



SHORT COURSE ON SOLID WASTES
COLLECTION AND DISPOSAL

Damascus, 20-30 May 1968

EMRO 134

Lecture No. 3

Measuring and Predicting Quantities

Quantity -

1. Per capita/day (calendar day)
U.S. - 4.5 lb./cap/day, increasing at the rate of 4%/year
2. Volume or density
 - a. Best on weight basis
 - b. Volume - variable due to method of handling and compacting
ordinary uncompacted refuse 200-350 lb./cu. yd.
compaction results in density 400-500 lb./cu. yd.
or more

Predicting Quantities Depends on -

1. Population
 - a. Growth
 - b. Density
 - c. Transient
2. Income level
3. Number and type of industry
4. Number and type of commercial establishments
5. Climate
6. Seasons
7. Technological advances
(prepackaging, more paper and plastics, less garbage)

8. Degree of on-site disposal
(amount produced always somewhat less than amount collected)
9. Frequency of collection; thoroughness of collection
10. Salvaging
11. Fees charged for collection service
12. Cost and availability of fuels
 - a. Gas and oil
 - b. Electricity
 - c. Solid fuels
13. Care in keeping records

TABLE 1 *

Annual Quantities of Raw Refuse Per Capita¹

Class	Weight lb	% by Weight	uncom- pacted volume Cu. yd	% by volume	Specific Weight lb/cu yd
Garbage	150	9.5	0.15	4.0	1000
Rubbish and all com- bustibles (except garbage)	1000	62.5	3.15	81.0	320
All noncombustibles	450	28.0	0.60	15.0	750
Total	1600	100	3.90	100	410

1 From: Wegman, Leonard S.- Planning a New Incinerator, Proceedings 1964
National Incinerator Conference, ASME

* From: Refuse Collection Practice, 3rd Edition, APWA, 1966, p.28

Table 2*

Pounds of Refuse Collected Per Capita
1965 APWA Survey

City	lb/cap/yr	lb/cap/day	Remarks
Residential Refuse Only, All Classes			
Cedar Rapids, Iowa	386	1.1	Original data in cu.yd. only; backyard burning is practiced
Vancouver, B.C.	454	1.2	
Washington D.C.	565	1.6	Some commercial garbage included
Philadelphia, Pa.	571	1.6	
Seattle, Wash.	603	1.7	
Cincinnati, Ohio	721	2.0	Some commercial combustible included
New York, N.Y.	768	2.1	
Los Angeles, Calif.	780	2.1	
Trenton, N.J.	782	2.1	Small amount of little commercial establishments
Evanston, Ill.	996	2.7	
Chandler, Ariz.	1100	3.0	Some commercial included
Winnetka, Ill.	1152	3.2	
Median	745	2.0	
Commercial and Industrial Refuse, All Classes			
Winnetka, Ill.	1480	1.3	Non-industrial city
Cincinnati, Ohio	514	1.4	Part of original data in cu.yd. only
Philadelphia, Pa.	555	1.5	No industrial, not all of commercial refuse
New York, N.Y.	715	2.0	Combustible construction and demolition wastes included
Seattle, Wash.	905	2.5	Extrapolated
Vancouver, B.C.	933	2.6	
Washington, D.C.	955	2.6	Extrapolated
Median	715	2.0	

* From: Refuse Collection Practice, 3rd Edition, APWA, 1966, p.29

Table 2 (continued)

City	lb/cap/yr	lb/cap/day	Remarks
All Refuse			
Newark, N.J.	856	2.3	Limited to 100 lbs per pickup
Chandler, Ariz.	1100	3.0	Non-industrial city
Philadelphia, Pa.	1126	3.1	No industrial, not all commercial refuse
Cincinnati, Ohio	1235	3.4	Non-combustible rubbish given in cu.yd.
Garden City, N.Y.	1308	3.6	No industrial
Vancouver, B.C.	1387	3.8	
New York, N.Y.	1483	4.1	Combustible construction and demolition wastes included
Seattle, Wash.	1508	4.1	Extrapolated
Washington, D.C.	1545	4.2	
Neptune, N.J.	1565	4.3	
Winnetka, Ill.	1632	4.5	Non-industrial city
Los Angeles, Calif.	2373	6.5	Demolition wastes included
Median	1435	3.9	

Table 3 *

Monthly Quantity and Density of Combined Residential Refuse
 Three Cities, 1959-1962
 From Studies Made by Purdue University

