# Chapter 24: Summary-Phase II

Phase II of the *Missouri Waste Composition Study* examined municipal solid waste (MSW) during three seasonal waste sorts at nine landfills and transfer stations throughout the state of Missouri. The same methodology for conducting waste sorts for Phase I was also used in Phase II. A summary description of the sampling procedure can be found on page 197.

During Phase II, 282 samples were selected and the materials sorted into 26 sub-categories, plus an "other waste" category. These categories are defined in Chapter 2. After the sample was completely sorted and placed into the appropriate containers they were weighed, volumes estimated, and the data recorded.

The average sample size was 227 pounds by weight and 49 cubic feet by volume. The total weight of the samples was 63,813 pounds, and the volume was 13,671 cubic feet.

Table 24-1 indicates the number of samples examined at each location, the weight and volume of those samples, and an estimated composition of the sample.

# MISSOURI WASTE COMPOSITION STUDY
## PHASE II
### SAMPLE SUMMARY

| Location | Number of Samples | Sample Size | | Composition | |
|---|---|---|---|---|---|
| | | Weight | Volume | Residential | Commercial |
| Poplar Bluff | 32 | 8,145 | 1,685 | 84% | 16% |
| West Plains | 34 | 7,384 | 1,623 | 60% | 40% |
| Rolla | 33 | 6,590 | 1,491 | 87% | 13% |
| Osage Beach | 32 | 6,797 | 1,517 | 77% | 23% |
| Sedalia | 29 | 6,186 | 1,296 | 70% | 30% |
| St. Joseph | 30 | 7,162 | 1,614 | 87% | 13% |
| Mooresville | 32 | 8,179 | 1,535 | 55% | 45% |
| Kirksville | 24 | 5,539 | 1,150 | 66% | 34% |
| Foristell | 36 | 7,849 | 1,760 | 86% | 14% |
| **Total** | **282** | **63,831** | **13,671** | **75%** | **25%** |

TABLE 24-1

**Results by weight**

Table 24-2 shows the percentage of materials, by weight, found in the MSW during the three seasonal sorts. The average is based on the total weight of that material for all three sorts, divided by the total weight sorted. A description of each category is listed in Chapter 2. Chart 24-1 represents the same information in four pie charts.

The results were fairly consistent from one round to the next. Small fluctuations are mentioned in each location chapter (15-23). There were only two major changes from one seasonal sort to the next.

One change was in the "fines" category (small items too small to be separated efficiently). A change in sorting procedure at the beginning of the third round of sorts resulted in decreased accuracy for the last sort period. This decrease is a result of changing sort crews between the second and third rounds. Since the sorters were the same the first two rounds (18 sorts), their accuracy was better when determining fines from separable materials. The final crew did not have as many opportunities to increase their accuracy.

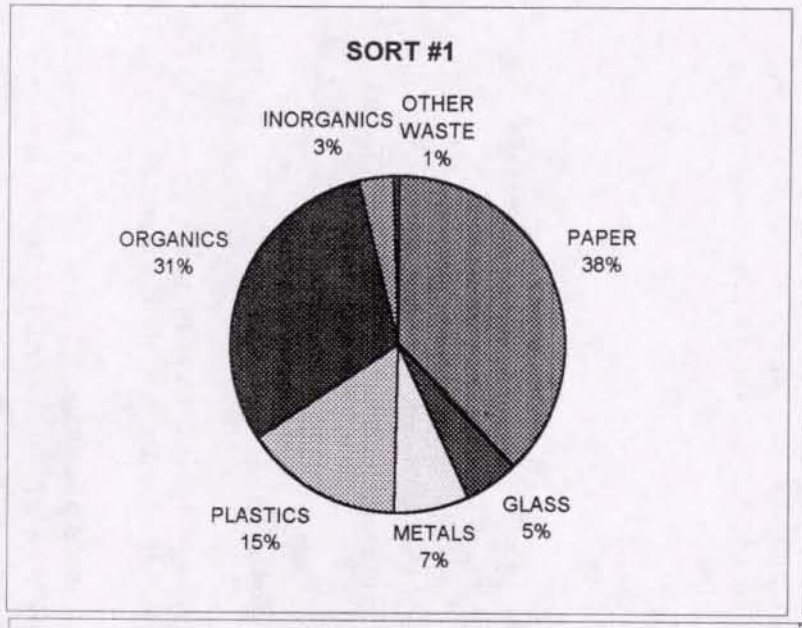
The second change was the decrease of ferrous food cans and increase in cardboard during the second round of sorts. The cardboard increase was due to higher levels of pizza boxes. This pattern may indicate that people eat out more and do less cooking in the summer months.

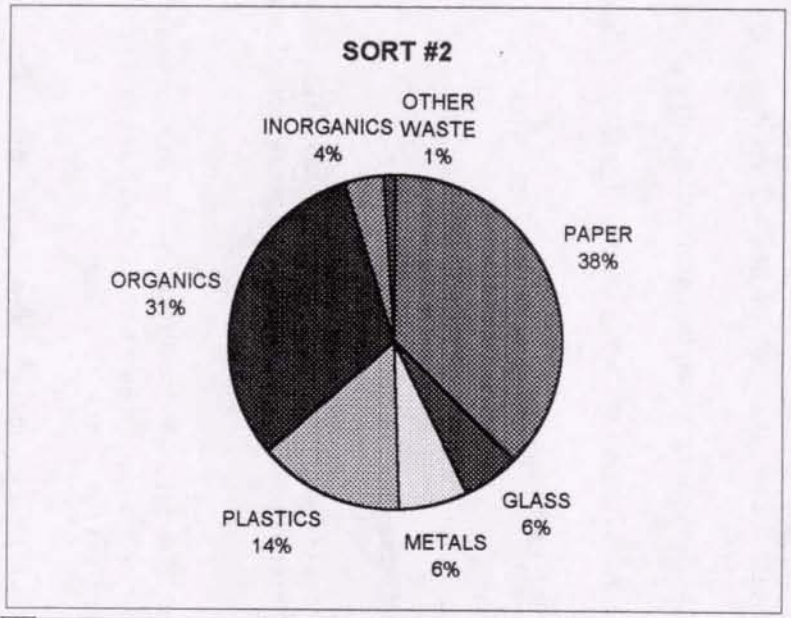
## *PHASE II SUMMARY RESULTS BY WEIGHT*

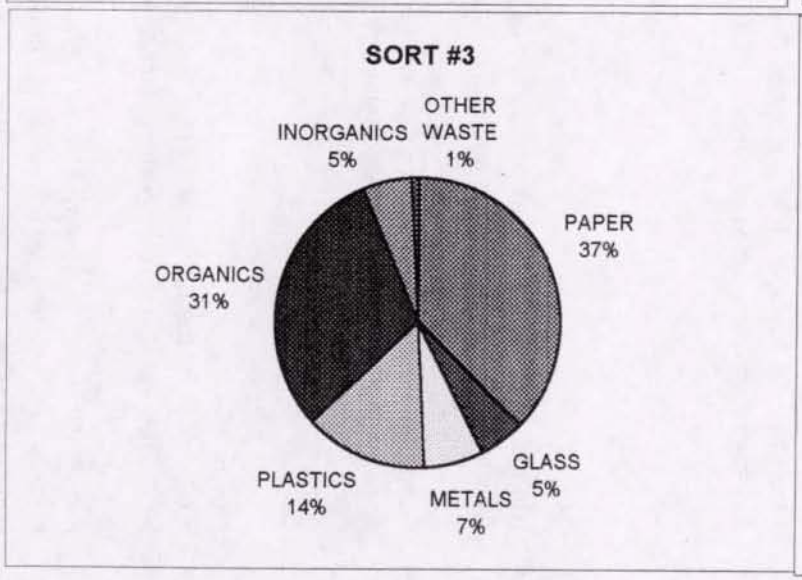
| CATEGORY | SORT # 1 2/3/97-4/1/97 WT. | SORT # 2 4/28/97-6/24/97 WT. | SORT #3 9/2/97-10/15/97 WT. | AVERAGE 2/3/97-10/15/97 WT. |
|---|---|---|---|---|
| Cardboard | 6.7% | 7.5% | 6.6% | 6.9% |
| Newsprint | 7.1% | 8.3% | 8.2% | 7.9% |
| Magazines | 3.7% | 3.5% | 4.7% | 4.0% |
| High Grade | 4.6% | 4.3% | 3.6% | 4.2% |
| Mixed | 15.8% | 13.7% | 14.0% | 14.4% |
| PAPER TOTALS | 37.8% | 37.2% | 37.1% | 37.4% |
| | | | | |
| Clear | 2.7% | 3.1% | 3.1% | 3.0% |
| Brown | 1.3% | 1.7% | 1.2% | 1.4% |
| Green | 0.6% | 0.4% | 0.4% | 0.5% |
| Other | 0.6% | 0.4% | 0.5% | 0.5% |
| GLASS TOTALS | 5.2% | 5.7% | 5.3% | 5.4% |
| | | | | |
| Alum. Cans | 1.6% | 1.5% | 1.5% | 1.5% |
| Other Alum | 0.9% | 0.7% | 0.7% | 0.8% |
| Non ferrous | 0.3% | 0.2% | 0.1% | 0.2% |
| Food Cans | 3.5% | 2.8% | 3.0% | 3.1% |
| Ferrous | 0.9% | 1.2% | 1.3% | 1.1% |
| Oil Filters | 0.2% | 0.1% | 0.1% | 0.1% |
| METAL TOTALS | 7.4% | 6.5% | 6.7% | 6.9% |
| | | | | |
| PET # 1 | 1.9% | 1.5% | 1.5% | 1.6% |
| HDPE # 2 | 1.9% | 2.1% | 2.3% | 2.1% |
| Film | 4.1% | 3.9% | 3.7% | 3.9% |
| Other Plastic | 7.2% | 6.7% | 6.4% | 6.8% |
| PLASTIC TOTALS | 15.1% | 14.3% | 13.9% | 14.4% |
| | | | | |
| Food Waste | 20.0% | 18.4% | 19.1% | 19.1% |
| Wood Waste | 0.9% | 0.7% | 0.8% | 0.8% |
| Textiles | 3.0% | 4.4% | 4.2% | 3.9% |
| Diapers | 4.1% | 3.8% | 3.8% | 3.9% |
| Other Organics | 2.6% | 4.1% | 2.7% | 3.2% |
| ORGANIC TOTALS | 30.6% | 31.5% | 30.6% | 30.9% |
| | | | | |
| Fines | 2.3% | 2.4% | 3.9% | 2.8% |
| Other Inorganics | 1.1% | 1.5% | 1.6% | 1.4% |
| INORGANIC TOTALS | 3.3% | 3.9% | 5.4% | 4.2% |
| OTHER WASTE TOTALS | 0.5% | 1.0% | 0.9% | 0.8% |
| | | | | |
| SORT TOTALS | 100% | 100% | 100% | 100% |

