Differences between *The Missouri Waste Composition Study* and other state waste composition studies

Several waste composition studies have been conducted during the past ten years. Virtually all waste composition studies use different methodology. Therefore comparing results is difficult and not entirely reliable. Differences in methodology depend on a number of variables. The *Missouri Waste Composition Study* chose a limited scope and sampled bagged waste in order to characterize the largest (MSW) portion of the waste component. Most waste composition studies use a "random scoop" method and hope to characterize the entire waste component (MSW, industrial, C&D, bulky items, etc.). Both approaches are appropriate but care must be taken to understand the underlying methodology of each study, especcially the sampling methodology, before arguing too intently over waste percentages.

Another problem in comparing waste composition studies is that most studies chose different waste categories or defined their categories differently. The differences in categories makes comparisons somewhat difficult but not impossible. For purposes of comparison and standardization, the major waste categories used in the *Missouri Waste Composition Study* (page 97) are used in the chart on page 113.

The Missouri Statewide Resource Recovery Feasibility and Planning Study: EIERA 1987

This was the first statewide waste composition study done in Missouri. Two seasonal sorts were conducted at four landfills throughout the state. The four landfills were the City of Springfield, the City of Lee's Summit, the City of Columbia, and the City of Willow Springs. The waste sorts were performed before yard waste was banned in Missouri, therefore yard waste is included in the "other organics" sub category. This comparison indicates how the Missouri waste component has changed over the past ten years. The chart on page 11 also displays the changes in the waste component between 1987 and 1997

Oregon Solid Waste Characterization and Composition 1992-93

The study was conducted by the Matrix Management Group and consisted of four seasonal sorts of residential and commercial waste. A total of 823 samples weighing 200 to 300 pounds each were collected at disposal sites in 10 counties during all four quarters of the year. The waste was sorted into 83 categories, so many of those categories were combined for comparison purposes. Oregon had an extensive waste reduction and recycling program in place before, and during, the waste sorts. Yard waste was not banned from landfills and is included as "other organics".

The Minnesota Solid Waste Composition Study 1990-1992

The Minnesota study was conducted by the Minnesota Pollution Control Agency. It consisted of four seasonal waste sorts conducted over a two-year period. The results found on page 20 are the average of sorts conducted throughout 1991 and 1992. Samples were taken from residential and commercial waste haulers. During the year, 1,119 samples weighing 343,007 pounds were sorted. The methodology for this study was used in planning the *Missouri Waste Composition Study.*

Waste Characterization Study for the City of Columbia Sanitary Landfill 1996
This study was designed and conducted by the University of Missouri at Columbia in cooperation with the City of Columbia. Waste sorts were conducted during each of the four quarters (or seasons) of 1996 at the City of Columbia Sanitary Landfill. Weight fractions of 32 waste components were quantified from the surrounding area. To accomplish this, 127 to 151 samples, with an average weight of 306 pounds were collected each quarter. The number of samples was determined using ASTM Standard D5231-92 to achieve 80% confidence that the true weight-fraction mean would lie within 10% of the measured mean. Standard errors and percent errors were reported at the 80% and 90% confidence levels. The results on page 114 are from the residential waste component in the City of Columbia, which is the only community in the State of Missouri with a deposit law (bottle bill) in effect.

