Solid Waste Characterization at an Army Facility

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WHAT IS A SWCS?

A process that measures the composition of *unprocessed* municipal solid waste through *manual* collection and sorting.
WHY CONDUCT A SWCS (BENEFITS)

- Composition is the First Step Toward Effective Management
- Accurate Information on SW Composition and Recycling Rates Can:
  - Help Minimize SW Program Costs
  - Size SW and Recycling Facilities
  - Optimize SW Disposal Contracts
  - Identify Potential Recyclable Materials and Provide Marketing Strategies
  - Provide a Baseline to Determine SW Program Management Recycling Rate, and Recycling Program Effectiveness
GOALS OF A SWCS

- Determine Generation Sources for Municipal Solid Waste
- Characterize Municipal Solid Waste Stream Components from Each Source
- Quantify Municipal Solid Waste from Each Source Area
- Identify Recyclable Materials and Quantities
HEALTH & SAFETY ISSUES

- Proper Clothing and Safety Equipment
- Vaccines (Hepatitis and Tetanus) (NOTE: Hep Vaccine is a Multi-part Event that Requires a Significant Time Lag Between Shots.)
- Biological Hazards (Rats, Snakes, Mice)
- Chemical Hazards (Potential Hazardous Wastes)
- Physical Hazards (Heavy Lifting, Climbing, Heavy Equipment)
- Sanitary Conditions
EQUIPMENT REQUIREMENTS

- Gloves, Safety Glasses, and Steel-Toed Shoes
- Scale with Acceptable Accuracy, Weight Capacity and Surface Sufficient to Measure Largest Potential Objects.
- Shelter or Tarps (Consider Climate – Wind, Rain)
- Sorting Containers of Various Sizes
- Broom, Garbage Cans, Dumpster/Roll Off, Garbage Bags
- Hand Sanitizer
- Pick-up Truck

Grad Students

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TASKS

- Perform Site Visit
- Develop Sort Categories
- Determine Sample Collection Methods
- Determine Sample Weight
- Determine Required Sample Size
- Determine Required Sampling Frequency
- Perform Data Collection
- Perform Data Analyses
INSTALLATION VISIT

- Determine Existing Conditions and Building Uses
- Determine Dumpster Locations
- Determine Solid Waste Collection Procedures and Schedule
- Determine Data Requirements to Achieve Required Goals
- Select Sorting Area (Covered and Windproof)
DEVELOP SORT CATEGORIES

- Paper
- Glass
- Metal
- Plastic
- Organics
- Construction and Demolition (C & D) Wastes
- Special Wastes (usually installation specific)
DETERMINE SAMPLE COLLECTION METHODS

FACTORS

- Types of Solid Waste Containers
  - 90-Gallon/Residential
  - Dumpsters (3 CY, 4 CY, 6 CY, 10 CY)
  - Roll Offs (10 CY, 20 CY, 30 CY, 40 CY)
  - Compactors (Special Procedures)

- Method of Transport
  - Installation Vehicle
  - Commercial Contractor

- Collection Schedule

- Destination
  - On-Post or Off-Post Landfill or Transfer Station

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## DETERMINE SAMPLE COLLECTION METHODS

### COMPARISON

<table>
<thead>
<tr>
<th></th>
<th>Direct from Dumpsters</th>
<th>Landfill or Transfer Station</th>
</tr>
</thead>
<tbody>
<tr>
<td>Requires Entry</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Central Sorting Area</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Sort Data by Building</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Sort Data by Activity</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Sample Volume</td>
<td>Smaller</td>
<td>Larger</td>
</tr>
<tr>
<td>Sample Diversity</td>
<td>Smaller</td>
<td>Larger</td>
</tr>
</tbody>
</table>

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DETERMINE SAMPLE PARAMETERS

Use ASTM D-5231-92 for Guidance

Two Areas:

- Residential
- Other (Industrial, Office, Shops)

Three Concerns:

- Weight of Sample
- Number of Samples
- Frequency of Samples
DETERMINE SAMPLE WEIGHT

Use ASTM D-5231-92 for Guidance

Two Areas:

- Residential (sample entire contents of container)
- Other (200-300 pounds, 3.0 CY, or entire contents)*

*If sample size does not equal weight or volume requirements, perform multiple collections with separate sorts and weights and combined in data analysis.
DETERMINE SAMPLING TIMING & FREQUENCY

- Seasonal Environmental Factors
- Seasonal Training/Personnel Schedules
- Other Mission Fluctuations
- Economic Factors
- Number of Required Samples/Number of Dumpsters
- Multiple Sampling Events May Be Required
DETERMINE SAMPLE SIZE