TABLE 24-2

# PHASE II SUMMARY RESULTS BY WEIGHT



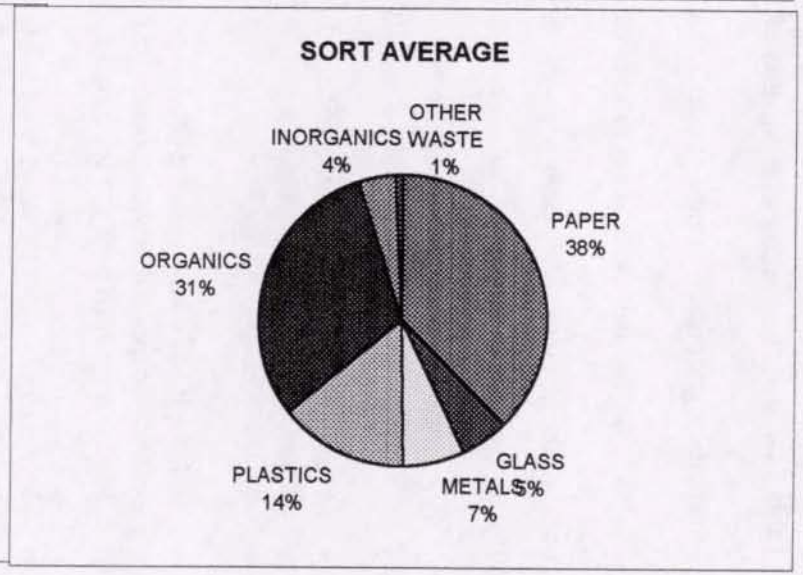




CHART 24-1

**Comparison of waste composition among locations**

Table 24-3 lists the average composition of waste at each location. Chart 24-2 represents this information graphically for the six major categories (paper, glass, metals, plastics, organics, and inorganics). The following observations were noted during the waste sorts which may explain some of the obvious differences between sorting locations:

**Paper**

- Osage Beach had the highest cardboard percentages (especially in the summer). This may be a result from the tourist season during the summer and the outlet mall business located in the city.
- St. Joseph has a high amount of newsprint. Since it is the fourth largest city in Missouri, the local newspaper is fairly substantial. St. Joseph is also located near Kansas City, and many samples contained both the local newspaper and the *Kansas City Star*.
- Mooresville's paper percentages were fairly high, even though there is a paper pelletizer located in Chillicothe. It was noticed that Chillicothe bags were mostly free of mixed paper, but bags from rural areas surrounding Chillicothe still contained a large amount of paper.

**Glass**

- Mooresville had the lowest percentage of glass, probably due to the high level of recycling in Chillicothe and surrounding areas.
- Osage Beach had markedly higher levels of glass. The amount of glass increased during the summer, with more beverages containers being used (beer bottles, etc.) due to the tourists.

**Metals**

- Kirksville had the lowest percentage of metals probably due to emphasis on metals by the local "buy back" recycling centers (scrap metals, industrial metals, cans, etc.).
- Poplar Bluff and St. Joseph had the highest metal percentages. These cities are industrial centers for their area, which could explain the higher level of metal products. However, recycling for these products are not as prevalent in these areas.

## Plastics

- Plastic film percentages were high in West Plains. This could be explained by the light commercial truck routes that picked up from local hotels and nursing homes.

- Mooresville had higher plastics #1 and #2 percentages than expected, even with unit-based pricing and recycling in Chillicothe. The sheltered workshop (which accepts plastics and other recyclables) does collect from surrounding communities.

## Organics

- Food waste is the highest percentage material at all sites.

- Poplar Bluff had the highest percentage of diapers.

## Inorganics

- Most of the other inorganic category was kitty litter.

- Kirksville had a high percentage of kitty litter while the University was in session, suggesting that there may be a large number of students with pet cats. This trend was also noticed at Maryville (Northwest Missouri State University) during the Phase I.

## *COMPARABLE RESULTS BY LOCATION*

| CATEGORY | Poplar Bluff PCT. BY WT. | West Plains PCT. BY WT. | Rolla PCT. BY WT. | Osage Beach PCT. BY WT. | Sedalia PCT. BY WT. |
|---|---|---|---|---|---|
| Cardboard | 6.4% | 5.7% | 6.9% | 8.1% | 7.9% |
| Newsprint | 7.0% | 4.2% | 7.4% | 6.7% | 6.0% |
| Magazines | 4.3% | 3.7% | 3.8% | 3.5% | 3.8% |
| High Grade | 3.2% | 8.4% | 4.2% | 4.4% | 4.1% |
| Mixed | 15.2% | 18.2% | 12.9% | 12.2% | 15.7% |
| **PAPER TOTALS** | **36.1%** | **40.2%** | **35.2%** | **34.9%** | **37.5%** |
| Clear | 2.9% | 2.3% | 3.4% | 4.6% | 2.9% |
| Brown | 1.2% | 0.9% | 1.5% | 2.3% | 1.2% |
| Green | 0.5% | 0.5% | 0.4% | 1.0% | 0.3% |
| Other | 0.9% | 0.5% | 0.6% | 0.5% | 0.3% |
| **GLASS TOTALS** | **5.5%** | **4.2%** | **5.9%** | **8.4%** | **4.7%** |
| Alum. Cans | 1.5% | 1.5% | 1.3% | 1.9% | 1.7% |
| Other Alum | 0.9% | 0.5% | 0.7% | 0.6% | 0.6% |
| Non ferrous | 0.3% | 0.3% | 0.2% | 0.3% | 0.0% |
| Food Cans | 4.2% | 3.0% | 3.4% | 2.8% | 3.0% |
| Ferrous | 1.2% | 0.9% | 1.1% | 1.0% | 0.9% |
| Oil Filters | 0.0% | 0.4% | 0.1% | 0.1% | 0.0% |
| **METAL TOTALS** | **8.1%** | **6.6%** | **6.8%** | **6.7%** | **6.2%** |
| PET # 1 | 1.8% | 1.7% | 1.6% | 1.5% | 1.4% |
| HDPE # 2 | 2.2% | 2.0% | 2.0% | 1.9% | 2.0% |
| Film | 3.9% | 4.8% | 4.0% | 3.4% | 4.1% |
| Other Plastic | 6.4% | 8.3% | 6.8% | 6.6% | 7.4% |
| **PLASTIC TOTALS** | **14.3%** | **16.8%** | **14.4%** | **13.4%** | **14.9%** |
| Food Waste | 20.3% | 18.5% | 22.1% | 20.5% | 20.4% |
| Wood Waste | 0.5% | 0.8% | 0.6% | 0.8% | 0.4% |
| Textiles | 3.2% | 2.3% | 3.9% | 3.5% | 3.2% |
| Diapers | 4.5% | 3.3% | 4.2% | 3.7% | 3.9% |
| Other Organics | 2.6% | 3.0% | 3.0% | 3.4% | 3.4% |
| **ORGANIC TOTALS** | **31.1%** | **27.9%** | **33.8%** | **31.9%** | **31.3%** |
| Fines | 2.8% | 2.5% | 2.3% | 3.1% | 3.0% |
| Other Inorganics | 1.7% | 1.3% | 0.8% | 0.9% | 1.9% |
| **INORGANIC TOTALS** | **4.5%** | **3.8%** | **3.1%** | **4.0%** | **4.9%** |
| **OTHER WASTE** | **0.4%** | **0.3%** | **0.7%** | **0.6%** | **0.4%** |
| **TOTAL** | **100.0%** | **100.0%** | **100.0%** | **100.0%** | **100.0%** |