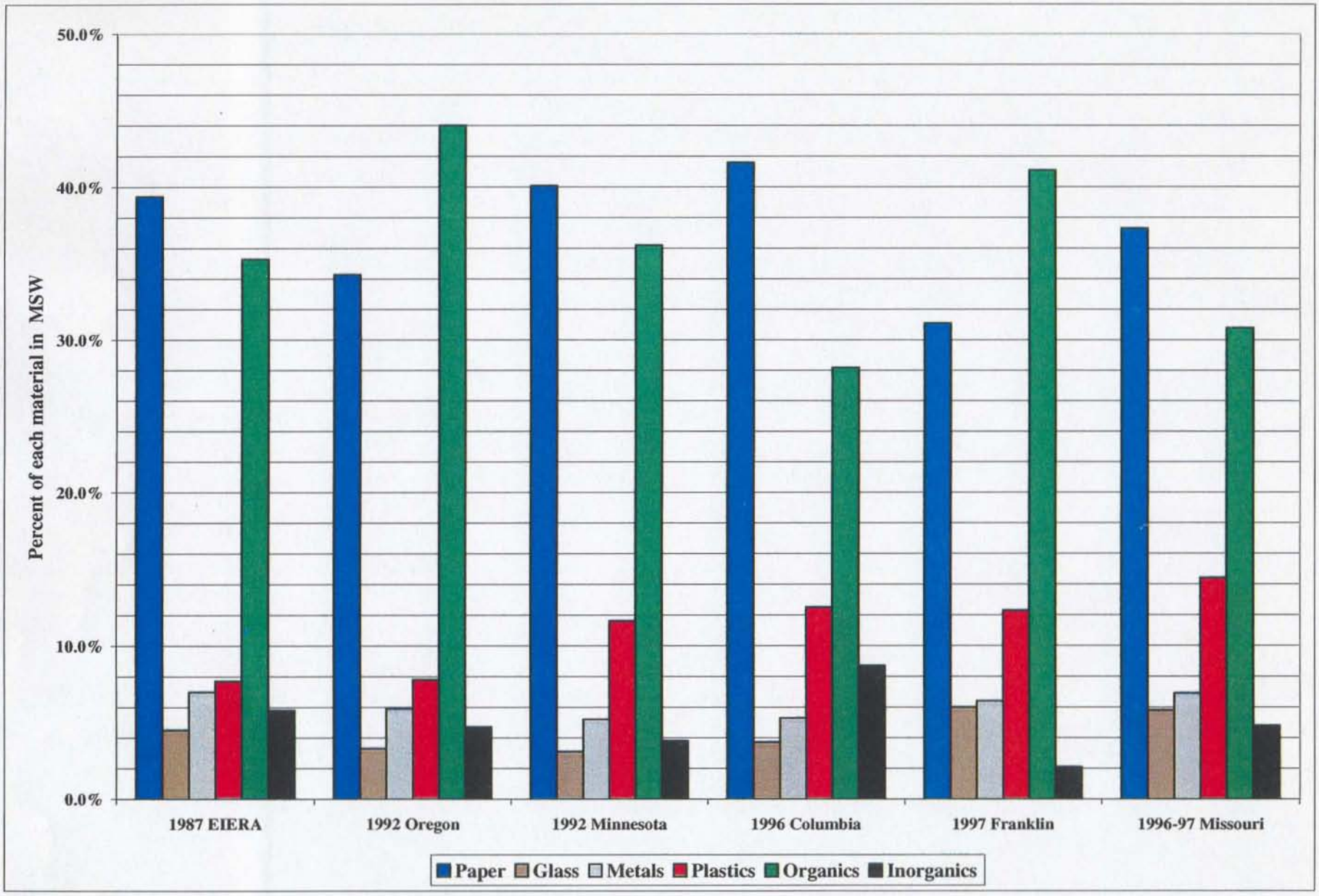
Characterization of Municipal Solid Waste in the United States: 1996 update
This study was funded, and distributed by the Environmental Protection Agency. It is better known in solid waste circles as the "Franklin Study". The authors of the study, Franklin and Associates use the "material flows methodology " to determine the composition of solid waste. This methodology is based on production data (by weight) for the materials and products in the waste component, with adjustments for imports, exports, and product lifetimes. The Franklin study defined categories differently than other waste composition studies. Main divisions include durable goods, Non-durable goods, containers and packaging, and other wastes. Materials can be listed in one or more of these major divisions. Every effort was made to maintain accuracy and still fit the "Franklin categories" into the categories used for comparisons.

