



Studies on solid waste generation and composition in the commercial area of Akhnoor Town, district Jammu

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Abstract

The present paper deals with the analysis of solid waste generation and composition within the municipal limits of Akhnoor town which marks its beginning from the main bridge on the river Chenab and extends up to Sohal-Sungal turn. The commercial area was divided into four different zones for the purpose of studies. From each zone, five different types of shops were selected for the sampling and analysis of solid waste for a period of one year. Characterization and management of solid waste along with methods of disposal of Municipal Solid Waste (MSW) were studied to analyze its impact on the environment and people inhabiting the area. Proper disposal methods have also been suggested so that the environment in general and the population inhabiting the area in particular is saved from the hazardous effect of fast increasing menace of the waste.

Keywords: Solid waste, MSW, environment, disposal

Introduction

Waste is an unavoidable by product of human activities. Economic development, urbanization and improving the living standards in cities, have led to increase in the quantity and complexity of generated waste. Management of solid waste resulting out of rapid urbanization has become a serious concern not only for the government departments, pollution control agencies, regulatory bodies but also for the general public in most of the developing countries. Various workers, both from India and abroad have worked a lot on generation, composition and management of solid waste, but no work seems to have been done on solid waste generated in the commercial area of Akhnoor town. However, some workers like Rampal *et al.* (2002), Kour (2004), Rampal *et al.* (2005), Gupta *et al.* (2007), Gupta *et al.* (2008), Jaswal (2008) and Kewal (2010) have provided some fragmentary information on the generation and characteristics of waste of Jammu Municipality. In present study, an attempt has been made to assess the status of solid waste pollution in commercial areas of Akhnoor town.

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Material and Methods

Study Area

The present study was conducted within the municipal limits of Akhnoor town which starts from the main bridge on River Chenab and extends up to Sohal-Sungal turn. Geographically, Akhnoor lies at a latitude of 32.9⁰N and longitude of 74.75⁰ E, situated in the North-West part of India and eastern part of Pakistan and is about 32Km from Jammu. It has a total area of 1.5 sq Km with a population of 11346.

Methodology

The study area was divided into four different zones for the purpose of waste collection. Five shops of each type i.e., Karyana, barber, tea stall, juice stall and fruit and vegetable shop were selected for the purpose of study, from each zone, thus totalling hundred shops from four different zones, for purpose of studies. The sampling was done over a period of one year, i.e., from June, 2007 to May, 2008. Monthly sampling of solid waste was done by collecting waste from each shop, segregated into different components and weighed separately with the help of spring balance. The various components of waste collected for analysis were identified as paperware, cardboard, clothware, jute, foliage, cotton, wood, food and



garbage (biodegradable); plasticware, metallicware, glassware, thermocoal, rubber, leather, egg shells and bones (non-biodegradable) and inert wastes. The calculated values indicating average of each type of shop was tabulated in tables 1-4.

Results and Discussion

The results of 12 months data on solid waste generation and composition are presented in Table-1, 2, 3 and 4. Comparative study of average solid waste (Kg/shop/month) generation at four different study zones, i.e. Zone-I to Zone -IV containing 5 different types of shops, 5 each, during one year has been made (Table 5). A critical evaluation of Table-5 has revealed that in the study area (i.e, Zone I to

Zone-IV) the total solid waste generated (Kg/shop) was estimated to be 6797.71Kg with an average of 566.476 ±4.488 Kg out of which 6600.504 Kg was contributed by biodegradable waste (97.09%) comprising of paperware, card board, clothware, jute, foliage, cotton, wood, food/garbage, etc. Non-bio-degradable waste was found to be 89.532 Kg (1.31%) comprising of plasticware, metallicware, glassware, thermocoal, rubber, etc and 107.676 Kg of inert waste (1.6%) which comprised of hair, dust, pebbles, sand, gravels, etc with average values of 550.042±4.395 Kg, 7.461±0.051 Kg and 8.973±0.042 Kg, respectively. The per shop generation of these various components have been depicted in Table 1-5.