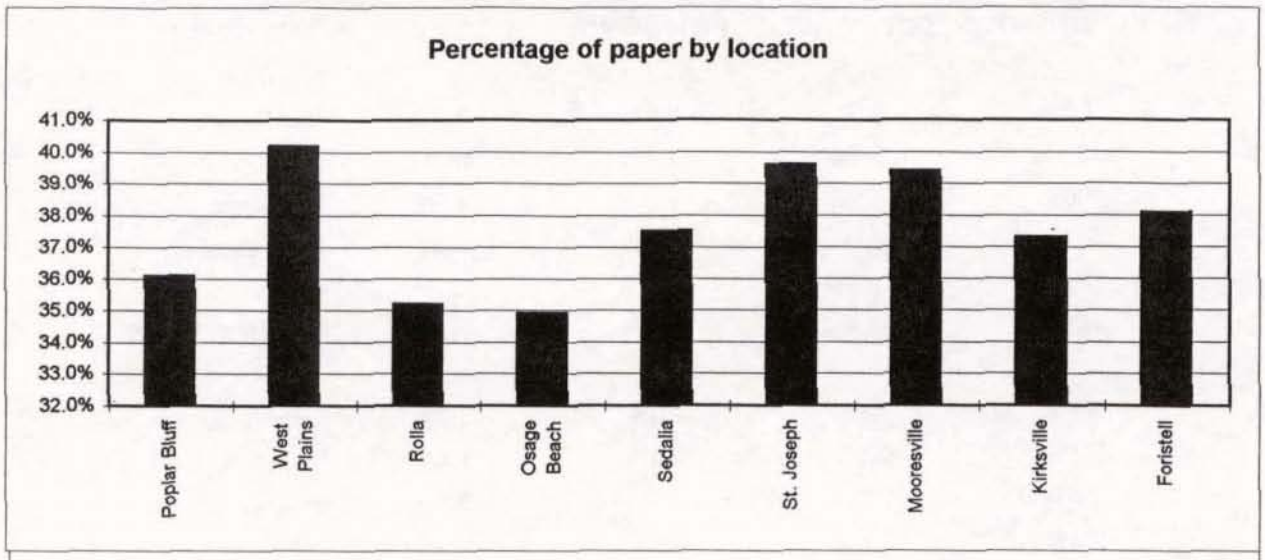
TABLE 24-3

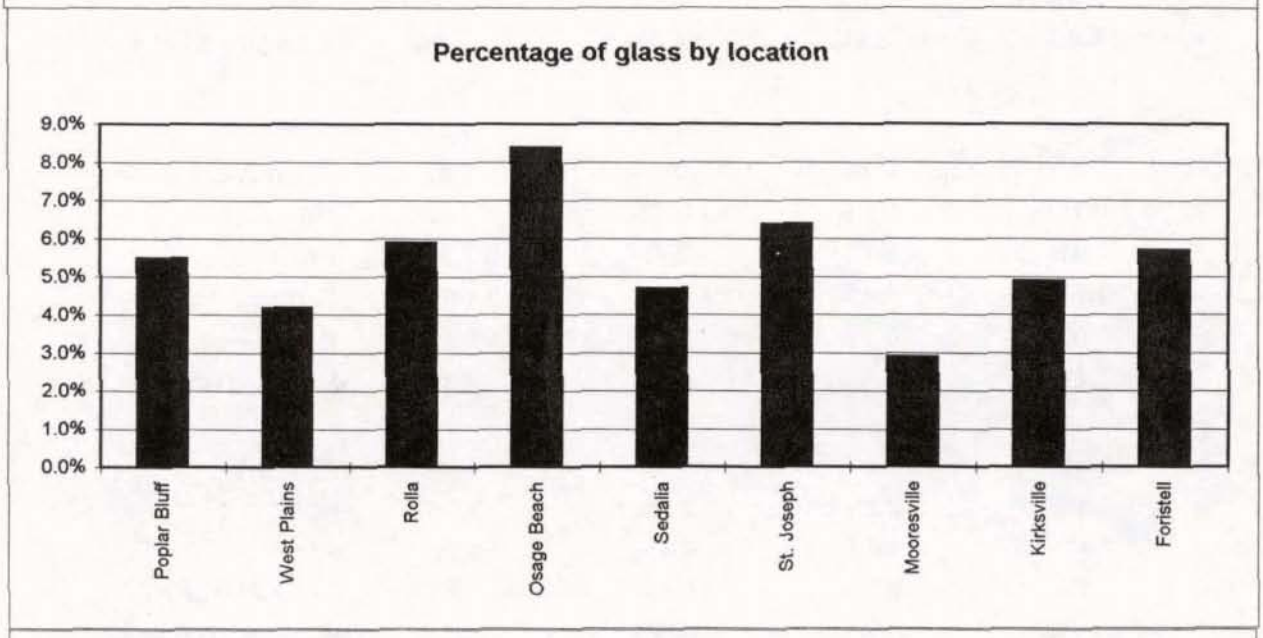
## *COMPARABLE RESULTS BY LOCATION*

| St. Joseph PCT. BY WT. | Mooresville PCT. BY WT. | Kirksville PCT. BY WT. | Foristell PCT. BY WT. | CATEGORY |
|---|---|---|---|---|
| 7.6% | 6.5% | 6.9% | 7.1% | Cardboard |
| 12.1% | 9.3% | 7.7% | 10.0% | Newsprint |
| 3.6% | 4.5% | 4.3% | 4.0% | Magazines |
| 2.7% | 4.4% | 3.2% | 3.8% | High Grade |
| 13.6% | 14.7% | 15.2% | 13.2% | Mixed |
| **39.6%** | **39.4%** | **37.3%** | **38.1%** | PAPER TOTALS |
| 3.1% | 1.8% | 2.8% | 3.0% | Clear |
| 2.3% | 0.5% | 1.3% | 1.4% | Brown |
| 0.5% | 0.2% | 0.3% | 0.8% | Green |
| 0.5% | 0.4% | 0.5% | 0.5% | Other |
| **6.4%** | **2.9%** | **4.9%** | **5.7%** | GLASS TOTALS |
| 1.4% | 1.3% | 1.3% | 1.6% | Alum. Cans |
| 0.8% | 0.7% | 0.7% | 0.8% | Other Alum |
| 0.1% | 0.3% | 0.2% | 0.2% | Non ferrous |
| 3.4% | 2.7% | 2.7% | 2.5% | Food Cans |
| 1.5% | 1.4% | 0.9% | 1.0% | Ferrous |
| 0.0% | 0.1% | 0.2% | 0.2% | Oil Filters |
| **7.2%** | **6.5%** | **6.0%** | **6.3%** | METAL TOTALS |
| 1.6% | 1.5% | 1.5% | 1.7% | PET # 1 |
| 2.1% | 2.2% | 2.3% | 2.0% | HDPE # 2 |
| 3.4% | 4.6% | 4.4% | 3.5% | Film |
| 5.6% | 6.5% | 6.4% | 7.3% | Other Plastic |
| **12.7%** | **14.8%** | **14.6%** | **14.5%** | PLASTIC TOTALS |
| 19.7% | 16.8% | 17.9% | 17.8% | Food Waste |
| 0.8% | 1.9% | 0.6% | 0.6% | Wood Waste |
| 3.2% | 4.2% | 3.9% | 6.1% | Textiles |
| 2.8% | 4.9% | 5.1% | 4.0% | Diapers |
| 2.9% | 3.4% | 3.6% | 2.6% | Other Organics |
| **29.4%** | **31.2%** | **31.1%** | **31.1%** | ORGANIC TOTALS |
| 2.8% | 3.8% | 3.4% | 2.5% | Fines |
| 1.3% | 1.1% | 2.3% | 1.4% | Other Inorganics |
| **4.1%** | **4.9%** | **5.7%** | **3.9%** | INORGANIC TOTALS |
| **0.5%** | **0.3%** | **0.6%** | **0.4%** | OTHER WASTE |
| **100.0%** | **100.0%** | **100.0%** | **100.0%** | TOTAL |