Possible reasons for the differences between the waste composition studies
Comparisons between the different waste composition data is interesting. If we assume that the methodology used to conduct the study has provided accurate results, there seem to be two main components that effect the data. These two are banned items and recycling. The items that are banned from disposal in Missouri landfills are:

- Major appliances (white goods)
- Waste oil
- Lead-acid batteries
- Yard waste or clippings
- Whole Tires
- Small quantities of hazardous waste (large quantities were already banned)

The ban on yard waste seems to have a remarkable effect on reducing the amount of organic materials in the waste component. The organic component in the Missouri waste component is considerably lower than the organic materials in the other studies. The most plausible explanation seems to be the lack of yard waste.
Recycling also seems to have an effect on the composition of the waste component. Oregon, and Minnesota had strong recycling programs in effect during their waste sorts. The only Missouri location that has a similar recycling program is the City of Maryville. The percentage of "recyclable material" in the Maryville waste component seems to be comparable to the percentage of "recyclable material" within the Oregon and Minnesota waste component.

Comparable MSW Composition Studies



The Volume of the Waste Component

Most solid waste composition studies are recorded by weight. However, in many instances volume of the material may be more significant. Some examples are: calculations for landfill capacities, vehicle and storage space for recyclable materials, and compaction rates for waste haulers. This study attempted to quantify the volume of waste as well as the weight of that waste. During the sorting procedure all materials were placed into identical containers which were three cubic feet in volume. As the container was weighed, the volume of the material within that container was estimated. Both the weight and the volume were recorded on the sample data sheet.

The relationship between weight and volume found during the MSW waste sorts are listed below. **These volumes are for uncompacted waste.**

Category	Pounds per cubic foot	Cubic yards per ton
Cardboard	2.49	29.7
Newsprint	6.42	11.5
Magazines	8.51	8.7
High Grade Paper	5.20	14.2
Mixed Paper	4.07	18.2
Clear Glass	9.97	7.4
Brown Glass	9.39	7.9
Green Glass	8.25	9.0
Other Glass	9.61	7.9
Aluminum Cans	2.61	28.4
Other Aluminum	3.61	20.5
Non Ferrous Metals	6.50	11.4
Ferrous Food Cans	5.27	14.1
Other ferrous Metals	7.65	9.7
Oil Filters	12.60	5.9
PET #1 Plastic	1.95	38.0
HDPE #2 Plastic	1.88	39.4
Plastic Film	1.94	38.2
Other Plastics	2.46	30.1
Food Waste	11.25	6.6
Wood Waste	7.43	10
Textiles	5.28	14
Diapers	8.67	8.5
Other Organics	5.82	8.7
Fines	8.54	8.7
Other Inorganics	10.66	6.9

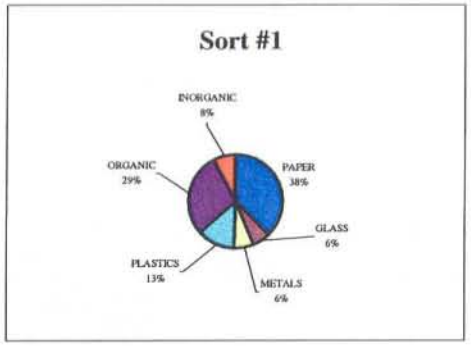
Seasonal Changes in the Waste Component

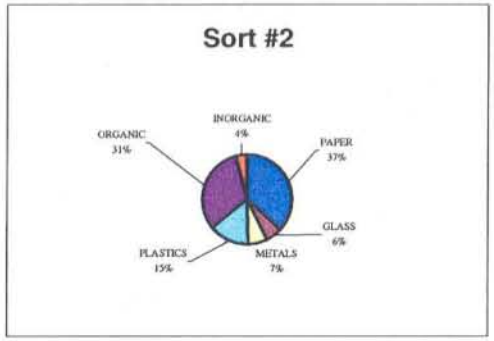
The table on page 116 reflects the percentage of each material found in the MSW (by volume) component during the three seasonal sorts. The seasonal sort average is based on the total volume of that material, divided by the total volume sorted during that round. The pie charts on page 117 compares the percentages in each major category found during each of the seasonal sorts and the bar graph illustrates the average percentage of each material found during the sorting process. The chart on page 119 compares weight percentages to volume percentages.