Month	Milwaukee, 1959-1960			Bloomington, ¹ 1961-1962			Indianapolis, ¹ 61-62		
	Weight Lb/cap/ day	Weight % of Mean	Density ² Lb/ cu.yd.	Weight Lb/cap/ day	Weight % of Mean	Density Lb/ cu.yd.	Weight Lb/cap/ day	Weight % of Mean	Density Lb/ cu.yd.
January	1.52	87	Winter 378 (405 in packer)	0.98	98	302	1.05	85	464
February	1.29	74		0.94	94	308	0.91	74	473
March	1.57	90		0.91	91	319	0.90	73	452
April	2.27	131	Summer 373 (405 in packer)	0.91	91	305	1.05	85	473
May	2.05	118		0.94	94	292	1.34	109	497
June	1.85	106		0.96	96	284	1.48	120	513
July	1.71	98		1.02	102	281	1.61	131	500
August	1.79	103		1.00	100	300	1.25	102	475
September	1.73	99		1.02	102	294	1.47	119	551
October	1.80	104		1.14	114	327	1.56	127	619
November	1.71	98		1.09	109	311	1.13	92	462
December	1.55	89		1.00	100	294	1.04	85	511
Mean	1.74	100		1.00	100	301	1.23	100	502

1 Considerable on-site burning of combustible rubbish and garbage is practiced by the residents.

2 Density is measured in open trucks or containers unless otherwise specified.

* From: Refuse Collection Practice, 3rd Edition, APWA, 1966, p.33

Table 4 *

Refuse Density, 1965

Class of Refuse	City	Density Lb/cu.yd.	Remarks ¹
Combined	Evanston, Ill.	525	
	Los Angeles, Calif.	500,570	Different size trucks
	Neptune, N.J.	600	
	Newark, N.J.	450	
	New York, N.Y.	390	Municipal collection
		480	Private collection
	Philadelphia, Pa.	450	
	San Francisco, Calif.	324	Estimated
	Seattle, Wash.	350,470	Different contractors
	Trenton, N.J.	450	
	Vancouver, B.C.	432	Different truck models
		582,683,712	
	Winnetka, Ill.	300	Commercial
		750	Residential
Rubbish	Atlanta, Ga.	400	
	Cincinnati, Ohio	580,600	Combustibles, different size trucks
		670,700	Noncombustibles; different size trucks
	Philadelphia, Pa.	350,509,625	Different size trucks
	Washington, D.C.	222	Open truck
Garbage	Los Angeles, Calif.	1,325	Non-compactor; restaurants only
	Philadelphia, Pa.	900	Non-compactor, residential only
	Washington, D.C.	1,000	Non-compactor
Bulky Wastes	Philadelphia, Pa.	200	Open trucks
Ashes	Philadelphia, Pa.	800	Non-compactor

¹ All densities were measured in compactor trucks unless otherwise noted.

* From: Refuse Collection Practice, 3rd Edition, APWA, 1966, p.34

From Table 4 (Density measured in compaction trucks except as noted)

1. Combined refuse density varies from 300 to 750 lb./cu. yd. with a median value of 475 lb./cu. yd.
2. Rubbish density varies from 350 to 700 lb./cu. yd. with a median of 590 lb./cu. yd. In open trucks density at 222 lb./cu. yd.
3. Non-combustibles reported as approximately 100 lb./cu. yd. more dense than combustibles (Cincinnati)
4. Garbage collected separately in non-compactor trucks, density ranged 900-1325 lb./cu. yd. median 1000 lb./cu. yd.

Table 5 *

Density of Various Classes of Refuse, Lb/cu.yd.

Classes of Refuse	1939				1955				1965 ¹			
	No. Cities	Min	Md	Max	No. Cities	Min	Md	Max	No. Cities	Min	Md	Max
Garbage	7	798	936	1540	-	-	-	-	3	900	1000	1325
Rubbish	5	200	214	677	5	60	383	605	3	350	590	700
Ashes	-	1150	1250	1400	-	-	-	-	1	-	800	-
Garbage and combustible rubbish	5	214	442	800	3	234	392	502	1	580	-	600
Rubbish and Ashes	7	400	692	1000	-	-	-	-	-	-	-	-
Noncombustible Rubbish ²	4	747	883	1165	3	396	543	605	1	670	-	700
Combined Refuse	6	500	604	1000	7	300	356	667	11	300	475	750

1 In 1965 all densities are reported for compactor trucks except for garbage and ashes.

2 Includes some ashes.

Data are from APWA surveys.

Facilities for Measuring Quantity -

1. Scales - platform
portable
automatic registering
2. Volume - measure truck bodies
measure in place
3. Density - both weight and volume

* From: Refuse Collection Practice, 3rd Ed., APWA, 1966, p.96