TABLE 24-3

# *COMPARISON OF CATEGORIES BY LOCATION*



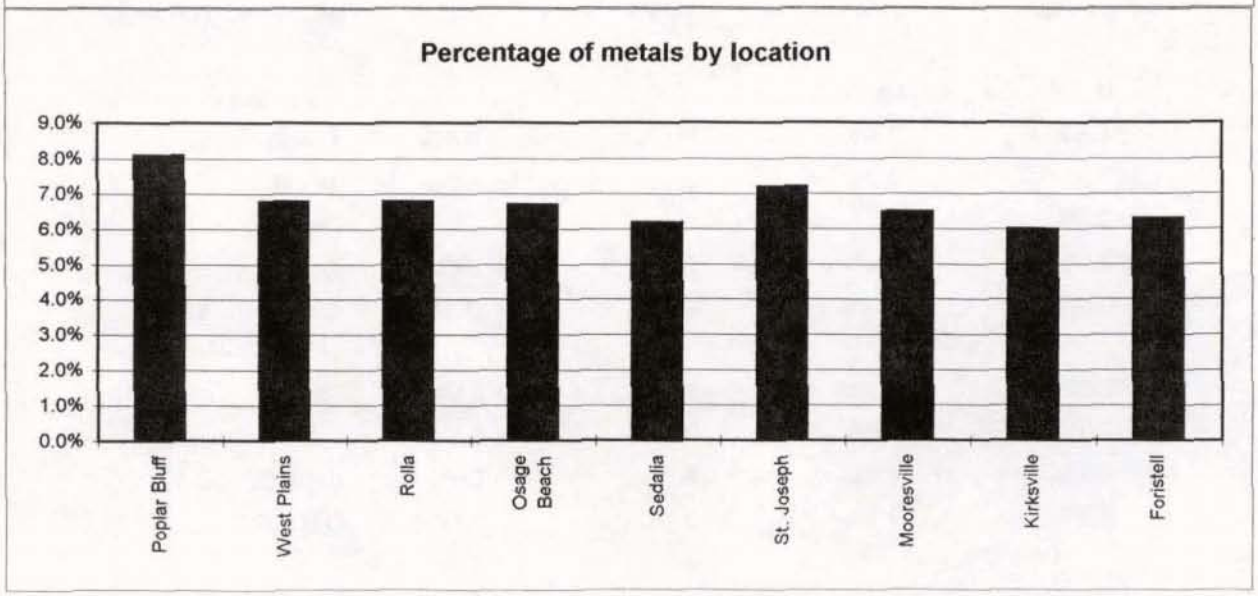
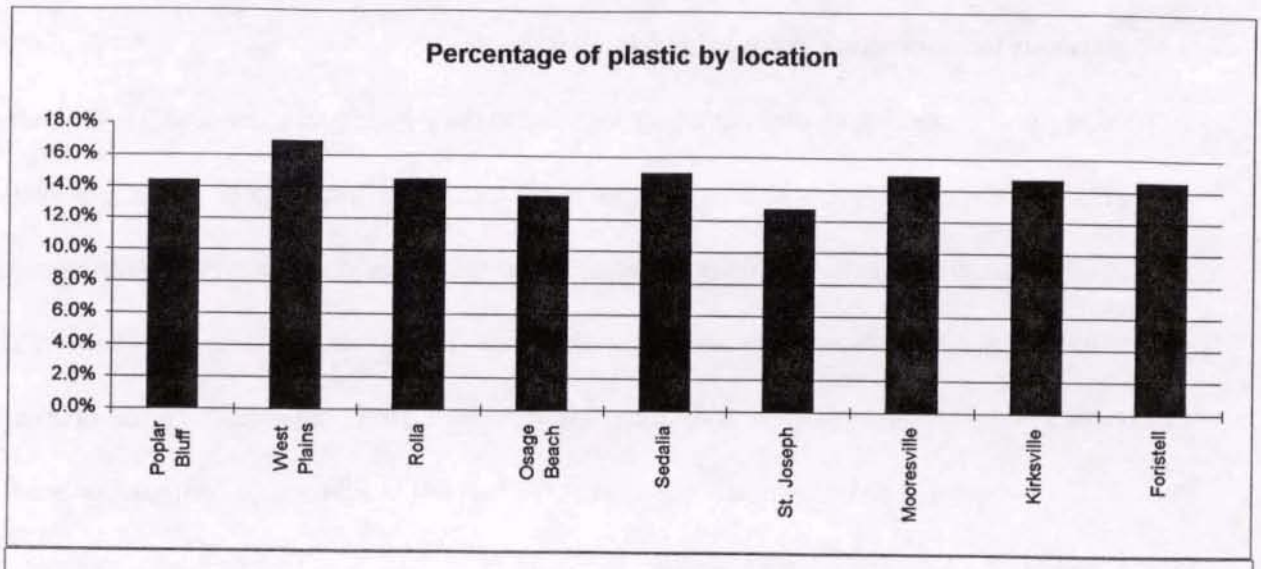
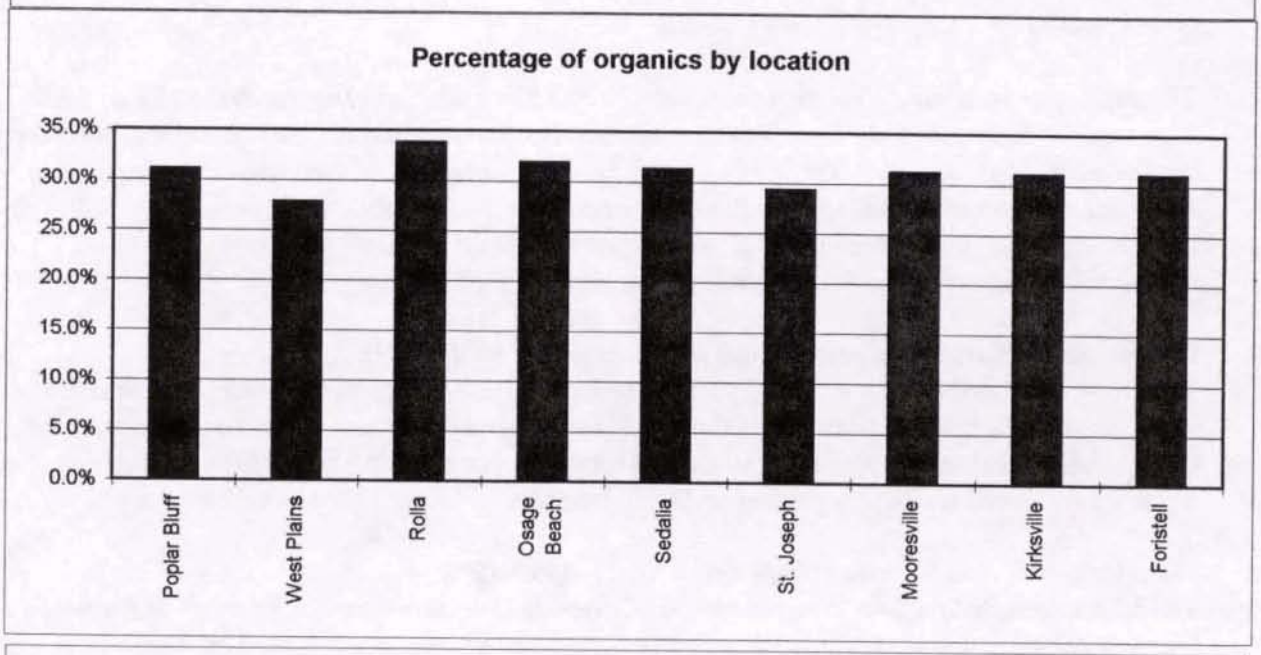




CHART 24-2

# COMPARISON OF CATEGORIES BY LOCATION



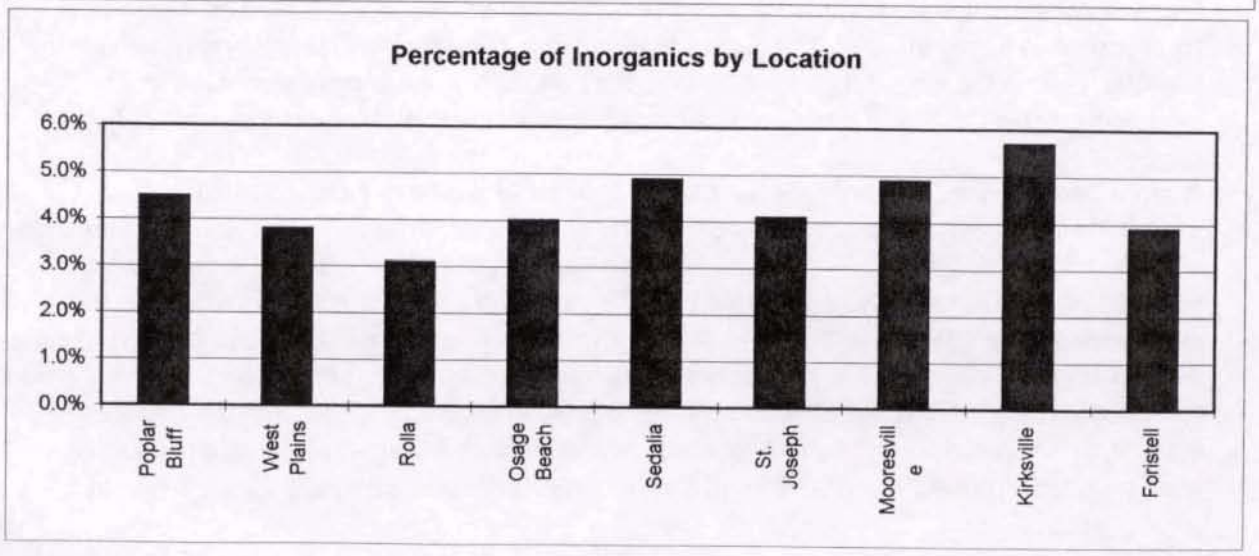




CHART 24-2

**Comparisons to other waste composition studies**

Several waste composition studies have been conducted during the past ten years. These studies vary greatly in the type of methodology used to gather the data. Most of these waste composition studies chose different waste categories or defined their categories differently. This difference in categories makes comparisons somewhat difficult but not impossible. In some cases sub-categories were grouped together to form the major categories for comparison. The comparisons are listed in Table 24-4 and graphically portrayed on Chart 24-3. Five waste composition studies were selected for comparison with Phase II:

***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. The waste sorts were performed before yard waste was banned in Missouri, therefore it is included in the other organics sub category. This comparison indicates how the Missouri waste stream has changed over the past ten years. The chart on page 11 displays the changes in the waste stream between 1987 and 1997

***Oregon Solid Waste Characterization and Composition 1992-93***
The study consisted of four seasonal sorts of residential and commercial waste. 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 used on Table 13-4 are from sorts conducted in 1991-92. 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 20 are from the

residential waste stream 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: 1994 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 stream, 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.

**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

The ban on yard waste seems to have a remarkable effect on reducing the amount of organic materials in the waste stream. Recycling also seems to have an effect on the composition of the waste stream. Oregon and Minnesota had strong recycling programs in effect during their waste sorts.

Table 24-5 shows a comparison of Phase I and Phase II percentage results for each category. The results were very consistent, with the exception of the glass percentages.