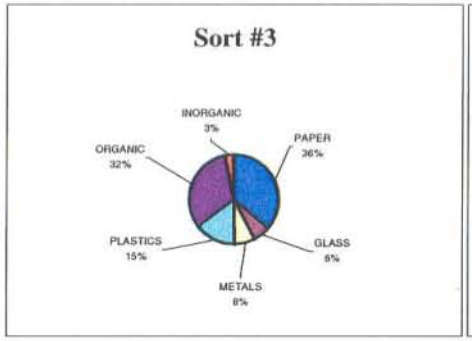
Seasonal Results by Volume

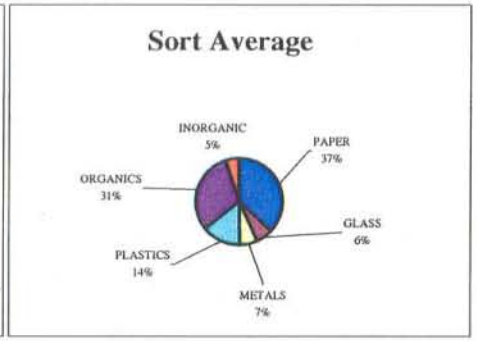
CATEGORY	SORT # 1 VOL.	SORT # 2 VOL.	SORT #3 VOL.	AVERAGE VOL.
Cardboard	11.8%	11.6%	11.5%	11.6%
Newsprint	5.5%	5.6%	5.7%	5.6%
Magazines	1.9%	1.8%	1.9%	1.9%
High Grade	3.2%	3.4%	3.4%	3.3%
Mixed	18.5%	17.5%	16.9%	17.7%
PAPER TOTALS	**40.9%**	**39.9%**	**39.3%**	**40.1%**
Clear	1.5%	1.3%	1.2%	1.3%
Brown	0.8%	0.8%	0.7%	0.7%
Green	0.2%	0.2%	0.2%	0.2%
Other	0.3%	0.3%	0.3%	0.3%
GLASS TOTALS	**2.8%**	**2.5%**	**2.4%**	**2.6%**
Alum. Cans	2.3%	2.8%	3.1%	2.8%
Other Alum	1.2%	0.9%	1.1%	1.1%
Non ferrous	0.2%	0.2%	0.1%	0.2%
Food Cans	3.1%	2.5%	2.9%	2.8%
Ferrous	0.7%	0.6%	0.7%	0.7%
Oil Filters	0.0%	0.0%	0.0%	0.0%
METAL TOTALS	**7.6%**	**7.1%**	**8.0%**	**7.5%**
PET # 1	4.1%	3.6%	3.9%	3.9%
HDPE # 2	4.8%	4.9%	5.8%	5.1%
Film	9.2%	8.5%	8.5%	8.8%
Other Plastic	12.4%	13.8%	13.6%	13.3%
PLASTIC TOTALS	**30.6%**	**30.8%**	**31.8%**	**31.0%**
Food Waste	6.9%	8.4%	8.0%	7.8%
Wood Waste	0.5%	0.5%	0.6%	0.5%
Textiles	3.5%	3.6%	3.3%	3.5%
Diapers	2.4%	2.0%	2.0%	2.1%
Other Organics	2.0%	2.9%	2.4%	2.4%
ORGANIC TOTALS	**15.4%**	**17.3%**	**16.2%**	**16.3%**
Fines	2.1%	1.7%	1.6%	1.8%
Other Inorganics	0.7%	0.7%	0.6%	0.7%
INORGANIC TOTALS	**2.8%**	**2.4%**	**2.2%**	**2.5%**
SORT TOTALS	**100%**	**100%**	**100%**	**100%**