Table 1:- Qualitative and Quantitative Composition of Solid Waste (Kg/shop) at Zone-I

Shops	Biodegradable waste					Non-biodegradable waste					Inert material					Total solid waste					
	Shop-01 Karyana	Shop-02 Barber	Shop-03 Tea stall	Shop-04 Juice stall	Shop-05 Fruit and vegetable	Shop-01 Karyana	Shop-02 Barber	Shop-03 Tea stall	Shop-04 Juice stall	Shop-05 Fruit and vegetable	Shop-01 Karyana	Shop-02 Barber	Shop-03 Tea stall	Shop-04 Juice stall	Shop-05 Fruit and vegetable	Shop-01 Karyana	Shop-02 Barber	Shop-03 Tea stall	Shop-04 Juice stall	Shop-05 Fruit and vegetable	
Months																					
June	212.4	13.35	44.7	2250	889.2	10.8	8.25	10.95	0	6.15	4.5	23.4	1.5	0	1.8	227.7	45	57.15	2250	897.15	
July	207.6	10.2	41.85	2587.5	970.8	5.85	12.15	9.15	0	8.4	4.2	27.15	1.95	0	2.7	217.65	49.5	52.95	2587.5	981.9	
August	232.95	13.35	49.8	2572.5	1191	10.95	9.75	12.3	0	8.55	4.2	24.45	2.85	0	3.15	248.1	47.55	64.95	2572.5	1202.7	
September	262.8	14.7	51.45	2437.5	1281.6	15.6	11.4	15.9	0	9	5.4	27.9	3.3	0	2.7	283.8	54	70.65	2437.5	1293.3	
October	245.25	14.1	52.8	2212.5	1189.2	15	10.65	15.75	0	8.7	4.5	27.15	2.7	0	1.65	264.75	51.9	71.25	2212.5	1199.55	
November	218.85	3.9	45.15	1554	1205.4	14.7	10.5	17.25	0	9.15	4.2	27.75	1.95	0	2.25	237.75	42.15	64.35	1554	1216.8	
December	222.45	5.7	45.75	1243.5	1082.7	13.65	11.4	18.75	0	8.7	3	28.35	2.25	0	1.5	239.1	45.45	66.75	1243.5	1092.9	
January	201.75	6.45	42	1144.5	928.5	9.9	10.95	18	0	6.15	1.95	27	1.35	0	1.2	213.6	44.4	61.35	1144.5	935.85	
February	199.5	7.35	37.35	1087.5	823.95	6.45	11.25	15.45	0	6.75	2.7	27.45	1.95	0	1.5	208.65	46.05	54.75	1087.5	832.2	
March	189.45	7.95	35.4	1152	810.45	4.95	12.15	14.55	0	5.55	3	29.25	1.5	0	1.05	197.4	49.35	51.45	1152	817.05	
April	195.6	11.25	41.7	1617	960.75	8.7	14.1	17.4	0	4.95	4.05	27.9	1.95	0	2.25	208.35	53.25	61.05	1617	967.95	
May	119.55	8.4	39.9	1927.5	725.55	7.35	12.75	13.05	0	2.55	3.3	22.5	1.35	0	1.5	130.2	43.65	54.3	1927.5	729.6	
Total	2508.15	116.7	527.85	21786	12059.1	123.9	135.3	178.5	0	84.6	45	320.25	24.6	0	23.25	2677.05	572.25	730.95	21786	12167	
Total per month	209.013	9.725	43.988	1815.5	1004.93	10.325	11.275	14.875	0	7.05	3.75	26.688	2.05	0	1.938	223.088	47.688	60.913	1815.5	1013.91	
Per Month/ Shop																					
	41.803	1.945	8.798	363.1	200.985	2.065	2.255	2.975	0	1.41	0.75	5.338	0.41	0	0.388	44.618	9.538	12.183	363.1	202.783	
Total per day	6.967	0.324	1.466	60.517	33.498	0.344	0.376	0.496	0	0.235	0.125	0.89	0.068	0	0.065	7.436	1.59	2.03	60.517	33.797	
Per day/ Shop																					
	1.393	0.065	0.293	12.103	6.7	0.069	0.075	0.099	0	0.047	0.025	0.178	0.014	0	0.013	1.487	0.318	0.406	12.103	6.759	
A.V.	209.013	9.725	43.988	1815.5	1004.93	10.325	11.275	14.875	0	7.05	3.75	26.688	2.05	0	1.938	223.088	47.688	60.913	1815.5	1013.91	
S.D.	35.393	3.62	5.397	585.45	181.494	3.767	1.486	2.972	0	2.053	0.964	2.086	0.624	0	0.663	38.581	3.9	6.828	585.45	183.658	