## *COMPARISSON OF OTHER WASTE COMPOSITION STUDIES*

| CATEGORY | 1987 EIERA | 1992 Oregon | 1992 Minnesota | 1994 Franklin | 1996 Missouri Univ. of MO | 1997 Missouri WCS-Phase II |
|---|---|---|---|---|---|---|
| Cardboard | 15.1% | 6.1% | 8.7% | 11.1% | 0.0% | 6.9% |
| Newsprint | 6.6% | 4.3% | 4.0% | 4.3% | | 7.9% |
| Magazines | 1.7% | 2.5% | 2.9% | 2.2% | | 4.0% |
| High Grade | 3.2% | 3.1% | 4.5% | 2.8% | | 4.2% |
| Mixed | 12.7% | 18.3% | 20.0% | 17.2% | | 14.4% |
| **PAPER TOTALS** | **39.4%** | **34.3%** | **40.1%** | **37.6%** | **0.0%** | **37.4%** |
| | | | | | | |
| Clear | 3.0% | 3.0% | 2.0% | 2.5% | | 3.0% |
| Brown | 0.8% | N/A | N/A | 2.4% | | 1.4% |
| Green | 0.7% | N/A | N/A | 0.9% | | 0.5% |
| Other | N/A | 0.3% | 1.1% | 0.8% | | 0.5% |
| **GLASS TOTALS** | **4.5%** | **3.3%** | **3.1%** | **6.6%** | **0.0%** | **5.4%** |
| | | | | | | |
| Alum. Cans | 1.0% | 0.1% | 0.5% | 0.4% | | 1.5% |
| Other Alum | 0.5% | 0.2% | 0.4% | 0.2% | | 0.8% |
| Non ferrous | 0.1% | N/A | 0.5% | N/A | | 0.2% |
| Food Cans | 2.0% | 2.0% | 0.9% | 1.0% | | 3.1% |
| Ferrous | 3.5% | 3.6% | 2.8% | 6.7% | | 1.1% |
| Oil Filters | N/A | N/A | 0.1% | N/A | | 0.1% |
| **METAL TOTALS** | **7.0%** | **5.9%** | **5.2%** | **8.3%** | **0.0%** | **6.9%** |
| | | | | | | |
| PET # 1 | 0.4% | N/A | 0.3% | 0.2% | | 1.6% |
| HDPE # 2 | 0.3% | N/A | 0.7% | 0.3% | | 2.1% |
| Film | N/A | N/A | 4.7% | 1.7% | | 3.9% |
| Other Plastic | 7.1% | N/A | 5.9% | 7.1% | | 6.8% |
| **PLASTIC TOTALS** | **7.7%** | **7.8%** | **11.6%** | **9.3%** | **0.0%** | **14.4%** |
| | | | | | | |
| Food Waste | 8.3% | 22.3% | 13.2% | 6.7% | | 19.1% |
| Wood Waste | N/A | 3.9% | 6.6% | 6.6% | | 0.8% |
| Textiles | 3.9% | 2.4% | 3.0% | 2.4% | | 3.9% |
| Diapers | 1.5% | 2.2% | 2.4% | 1.3% | | 3.9% |
| Other Organics | 21.6% | 13.2% | 11.0% | 19.3% | | 3.2% |
| **ORGANIC TOTALS** | **35.3%** | **44.0%** | **36.2%** | **36.3%** | **0.0%** | **30.9%** |
| | | | | | | |
| Fines | 2.9% | 3.0% | N/A | N/A | | 2.8% |
| Other Inorganics | 2.9% | 1.7% | 3.8% | 1.9% | | 1.4% |
| **INORGANIC TOTALS** | **5.8%** | **4.7%** | **3.8%** | **1.9%** | **0.0%** | **4.2%** |
| | | | | | | |
| **TOTAL** | **100.0%** | **100.0%** | **100.0%** | **100.0%** | **0.0%** | **100.0%** |

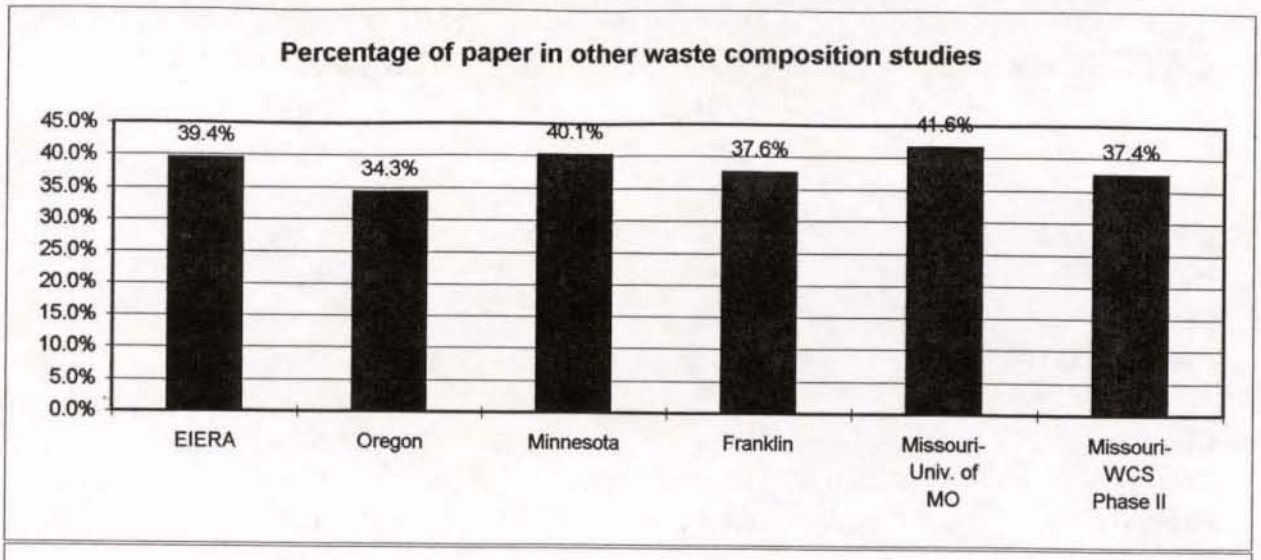
TABLE 24-4

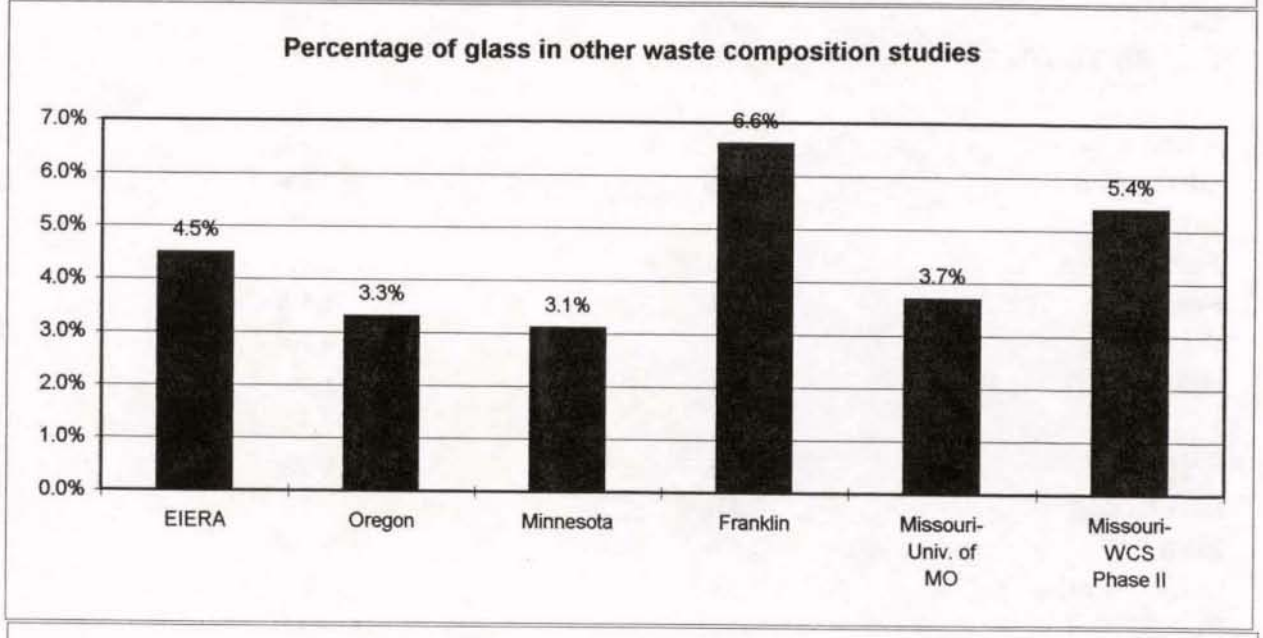
## *MISSOURI WCS PHASE I AND PHASE II COMPARISONS*

| CATEGORY | WCS-PHASE I 1996 | WCS-PHASE II 1997 |
|---|---|---|
| Cardboard | 6.4% | 6.9% |
| Newsprint | 7.8% | 7.9% |
| Magazines | 3.5% | 4.0% |
| High Grade | 2.9% | 4.2% |
| Mixed | 16.2% | 14.4% |
| PAPER TOTALS | **36.8%** | **37.4%** |
| | | |
| Clear | 3.3% | 3.0% |
| Brown | 1.7% | 1.4% |
| Green | 0.4% | 0.5% |
| Other | 0.7% | 0.5% |
| GLASS TOTALS | **6.1%** | **5.4%** |
| | | |
| Alum. Cans | 1.5% | 1.5% |
| Other Alum | 0.8% | 0.8% |
| Non ferrous | 0.3% | 0.2% |
| Food Cans | 3.1% | 3.1% |
| Ferrous | 1.1% | 1.1% |
| Oil Filters | 0.1% | 0.1% |
| METAL TOTALS | **6.9%** | **6.9%** |
| | | |
| PET # 1 | 1.7% | 1.6% |
| HDPE # 2 | 2.1% | 2.1% |
| Film | 3.5% | 3.9% |
| Other Plastic | 7.0% | 6.8% |
| PLASTIC TOTALS | **14.3%** | **14.4%** |
| | | |
| Food Waste | 18.1% | 19.1% |
| Wood Waste | 0.8% | 0.8% |
| Textiles | 4.1% | 3.9% |
| Diapers | 4.3% | 3.9% |
| Other Organics | 3.3% | 3.2% |
| ORGANIC TOTALS | **30.6%** | **30.9%** |
| | | |
| Fines | 3.6% | 2.8% |
| Other Inorganics | 1.6% | 1.4% |
| INORGANIC TOTALS | **5.2%** | **4.2%** |
| | | |
| TOTAL | **100.0%** | **100.0%** |