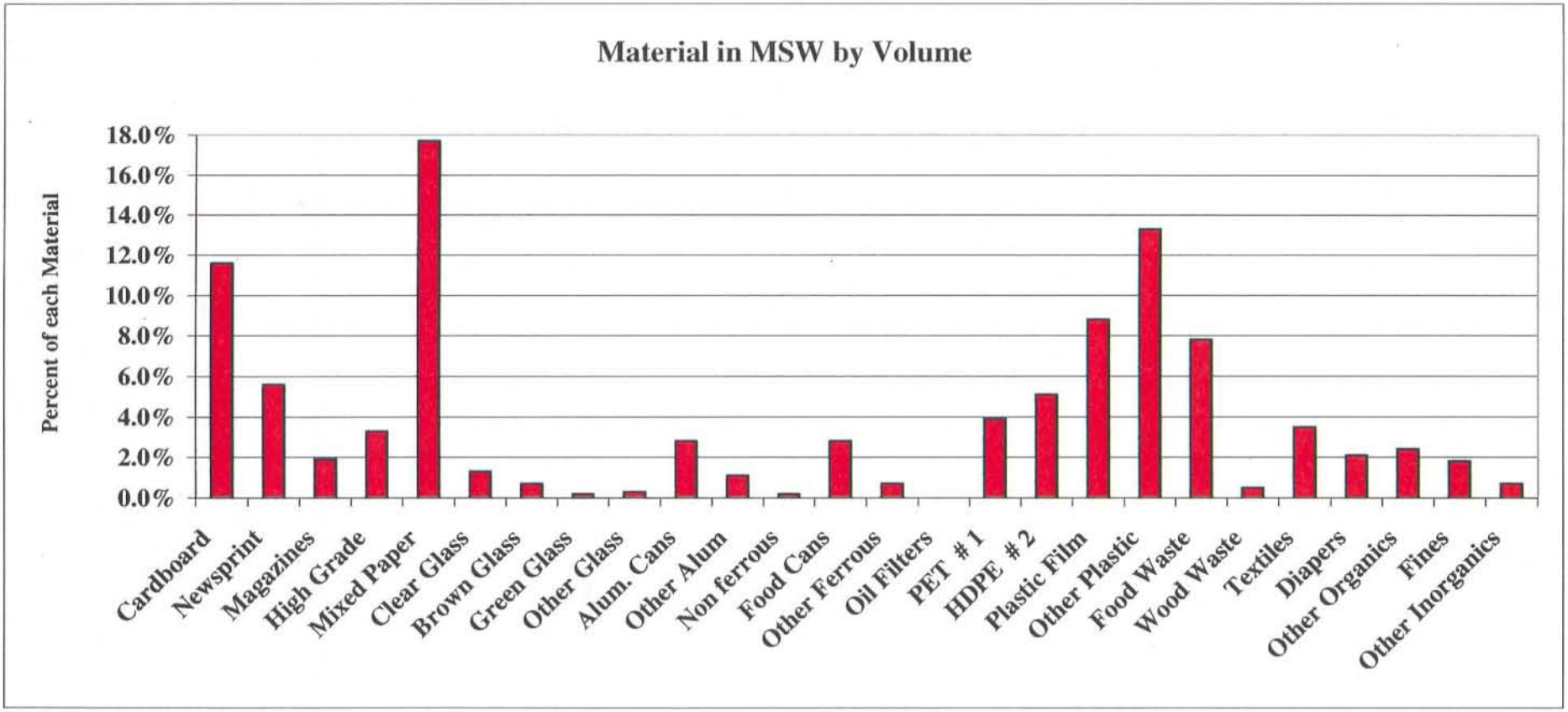
Municipal Solid Waste Composition by Volume