A.V. -Average

S.D- Standard Deviation



Studies on solid waste generation

Table 2:- Qualitative and Quantitative Composition of Solid Waste (Kg/shop) at Zone-II

Months	Biodegradable waste					Non-biodegradable waste					Inert material					Total solid waste				
	Shop-01 Karyana	Shop-02 Barber	Shop-03 Tea stall	Shop-04 Juice stall	Shop-05 Fruit and vegetable	Shop-01 Karyana	Shop-02 Barber	Shop-03 Tea stall	Shop-04 Juice stall	Shop-05 Fruit and vegetable	Shop-01 Karyana	Shop-02 Barber	Shop-03 Tea stall	Shop-04 Juice stall	Shop-05 Fruit and vegetable	Shop-01 Karyana	Shop-02 Barber	Shop-03 Tea stall	Shop-04 Juice stall	Shop-05 Fruit and vegetable
June	239.55	11.7	48.75	1537.5	740.55	12.6	10.05	13.8	0	5.4	5.7	82.95	1.95	0	2.4	257.85	104.7	64.5	1537.5	748.35
July	209.85	13.5	46.65	1912.5	1006.8	12.45	10.8	12.75	0	5.85	4.2	88.95	1.5	0	1.95	226.5	113.25	60.9	1912.5	1014.6
August	221.4	8.7	50.25	2194.5	911.55	9.6	9.9	14.7	0	6.75	4.8	92.25	2.7	0	3	235.8	110.85	67.65	2194.5	921.3
September	229.05	6.3	48.9	1912.5	980.85	11.55	11.7	19.65	0	8.4	3	101.4	3.15	0	1.35	243.6	119.4	71.7	1912.5	990.6
October	195.9	4.05	43.2	1597.5	840.3	11.4	8.85	18	0	6.15	2.7	90	1.65	0	1.5	210	102.9	62.85	1597.5	847.95
November	189.9	5.85	44.1	1402.5	904.8	11.4	10.8	15.15	0	5.85	3.15	87.75	2.25	0	1.35	204.45	104.4	61.5	1402.5	912
December	169.2	5.4	45.75	1350	990	11.25	10.8	14.4	0	6.15	2.85	84.45	0.75	0	1.5	183.3	100.65	60.9	1350	997.65
January	158.4	6.15	46.8	1312.5	843.3	10.5	11.85	16.35	0	7.35	3.3	71.55	1.5	0	1.2	172.2	89.55	64.65	1312.5	851.85
February	141.45	7.5	42.9	1333.5	861.6	10.35	9.3	16.5	0	6	2.55	72.9	1.2	0	1.5	154.35	89.7	60.6	1333.5	869.1
March	134.1	6.3	38.85	1425	700.8	9	9.45	15.15	0	4.65	2.85	70.8	2.1	0	1.05	145.95	86.55	56.1	1425	706.5
April	160.2	10.05	43.5	1469.85	875.4	12	10.95	15.75	0	3.75	4.05	73.8	2.7	0	1.35	176.25	94.8	61.95	1469.85	880.5
May	200.7	10.35	45.15	1647	781.2	13.35	11.1	14.25	0	4.35	3.15	76.8	1.2	0	1.95	217.2	98.25	60.6	1647	787.5
Total	2249.7	95.85	544.8	19094.9	10437.2	135.45	125.55	186.45	0	70.65	42.3	993.6	22.65	0	20.1	2427.45	1215	753.9	19094.9	10527.9
Total per month	187.48	7.988	45.4	1591.24	869.763	11.288	10.463	15.538	0	5.888	3.525	82.8	1.888	0	1.675	202.288	101.25	62.825	1591.24	877.325
Per Month/Shop	37.495	1.598	9.08	318.248	173.953	2.258	2.093	3.108	0	1.178	0.705	16.56	0.378	0	0.335	40.458	20.25	12.565	318.248	175.465
Total per day	6.249	0.266	1.513	53.041	28.992	0.376	0.349	0.518	0	0.196	0.118	2.76	0.063	0	0.056	6.743	3.375	2.094	53.041	29.244
Per day/Shop	1.25	0.053	0.303	10.608	5.798	0.075	0.07	0.104	0	0.039	0.024	0.552	0.013	0	0.011	1.349	0.675	0.419	10.608	5.849
A.V.	187.48	7.988	45.4	1591.24	869.763	11.288	10.463	15.538	0	5.888	3.525	82.8	1.888	0	1.675	202.288	101.25	62.825	1591.24	877.325
S.D.	34.686	2.87	3.162	279.072	96.909	1.262	0.949	1.891	0	1.281	0.965	9.713	0.719	0	0.561	35.936	10.124	3.969	279.072	97.591

