet material landfilled. The Midwest region landfilled the second largest quantity of wood pallet material, 17% or approximately 726 thousand tons.

In the South, pallet material accounted for 1.9% of total waste landfilled (all types). In the Midwest, Northeast, and Western regions, wood pallet material accounted for 1.8%, 0.8%, and 0.8% of the total waste landfilled, respectively. However, in terms of wood pallets as a percentage of total wood waste landfilled, the Midwest emerged as the number one region with 29.3% of its wood waste being pallet waste. In the South, pallet waste was 24.2% of the total wood waste landfilled.

MSW Landfill Recycling And Tipping Fees

As mentioned, over one-third (37.9% to be exact) of the responding MSW landfills operated a wood/yard waste processing facility (Table 1). In the South, almost one-half of the landfills operated a processing facility. The percentage of landfills that manage a wood/yard waste processing facility in the Midwest, Northeast, and West was 30.8, 38.2, and 27.0, respectively (Table 1). In addition, over 6% of the respondents indicated that they have plans to operate a wood/yard waste processing facility within the next two years. There appears to be interest in recycling of wood/yard waste, primarily to save landfill space and secondarily to recover the wood.

The landfills that have a processing facility are either banning the landfilling of wood pallets or provid-
Table 3. Regional mean tipping fees for wood pallets at MSW landfills in the contiguous United States that operate wood/yard waste processing facilities: 1995

<table>
<thead>
<tr>
<th>Region</th>
<th>At landfill for landfilling as-is</th>
<th>At wood/yard waste processing facility</th>
</tr>
</thead>
<tbody>
<tr>
<td>Midwest</td>
<td>29.40</td>
<td>19.33</td>
</tr>
<tr>
<td>Northeast</td>
<td>57.80</td>
<td>32.46</td>
</tr>
<tr>
<td>South</td>
<td>30.70</td>
<td>23.08</td>
</tr>
<tr>
<td>West</td>
<td>32.80</td>
<td>22.85</td>
</tr>
<tr>
<td>United States</td>
<td>34.90</td>
<td>23.90</td>
</tr>
</tbody>
</table>

Landfills in the Northeast region provide the greatest financial incentive to recover pallets in the form of a tipping fee differential of over $25 per ton.

Wood Pallets Recovered & Recycled

In 1995, 7.4 million tons of wood/yard waste were received for recycling at landfill processing facilities. Figure 3 provides the quantity of wood/yard waste received for recycling in each region.

Of the 7.4 million tons of wood/yard waste, 880.8 thousand tons (11.9%) were wood pallet material. Again, if we assume that a pallet that is received at recycling facility weighs 55 lb., 32 million pallets were received at MSW processing facilities. The Southern region accounted for 60.6% of this wood pallet material. Figure 4 provides the quantity of wood pallet material recycled in each region.

When asked how the volume of wood pallets processed at wood/yard waste facilities has changed over the past two years, 24% of the respondents reported that the volume has increased. The average increase was approximately 8%. Nearly 16% of the respondents reported a decrease in volume and the average decrease was 4.3%. In addition, 48% of the respondents indicated that the volume of pallets received for recycling has not changed over the past two years. Approximately 13.5% of the respondents reported that they have been operating the wood/yard waste processing facility for fewer than two years and therefore could not comment on changes.

How was the pallet material used at the processing facilities? Grinding or chipping was the most common process used. Approximately 38 percent of the ground or chipped material was used for mulch, animal bedding, compost, soil amendment, core material for particleboard, and similar uses. Nearly 8% of the reduced material was used as landfill or road cover and another 34% of the ground or chipped material was used for fuel. Approximately 3% of the pallet material was reused as pallets. Table 4 provides the percentage of pallet material used for various purposes.

Figure 5 shows the percentage of pallets landfilled and used for those pallets that are recovered.

Approximately 58% of the recyclers reported that they give away ground or chipped pallet material. Of the respondents who sell ground or chipped pallets, the average (mean) sale price was $13.17 and the median sale price was $10.67.

So What Might All of This Mean

It means that we should be concerned about 185 million pallets going through landfill gates. And therefore, we need to think about municipal solid waste landfills being good sources for:

- used pallets to repair
- replacement boards
- colorized mulch material
- fuel pellet stock
- board products fiber

Use your imagination.

Another Thought

A substantial quantity of wood pallets is entering US landfills each year, thus rendering this valuable resource useless. Producers of wood pallet waste believe that it is more cost effective to send the used pallets to landfills than finding a recycler or putting them into

Figure 3. Estimated regional quantity and percentage of wood/yard waste recycled in 1995.

Total = 7.4 Million Tons

South 53.6%

Northeast 8.4%

Midwest 5.9%

West 32.1%
Figure 4. Estimated regional quantity and percentage of wood pallet material recycled in 1995.

Total = 880.8 Thousand Tons

- South 60.5%
- Northeast 14.1%
- Midwest 7.7%
- West 17.7%

Landfilled = 83%   Recovered = 17%

- Re-used as pallets (3.07%)
- Fuel (as-is) (6.7%)
- Landfill cover (7.8%)
- Ground for fuel (34.5%)
- Ground for mulch, compost, bedding, etc. (37.9%)
- Other (9.43%)

Figure 5. Percent of wood pallet landfilled and recovered and the recovery uses.
Table 4. Quantity and percentage of pallet material recovered for various uses at MSW landfills in the contiguous United States that have a recovery facility: 1995

<table>
<thead>
<tr>
<th>Use of recycled pallet material</th>
<th>Quantity recovered for each use (thousand tons)</th>
<th>Percentage recovered for each use (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Given away or sold as-is for reuse as pallets</td>
<td>29.0</td>
<td>3.3</td>
</tr>
<tr>
<td>Given away or sold as-is for fuel</td>
<td>59.5</td>
<td>6.8</td>
</tr>
<tr>
<td>Ground or chipped for fuel</td>
<td>300.1</td>
<td>34.1</td>
</tr>
<tr>
<td>Ground or chipped for use as landfill cover</td>
<td>69.5</td>
<td>7.9</td>
</tr>
<tr>
<td>Ground or chipped for other uses¹</td>
<td>337.9</td>
<td>38.4</td>
</tr>
<tr>
<td>Other uses</td>
<td>84.9</td>
<td>9.6</td>
</tr>
<tr>
<td>TOTAL</td>
<td>880.8</td>
<td>100</td>
</tr>
</tbody>
</table>

¹. e.g., mulch, animal bedding, compost, soil amendments, furnish for particleboard

Some Quick Facts —

A survey municipal solid waste (MSW) facilities by the Center for Forest Products Marketing provided estimates of wood and pallet waste landfilled in 1995. Here are some of the study results:

- Of the wood waste landfilled, approximately 4.2 million tons was pallet material.
- Approximately 32% of MSW landfills reported that they do not accept wood pallets for landfilling as-is.
- Approximately 38% of MSW landfills operate at least one wood/yard waste processing facility.
- Approximately 880.8 thousand tons of wood pallet material was recovered at MSW facilities in 1995.
- Recovered pallet material was used in a variety of ways. Approximately 41% of the pallet material was used for fuel. Another 38.4% of the pallet material was processed for use as mulch, animal bedding, composting, soil amendment, and material in particleboard.
- Approximately 80% of the recovered pallets were ground or chipped.
- Approximately 58% of the landfill operations gave away ground or chipped pallets. Among the facilities that sold the ground or chipped pallet material, the average price was $13 per ton.