Residential

- ASTM guidance recommends 10% of units
- Installations with few units may require a higher percentage to achieve statistical significance. For example, if there are only 10 units, sampling only 10% (1 unit) is not valid.
- Sampled 7 of 13 occupied units – 53.8%.
DETERMINE SAMPLE SIZE

Other Areas

Required Input

- Precision (10 or 20 percent)
- Confidence Level (90 or 95 percent)
DETERMINE SAMPLE SIZE

Governing Equation

\[ n = \frac{(t^* \cdot s)}{(e \cdot mean^e)^2} \]

WHERE:

- \( n \) = NUMBER OF SAMPLES REQUIRED
- \( t^* \) = STUDENT t -STATISTIC CORRESPONDING TO THE DESIRED CONFIDENCE LEVEL (90 or 95 %)
- \( s \) = ESTIMATED STANDARD DEVIATION (FROM TABLE 3, ASTM D5231-92)
- \( e \) = DESIRED PRECISION (usually 10 or 20 %)
- \( mean^e \) = ESTIMATED MEAN (FROM TABLE 3, ASTM D5231-92)

Standard deviation and mean are taken from previous studies.

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**DETERMINE SAMPLE SIZE**

<table>
<thead>
<tr>
<th>COMPONENT</th>
<th>STANDARD DEVIATION</th>
<th>MEAN</th>
<th>SAMPLE SIZE (t*=90%)</th>
<th>SAMPLE SIZE (t*=95%)</th>
<th>RERUN</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>e=10%</td>
<td>e=20%</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Newsprint</td>
<td>0.07</td>
<td>0.10</td>
<td>133</td>
<td>33</td>
<td>188</td>
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<tr>
<td></td>
<td></td>
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<td></td>
<td></td>
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<tr>
<td>Corrugated Cardboard</td>
<td>0.06</td>
<td>0.14</td>
<td>50</td>
<td>12</td>
<td>71</td>
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<tr>
<td></td>
<td></td>
<td></td>
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<td></td>
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<tr>
<td>Plastic</td>
<td>0.03</td>
<td>0.09</td>
<td>30</td>
<td>8</td>
<td>43</td>
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<td>Yard Waste</td>
<td>0.14</td>
<td>0.04</td>
<td>3,315</td>
<td>829</td>
<td>4,706</td>
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<td>Food Waste</td>
<td>0.03</td>
<td>0.10</td>
<td>24</td>
<td>6</td>
<td>35</td>
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<td>Wood</td>
<td>0.06</td>
<td>0.06</td>
<td>271</td>
<td>68</td>
<td>384</td>
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<tr>
<td>Other Organics</td>
<td>0.06</td>
<td>0.05</td>
<td>390</td>
<td>97</td>
<td>553</td>
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<td>Ferrous Metals</td>
<td>0.03</td>
<td>0.05</td>
<td>97</td>
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<tr>
<td>Aluminum</td>
<td>0.004</td>
<td>0.01</td>
<td>43</td>
<td>11</td>
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<td></td>
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<td></td>
<td></td>
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<tr>
<td>Glass</td>
<td>0.05</td>
<td>0.08</td>
<td>106</td>
<td>26</td>
<td>150</td>
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<tr>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other Inorganics</td>
<td>0.03</td>
<td>0.08</td>
<td>38</td>
<td>10</td>
<td>54</td>
</tr>
</tbody>
</table>

Standard deviation and mean are expressed in percent of total waste stream.

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PERFORM DATA COLLECTION

USACHPPM, Ground Water & Solid Waste Program
PERFORM DATA COLLECTION

USACHPPM, Ground Water & Solid Waste Program
PERFORM DATA COLLECTION

USACHPPM, Ground Water & Solid Waste Program
RESULTS

Facility Types

- Barracks
- Dining Areas
- Offices
- Ranges
- Recreation
- Residential Areas
- Retail (Px, Class VI, Commissary)
- Security (Fire and Police)
- Shops (Metal, Wood, Electric)
- Warehouses
RESULTS
Barracks

WASTE COMPOSITION - BARRACKS/LODGING

- PAPER 26.3%
- PLASTIC 24.5%
- GLASS 13.8%
- METAL 4.0%
- ORGANICS 21.2%
- C&D 3.7%
- SPECIAL 6.4%
RESULTS
Dining Areas

WASTE COMPOSITION - DINING/MESS AREAS

- ORGANICS 42.9%
- PLASTIC 17.3%
- METAL 4.3%
- GLASS 6.8%
- PAPER 22.0%
- C&D 1.2%
- SPECIAL 5.5%

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RESULTS
Offices

WASTE COMPOSITION - OFFICES

- PAPER 29.9%
- C&D 24.2%
- PLASTIC 11.6%
- ORGANICS 16.6%
- METAL 13.3%
- GLASS 0.8%
- SPECIAL 3.5%

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RESULTS
Ranges

WASTE COMPOSITION - RANGES

- ORGANICS 25.7%
- C&D 37.9%
- PAPER 20.6%
- PLASTIC 6.0%
- METAL 5.2%
- GLASS 1.0%
- SPECIAL 3.6%
- C&D 37.9%

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RESULTS
Recreation Facilities