A.V. -Average
S.D. - Standard Deviation

Table 3:- Qualitative and Quantitative Composition of Solid Waste (Kg/shop) at Zone-III

Months	Biodegradable waste					Non-biodegradable waste					Inert material					Total solid waste				
	Shop-01 Karyana	Shop-02 Barber	Shop-03 Tea stall	Shop-04 Juice stall	Shop-05 Fruit and vegetable	Shop-01 Karyana	Shop-02 Barber	Shop-03 Tea stall	Shop-04 Juice stall	Shop-05 Fruit and vegetable	Shop-01 Karyana	Shop-02 Barber	Shop-03 Tea stall	Shop-04 Juice stall	Shop-05 Fruit and vegetable	Shop-01 Karyana	Shop-02 Barber	Shop-03 Tea stall	Shop-04 Juice stall	Shop-05 Fruit and vegetable
June	62.55	7.05	39.75	2047.5	607.8	5.7	4.95	13.35	0	4.2	4.65	20.55	1.35	0	1.95	72.9	32.55	54.45	2047.5	613.95
July	71.25	4.05	42.9	2377.5	686.1	8.25	6	10.5	0	4.65	3.9	22.65	1.65	0	2.25	83.4	32.7	55.05	2377.5	693
August	62.55	3.9	42.15	2325	462.6	5.4	8.85	11.1	0	2.85	3.75	18.9	1.5	0	1.35	71.7	31.65	54.75	2325	466.8
September	68.7	5.85	49.95	2134.5	759.9	7.35	8.25	16.05	0	3.45	3.45	20.7	2.7	0	1.8	79.5	34.8	68.7	2134.5	765.15
October	67.8	7.35	50.55	1690.5	740.25	6.9	7.5	14.1	0	2.7	3.75	20.25	3	0	1.5	78.45	35.1	67.65	1690.5	744.45
November	65.7	6.75	48.3	1612.5	855.15	7.35	8.25	16.2	0	3	3.3	21.15	2.85	0	1.65	76.35	36.15	67.35	1612.5	859.8
December	63.75	5.4	48.75	1254	798.6	8.25	9.75	16.05	0	1.95	2.85	23.85	1.95	0	1.5	74.85	39	66.75	1254	802.05
January	150.75	6.45	33.6	1143	854.7	10.5	12.3	16.35	0	1.5	3.15	24.45	1.5	0	1.35	164.4	43.2	51.45	1143	857.55
February	133.95	4.35	31.65	1008	681.9	4.5	12.45	15.75	0	1.35	1.65	23.85	0.3	0	0.75	140.1	40.65	47.7	1008	684
March	129.75	7.05	30.3	1183.5	694.5	4.05	11.85	15.15	0	1.5	0.45	23.55	0.75	0	1.05	134.25	42.45	46.2	1183.5	697.05
April	104.1	7.65	35.85	1642.5	630.45	5.55	9	13.95	0	3.15	2.85	22.2	1.05	0	1.5	112.5	38.85	50.85	1642.5	635.1
May	87.45	9.6	40.2	1926	719.7	4.35	9.6	13.2	0	2.7	4.35	23.4	0.75	0	1.35	96.15	42.6	54.15	1926	723.75
Total	1068.3	75.45	493.95	20344.5	8491.65	78.15	108.75	171.75	0	33	38.1	265.5	19.35	0	18	1184.55	449.7	685.05	20344.5	8542.65
Total per month	89.025	6.288	41.163	1695.375	707.638	6.513	9.063	14.313	0	2.75	3.175	22.125	1.613	0	1.5	98.713	37.475	57.088	1695.38	711.888
Per Month/Shop	17.805	1.258	8.233	339.075	141.528	1.303	1.813	2.863	0	0.55	0.635	4.425	0.323	0	0.3	19.743	7.495	11.418	339.075	142.378
Total per day	2.968	0.21	1.372	56.513	23.588	0.217	0.302	0.477	0	0.092	0.106	0.738	0.054	0	0.05	3.29	1.249	1.903	56.513	23.73
Per day/Shop	0.594	0.042	0.274	11.303	4.718	0.043	0.06	0.095	0	0.018	0.021	0.148	0.011	0	0.01	0.658	0.25	0.381	11.303	4.746
A.V.	89.025	6.288	41.163	1695.375	707.638	6.513	9.063	14.313	0	2.75	3.175	22.125	1.613	0	1.5	98.713	37.475	57.088	1695.38	711.888
S.D.	32.306	1.673	7.228	474.423	109.905	1.933	2.347	1.994	0	1.052	1.16	1.775	0.873	0	0.394	31.575	4.196	8.244	474.423	109.616