TABLE 24-5

# COMPARISON OF OTHER WASTE COMPOSITION STUDIES



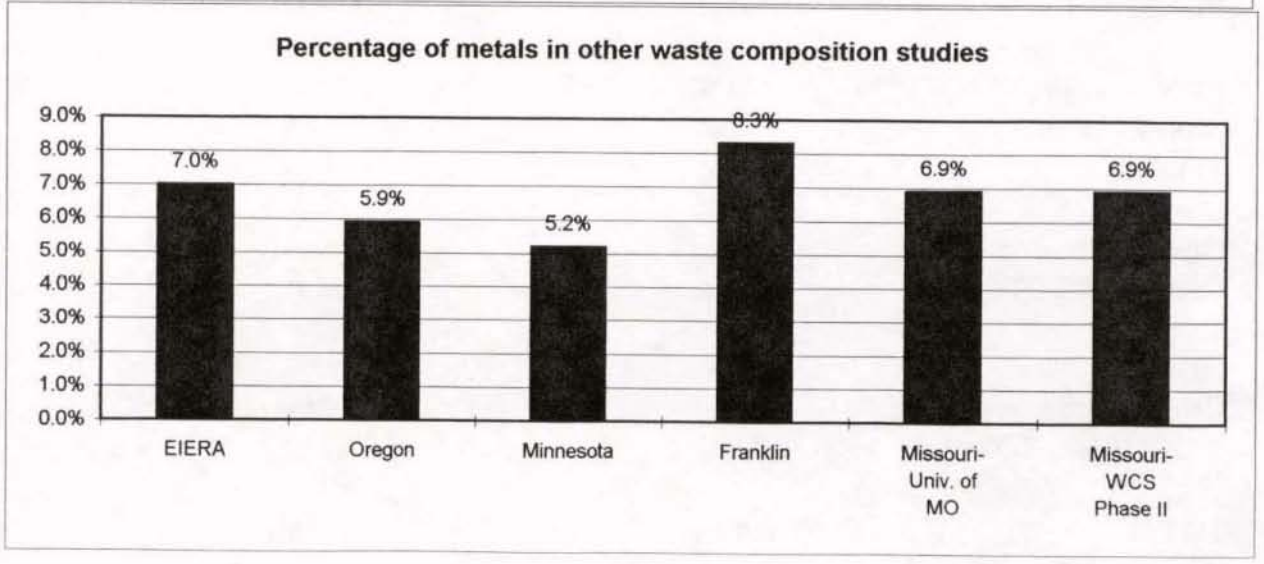
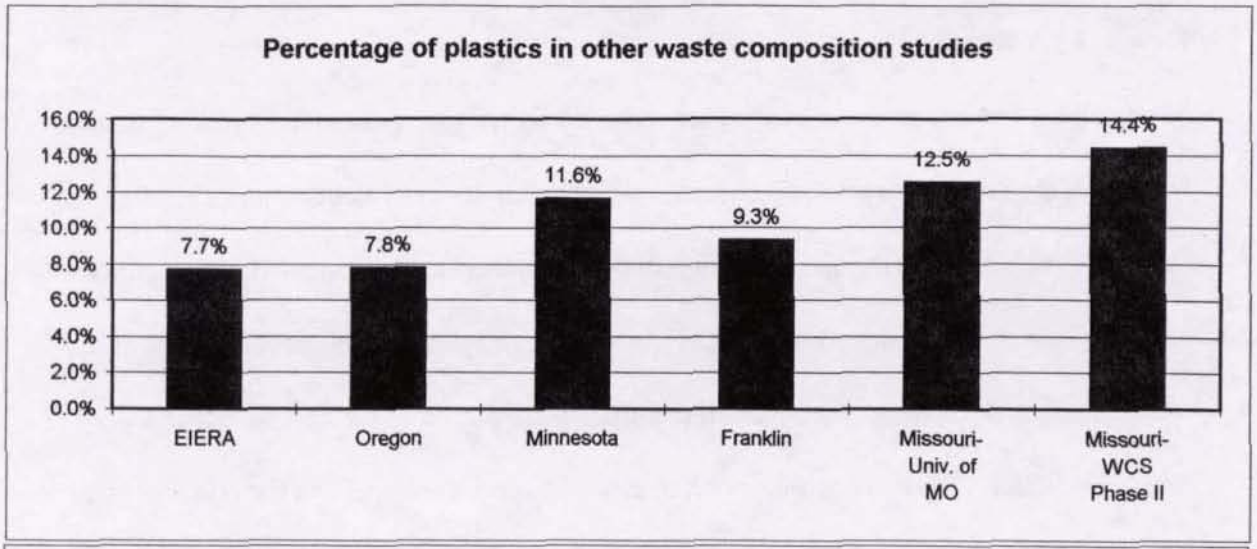
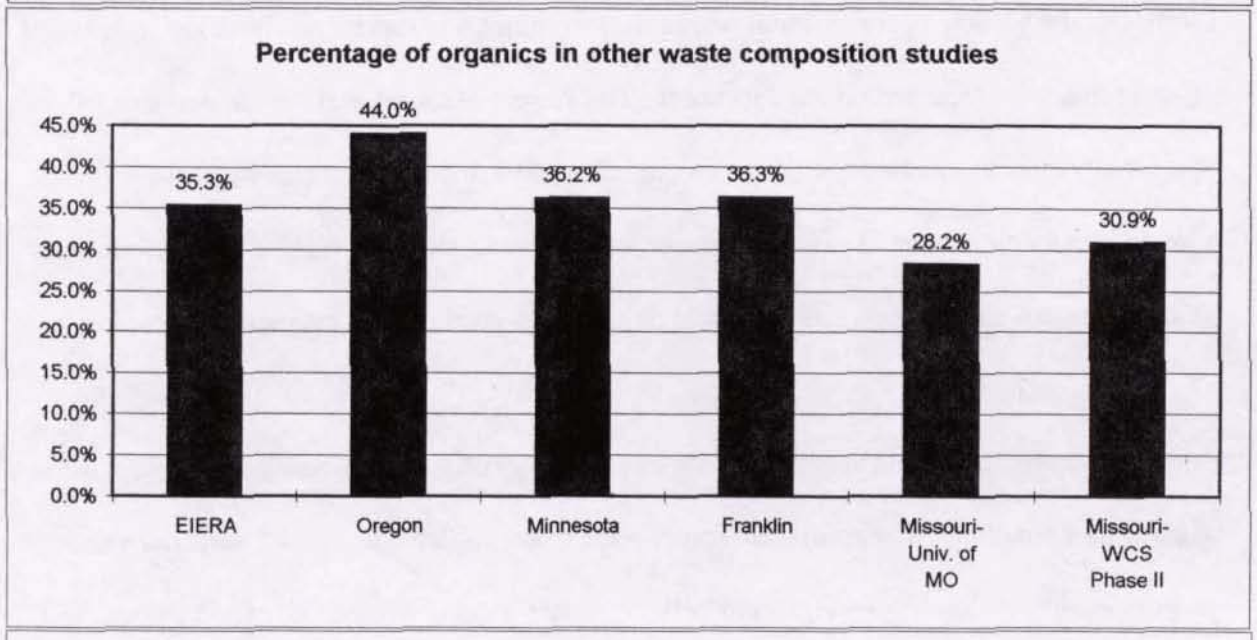