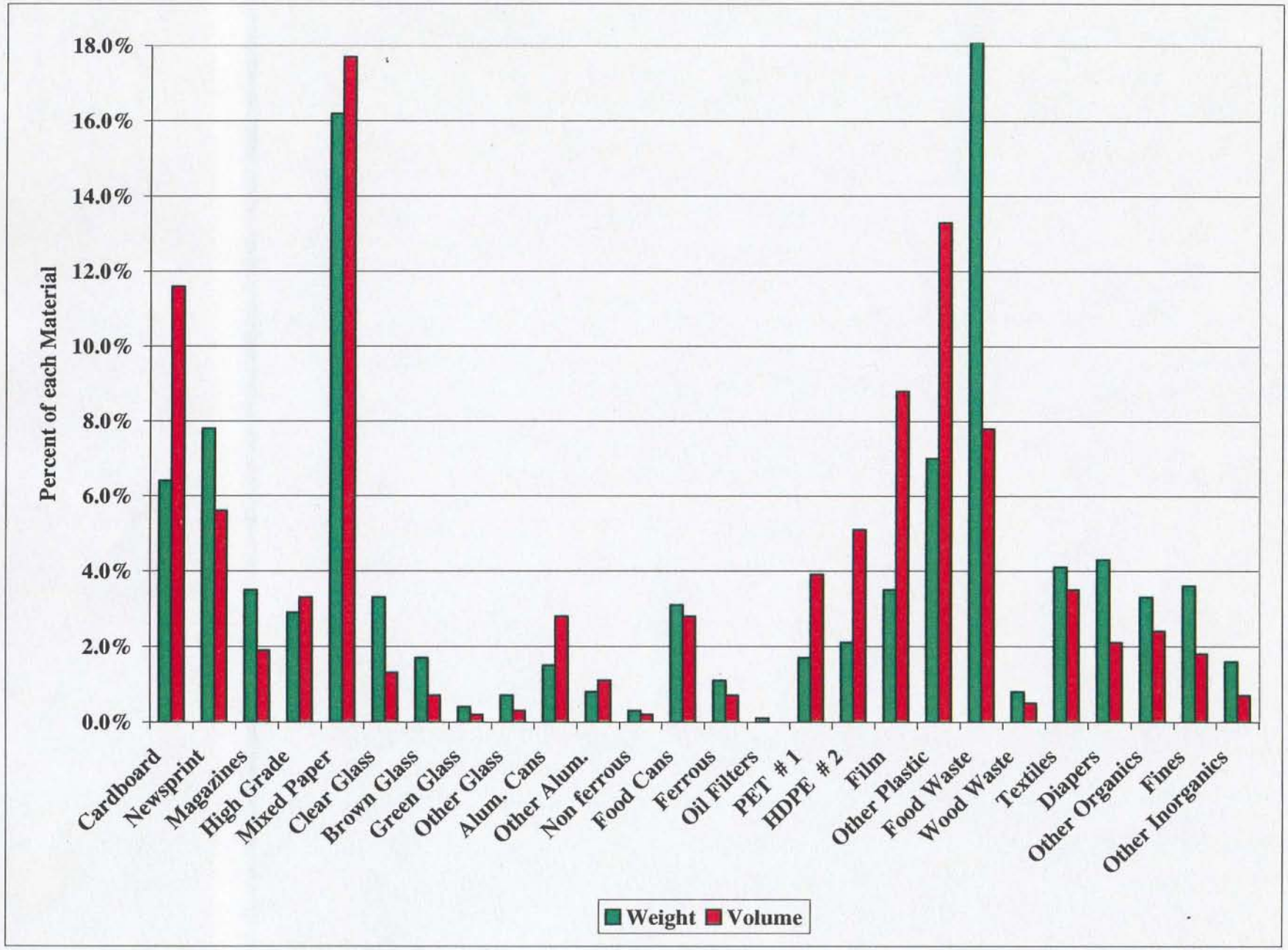








RELATIONSHIP BETWEEN WEIGHT AND VOLUME



Other Potentially Hazardous MSW Waste

One of the objectives of the *Missouri Waste Composition Study* was to measure the percentage of household hazardous wastes (HHW) in the municipal solid waste component. Household hazardous waste was not separated in the 1987 EIERA study but has been estimated at about 1% of the MSW component.

During the planning of the *Missouri Waste Composition Study* a category was established for Household Hazardous Waste. At the initial waste sort it became apparent that the definition of household hazardous waste was too vague to be of any significant value in the sorting process. Therefore a new category titled "other waste" was set up for any item or material which could possibly cause harm to the environment, ground water supplies, landfill liners, or solid waste handlers. The following is a list of the sub categories used to separate "other waste".

Over-the-Counter Medicine (OTC)- Medication bought over the counter. Examples: vitamins, antacid, aspirin, and cold medicine.

Prescription Medication (Rx)- Medication requiring a prescription. Examples: oral contraceptives, prescription inhalants, perspiration ointments, and vaccinations (human or animal).

Beauty/hygiene products- Items used for cosmetic or hygiene purposes. Examples: soap, shampoo, cosmetics, hair gel, deodorant, toothpaste, mouthwash, perfume/cologne, etc.