WASTE COMPOSITION - RECREATION FACILITIES

- C&D 53.6%
- ORGANICS 16.2%
- PLASTIC 19.4%
- METAL 2.2%
- GLASS 0.3%
- PAPER 6.6%
- SPECIAL 1.7%

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RESULTS
Residential Areas

WASTE COMPOSITION - RESIDENTIAL AREAS

- ORGANICS 35.3%
- PAPER 33.3%
- PLASTIC 15.0%
- METAL 4.8%
- GLASS 6.8%
- C&D 0.7%
- SPECIAL 4.1%

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RESULTS

Residential Areas

WASTE COMPOSITION - RESIDENTIAL AREAS

- ORGANICS 35.3%
- PAPER 33.3%
- PLASTIC 15.0%
- METAL 4.8%
- GLASS 6.8%
- C&D 0.7%
- SPECIAL 4.1%
- ORGANICS 35.3%

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RESULTS
Retail Areas

WASTE COMPOSITION - RETAIL AREAS

- PAPER 46.3%
- C&D 14.8%
- ORGANICS 12.7%
- PLASTIC 16.4%
- METAL 3.3%
- GLASS 3.5%
- SPECIAL 3.0%

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RESULTS
Security/Protection

WASTE COMPOSITION - SECURITY/PROTECTION

- PAPER 30.4%
- PLASTIC 13.9%
- ORGANICS 16.6%
- METAL 7.9%
- GLASS 3.7%
- C&D 23.7%
- SPECIAL 3.7%
- C&D 23.7%
- SPECIAL 3.7%

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RESULTS
Warehouses

WASTE COMPOSITION - WAREHOUSES

- ORGANICS 41.9%
- PLASTIC 9.9%
- METAL 3.5%
- GLASS 0.8%
- PAPER 8.3%
- SPECIAL 2.6%
- C&D 33.0%

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RESULTS

Installation

WASTE COMPOSITION - INSTALLATION

- PAPER 25.7%
- METAL 8.5%
- ORGANICS 18.9%
- PLASTIC 15.7%
- GLASS 2.6%
- C&D 25.4%
- SPECIAL 3.2%
CONCLUSIONS

- Paper comprised 25.7% of solid waste stream (25.7%) (C & D caveat).
- Organic materials comprised 18.9% of solid waste stream.
- Used targets comprised a significant percentage of the solid waste stream in range areas (45 to 54%), the majority recyclable.
- Almost no hazardous waste was observed in the solid waste stream.
- Approximately 67.5 pounds of MRE waste weighed during the study (weight after all sortable materials were segregated) and weighed separately.
GOALS OF A SWCS

- Determine Generation Sources for Municipal Solid Waste
- Characterize Municipal Solid Waste Stream Components from Each Source
- Quantify Municipal Solid Waste from Each Source Area
- Identify Recyclable Materials and Quantities
MEETING SUSTAINABILITY GOALS

How Can the Data be Used?

- Determine Waste Reduction Strategies
- Improve Recycling
  - Determine Target Components
  - Determine Proper Container Placement
  - Plan Efficient Collection
- Develop Baseline for Trend Analyses and Diversion Rates
- Measure Progress Toward Waste Reduction Goals
- Develop EMS Targets for Waste Reduction and Increased Recycling
LESSONS LEARNED

- Inform Collection Agent (DPW or Contractor) of Study and Obtain Current Pick-up Schedule.
- Sort and Weigh Perishable Items and Liquids ASAP
- Scout Dumpsters Prior to Study and Determine Those That Have Smaller Volumes. Schedule Sorts as Required to Obtain Maximum Volumes.
- Try to Determine the Major Waste Component and “Odd” Wastes Prior to Beginning Field Study.
SOLID WASTE CHARACTERIZATION STUDIES

For assistance

U.S. Army Center for Health Promotion and Preventive Medicine (USACHPPM)
Mr. Wayne Fox – (410) 436-5238
Wayne.Fox@us.army.mil

Other soil and ground-water services are available

USACHPPM, Ground Water & Solid Waste Program