CHART 24-3

# COMPARISON OF OTHER WASTE COMPOSITION STUDIES



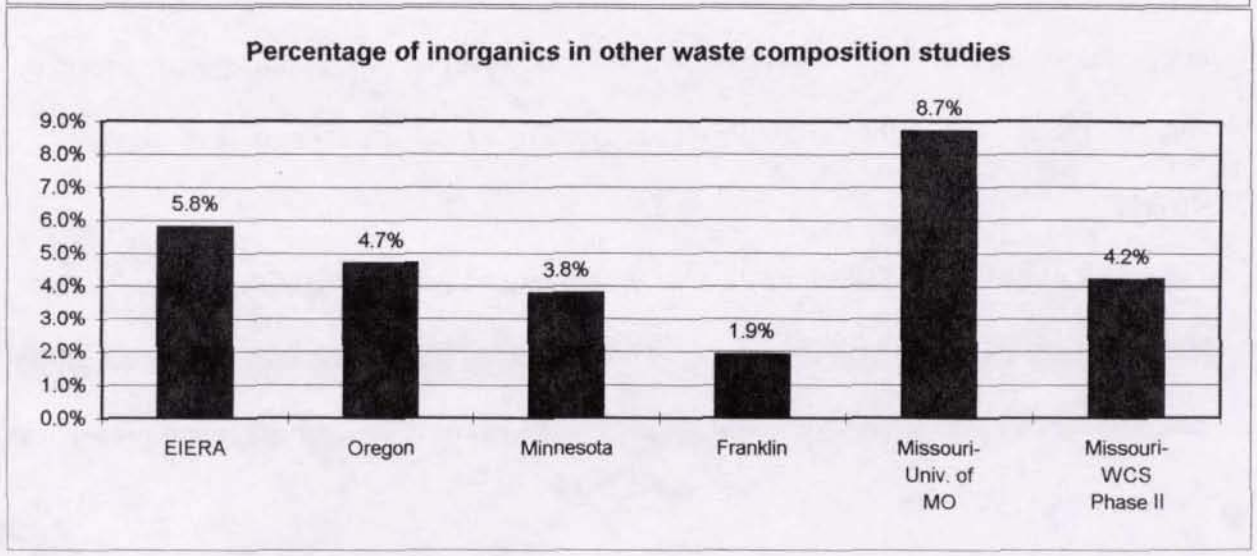




CHART 24-3

**Results by Volume**

Most solid waste composition studies are recorded by weight. However, in many instances volume of the material is more significant. Some examples are calculations on 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 in the appropriate category containers. Each identical container was 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 data sheet. The Project Manager and Sort Supervisor personally recorded and estimated the volume of all containers. This estimate is not "scientifically" accurate. However, in the process of estimating the volume of approximately 17,000 containers the waste sort personnel developed a good feel for estimating the volumes.

Table 24-6 lists the results of the Phase I waste sorts by volume and Chart 24-4 displays the same data in four pie charts The results are somewhat expected. Paper and metal percentages are approximately the same for weight and volume. Glass, organics (especially food wastes) and inorganics were much heavier and therefore produced lower percentages of the waste stream by volume. Plastics were lighter and their volumes took up a much greater portion of the waste stream.

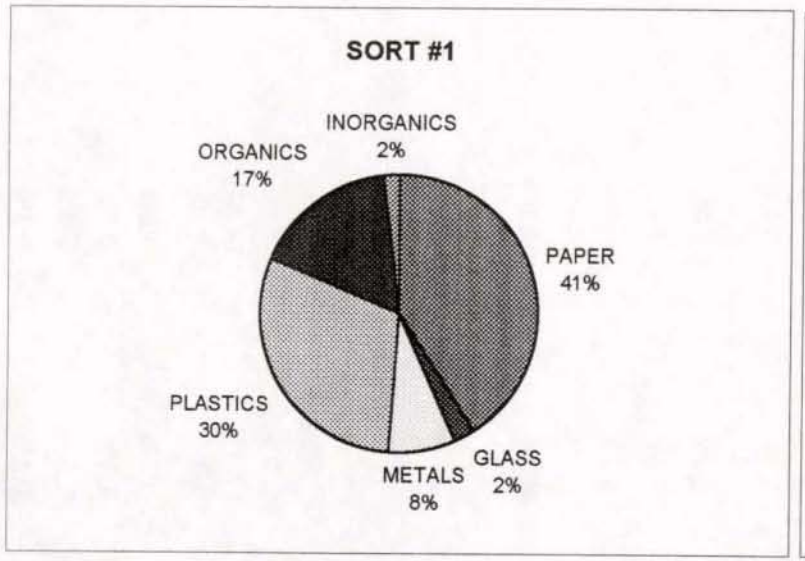
Table 24-7 and Chart 24-5 illustrate the relationship found between weight and volume in the Missouri waste stream. **These ratios are for uncompacted trash**. The average ratio for all materials was approximately 16 cubic yards per ton. Most conversion ratios for compacted trash is 2.5 to 4 cubic yards per ton.

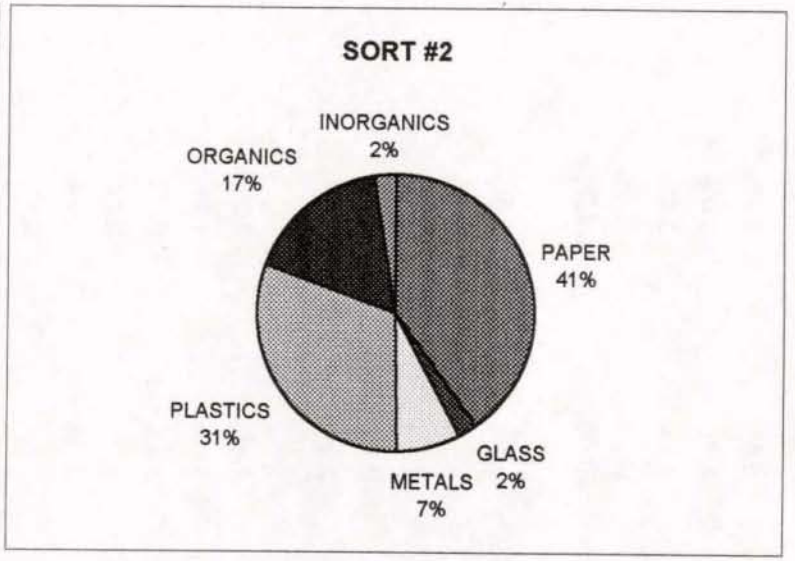
## *PHASE II SUMMARY RESULTS BY VOLUME*

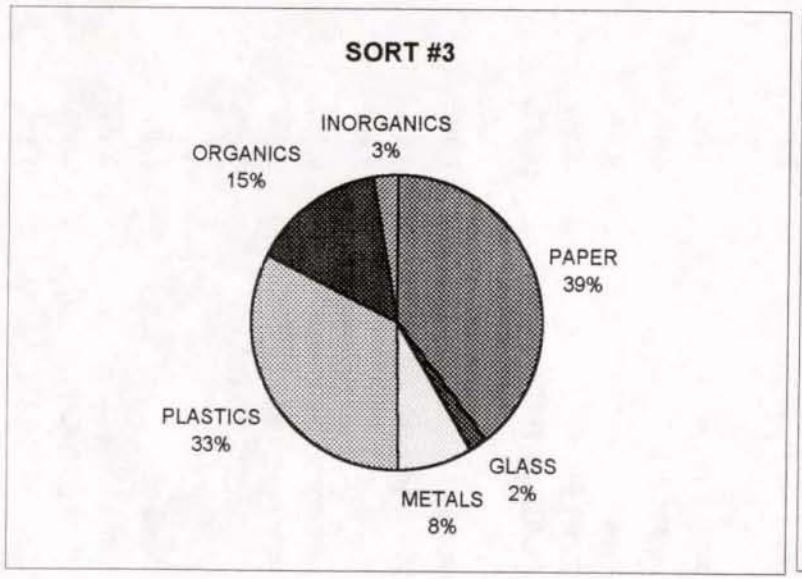
| | SORT # 1 | SORT # 2 | SORT #3 | AVERAGE |
|---|---|---|---|---|
| | 2/3/97-4/1/97 | 4/28/97-6/24/97 | 9/2/97-10/15/97 | 2/3/97-10/15/97 |
| CATEGORY | VOL. | VOL. | VOL. | VOL. |
| Cardboard | 10.9% | 11.8% | 11.4% | 11.4% |
| Newsprint | 5.6% | 5.8% | 5.7% | 5.7% |
| Magazines | 1.9% | 1.9% | 2.0% | 1.9% |
| High Grade | 4.3% | 4.2% | 3.9% | 4.1% |
| Mixed | 18.1% | 16.3% | 16.5% | 17.0% |
| PAPER TOTALS | 40.8% | 40.0% | 39.5% | 40.1% |
| | | | | |
| Clear | 1.2% | 1.1% | 1.0% | 1.1% |
| Brown | 0.7% | 0.8% | 0.4% | 0.7% |
| Green | 0.2% | 0.1% | 0.2% | 0.2% |
| Other | 0.3% | 0.2% | 0.3% | 0.3% |
| GLASS TOTALS | 2.4% | 2.3% | 2.0% | 2.2% |
| | | | | |
| Alum. Cans | 2.6% | 2.8% | 3.2% | 2.8% |
| Other Alum | 1.1% | 1.0% | 1.2% | 1.1% |
| Non ferrous | 0.1% | 0.3% | 0.1% | 0.2% |
| Food Cans | 3.3% | 2.7% | 2.8% | 2.9% |
| Ferrous | 0.6% | 0.6% | 0.7% | 0.7% |
| Oil Filters | 0.1% | 0.0% | 0.1% | 0.0% |
| METAL TOTALS | 7.8% | 7.4% | 8.1% | 7.8% |
| | | | | |
| PET # 1 | 3.6% | 3.4% | 3.9% | 3.6% |
| HDPE # 2 | 4.1% | 5.0% | 6.1% | 5.0% |
| Film | 9.8% | 8.7% | 9.4% | 9.3% |
| Other Plastic | 12.9% | 13.6% | 13.4% | 13.3% |
| PLASTIC TOTALS | 30.4% | 30.8% | 32.9% | 31.3% |
| | | | | |
| Food Waste | 9.1% | 8.1% | 7.3% | 8.2% |
| Wood Waste | 0.6% | 0.5% | 0.6% | 0.6% |
| Textiles | 2.6% | 3.7% | 3.2% | 3.2% |
| Diapers | 2.1% | 1.9% | 1.9% | 2.0% |
| Other Organics | 2.1% | 2.8% | 1.8% | 2.2% |
| ORGANIC TOTALS | 16.6% | 17.1% | 14.8% | 16.2% |
| | | | | |
| Fines | 1.4% | 1.7% | 1.9% | 1.6% |
| Other Inorganics | 0.5% | 0.7% | 0.7% | 0.6% |
| INORGANIC TOTALS | 1.9% | 2.3% | 2.6% | 2.3% |
| OTHER WASTE | 0.1% | 0.1% | 0.1% | 0.1% |
| | | | | |
| SORT TOTALS | 100% | 100% | 100% | 100% |