Beauty/hygiene aerosol products- Items in an aerosol can used for hygiene purposes. Examples: shaving cream, hair spray, deodorant.

Household cleaning products- Products used for cleaning items in a household. Examples: silver cleaner, floor wax, furniture oil, all-purpose chemical cleaners, bleach, dishwashing detergent, etc.

Household cleaning aerosol products- Products used for household cleaning in aerosol containers. Examples: furniture polish, oven cleaner, some glass cleaners, etc.

Aerosol Cans- Aerosol cans containing product. Examples: spray paint, some glues, and air fresheners.

Sharps/Blades- Items with sharp edges that could cause harm. Examples: knives, utility blades, saws.

Syringes and Needles

Automotive Products- Items used for car care and maintenance. Waxes, oils,

Hardware/Shop products- Items used for home improvement projects. Examples: rubber cement, caulking, wood stain, paint thinner, glue.

Gardening/Yard products- Items used for garden and lawn care and maintenance. Example: pesticides, plant food, garden chemicals, water treatment chemicals.

Pet Grooming Products- Items used to care for pets. Examples: pet medicines, shampoos.

Disposable razors

Alkaline batteries

Miscellaneous items- Unusual items which could be harmful but do not belong in any of the above.

These items were separated and listed by sub category. The results are on the chart on page 122. **The totals listed for each category are individual items and the container or package**. The percentage of "other waste" in the waste component was difficult to quantify because in many cases the container weighed more than the potentially hazardous contents.

POTENTIALLY HAZARDOUS ITEMS FOUND DURING WASTE SORTS

Solid Waste Management Districts

CATEGORY	A	B	C	D	E	F	G	I	J	K	L	M	N	O	P	Q	R	S	T	TOTAL
OTC Medicine	23	14	24	3	9	5	3	7	2	3	12	31	7	7	1	15	3	17	8	**194**
Prescription Medication	37	1	1	8	8	8	8	19	2	13	10	12	10	6	10	18	31	41	3	**246**
Beauty/Hygiene	45	10	18	23	40	14	16	17	5	9	76	21	10	16	25	21	21	24	21	**432**
Beauty/Hygiene Aerosols	10	2	5	2	1	2	2	5	3	2	6	4	7	9	2	2	0	8	1	**73**
Household Cleaning	5	3	1	3	6	3	3	3	2	5	4	9	4	11	0	3	2	6	1	**74**
Household Cleaning Aerosols	2	2	1	7	1	1	0	0	1	0	6	1	5	4	0	2	0	2	2	**37**
Other Aerosol Cans	4	0	2	12	4	8	14	4	3	2	4	11	4	1	3	6	1	9	5	**97**
Automotive products	7	0	0	0	7	1	2	0	1	0	3	6	0	3	1	1	3	1	0	**36**
Hardware/Shop Products	4	3	5	3	9	1	3	15	4	3	7	33	6	15	2	1	5	6	11	**136**
Gardening/Yard Products	1	2	0	0	4	2	1	3	1	0	2	1	2	7	0	0	3	3	2	**34**
Pet Grooming Products	2	0	0	0	3	2	0	1	0	0	1	0	0	1	1	0	0	1	0	**12**
Sharps/Blades	6	0	8	3	4	23	1	0	5	3	6	4	0	2	2	4	6	6	3	**86**
Syringes and Needles	196	47	20	23	10	6	33	31	50	40	11	5	26	31	39	40	70	20	22	**720**
Disposable Razors	52	28	18	29	31	11	27	18	11	23	27	56	20	5	35	59	53	39	17	**559**
Alkaline Batteries	106	45	44	69	53	30	28	42	25	37	31	61	40	30	28	68	47	74	62	**920**
Miscellaneous Items	24	11	2	10	7	9	12	16	7	4	3	10	7	5	10	19	8	7	5	**176**
Total Items Found	**524**	**168**	**149**	**195**	**197**	**126**	**153**	**181**	**122**	**144**	**209**	**265**	**148**	**153**	**159**	**259**	**253**	**264**	**163**	**3,832**