TABLE 24-6

# *PHASE II SUMMARY RESULTS BY VOLUME*



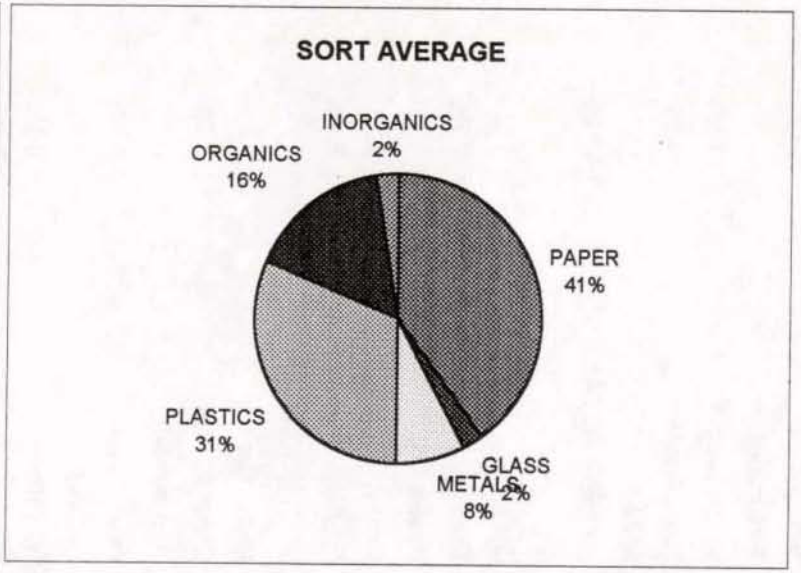




CHART 24-4

## *RELATIONSHIP BETWEEN WEIGHT AND VOLUME*

| CATEGORY | WEIGHT IN POUNDS | PCT. BY WEIGHT | VOLUME IN CU. FT. | PCT. BY VOLUME | RATIO LBS/CU.FT. |
|---|---|---|---|---|---|
| Cardboard | 4566 | 6.9% | 1554 | 11.4% | 2.94 |
| Newsprint | 5173 | 7.9% | 780 | 5.7% | 6.63 |
| Magazines | 2596 | 4.0% | 262 | 1.9% | 9.91 |
| High Grade | 2729 | 4.2% | 566 | 4.1% | 4.82 |
| Mixed | 9489 | 14.4% | 2320 | 17.0% | 4.09 |
| PAPER TOTALS | 24552 | 37.4% | 5482 | 40.1% | 4.48 |
| | | | | | |
| Clear | 1957 | 3.0% | 153 | 1.1% | 12.82 |
| Brown | 929 | 1.4% | 89 | 0.7% | 10.39 |
| Green | 308 | 0.5% | 25 | 0.2% | 12.22 |
| Other | 348 | 0.5% | 39 | 0.3% | 8.97 |
| GLASS TOTALS | 3555 | 5.4% | 306 | 2.2% | 11.62 |
| | | | | | |
| Alum. Cans | 1010 | 1.5% | 389 | 2.8% | 2.59 |
| Other Alum | 503 | 0.8% | 152 | 1.1% | 3.31 |
| Non ferrous | 142 | 0.2% | 23 | 0.2% | 6.22 |
| Food Cans | 2040 | 3.1% | 401 | 2.9% | 5.09 |
| Ferrous | 740 | 1.1% | 89 | 0.7% | 8.30 |
| Oil Filters | 83 | 0.1% | 6 | 0.00% | 12.95 |
| METAL TOTALS | 4517 | 6.9% | 1061 | 7.8% | 4.26 |
| | | | | | |
| PET # 1 | 1058 | 1.6% | 495 | 3.6% | 2.14 |
| HDPE # 2 | 1389 | 2.1% | 690 | 5.0% | 2.01 |
| Film | 2584 | 3.9% | 1274 | 9.3% | 2.03 |
| Other Plastic | 4453 | 6.8% | 1826 | 13.3% | 2.44 |
| PLASTIC TOTALS | 9483 | 14.4% | 4286 | 31.3% | 2.21 |
| | | | | | |
| Food Waste | 12546 | 19.1% | 1121 | 8.2% | 11.19 |
| Wood Waste | 533 | 0.8% | 81 | 0.6% | 6.60 |
| Textiles | 2570 | 3.9% | 437 | 3.2% | 5.88 |
| Diapers | 2568 | 3.9% | 270 | 2.0% | 9.53 |
| Other Organics | 2099 | 3.2% | 306 | 2.2% | 6.86 |
| ORGANIC TOTALS | 20316 | 30.9% | 2215 | 16.2% | 9.17 |
| | | | | | |
| Fines | 1854 | 2.8% | 223 | 1.6% | 8.32 |
| Other Inorganics | 905 | 1.4% | 87 | 0.6% | 10.45 |
| INORGANIC TOTALS | 2760 | 4.2% | 309 | 2.3% | 8.92 |
| OTHER WASTE | 517 | 0.8% | 19 | 0.1% | 27.08 |
| | | | | | |
| SORT TOTALS | 65699 | 100% | 13677 | 100.0% | 4.80 |

TABLE 24-7

## *RELATIONSHIP BETWEEN WEIGHT AND VOLUME*

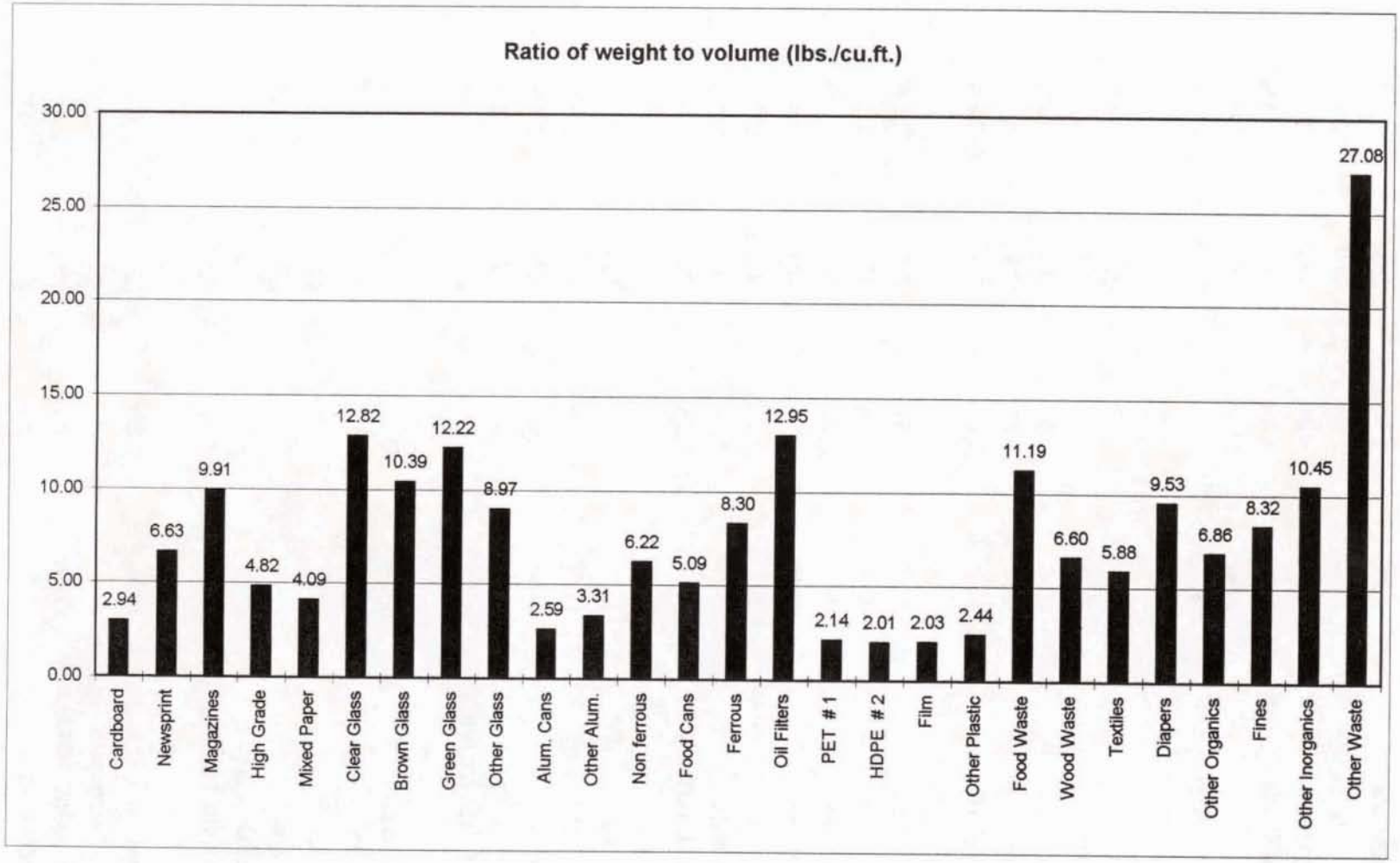



CHART 24-5