A.V. -Average
S.D. - Standard Deviation



Table 4:- Qualitative and Quantitative Composition of Solid Waste (Kg/shop) at Zone-IV

Shops	Biodegradable waste					Non-biodegradable waste					Inert material					Total solid waste					
	Shop-01 Karyana	Shop-02 Barber	Shop-03 Tea stall	Shop-04 Juice stall	Shop-05	Shop-01 Karyana	Shop-02 Barber	Shop-03 Tea stall	Shop-04 Juice stall	Shop-05	Shop-01 Karyana	Shop-02 Barber	Shop-03 Tea stall	Shop-04 Juice stall	Shop-05	Shop-01 Karyana	Shop-02 Barber	Shop-03 Tea stall	Shop-04 Juice stall	Shop-05	
	Fruit and vegetable					Fruit and vegetable					Fruit and vegetable					Fruit and vegetable					
Months																					
June	55.95	1.65	31.05	2344.5	613.8	7.05	3.9	10.95	0	3	2.55	17.7	0.75	0	1.35	65.55	23.25	42.75	2344.5	618.15	
July	60.9	2.7	30.15	2643	725.1	7.5	9.75	5.7	0	2.7	2.85	19.65	1.8	0	1.5	71.25	32.1	37.65	2643	729.3	
August	58.5	6.15	23.25	2614.5	676.65	5.25	7.2	10.65	0	2.1	1.95	18.15	1.95	0	1.05	65.7	31.5	35.85	2614.5	679.8	
September	63.6	7.65	26.4	2287.5	607.5	7.05	9.9	12.9	0	3.6	3.3	20.4	1.5	0	0.75	73.95	37.95	40.8	2287.5	611.85	
October	69.3	10.2	28.95	1777.5	753.45	6.75	10.65	14.7	0	1.95	3	21.15	1.35	0	1.5	79.05	42	45	1777.5	756.9	
November	70.8	10.95	31.95	1387.5	936	4.5	10.8	16.65	0	2.85	1.95	23.85	1.5	0	1.35	77.25	45.6	50.1	1387.5	940.2	
December	63.9	6.6	42.45	1327.5	1075.8	5.55	9	15.75	0	1.2	2.7	23.85	2.25	0	1.35	72.15	39.45	60.45	1327.5	1078.4	
January	67.5	6.45	42.75	1117.5	918.9	5.1	8.7	16.8	0	1.5	1.95	24.45	1.8	0	1.5	74.55	39.6	61.35	1117.5	921.9	
February	63.9	5.55	42.9	958.5	747.3	4.5	9.6	15.3	0	1.65	1.5	25.65	0.75	0	0.3	69.9	40.8	58.95	958.5	749.25	
March	63.15	5.4	39.45	1162.5	913.95	5.25	11.1	11.55	0	2.85	1.95	25.35	1.5	0	0.75	70.35	41.85	52.5	1162.5	917.55	
April	53.7	5.4	37.35	1867.5	573.9	6.45	7.95	12.9	0	2.55	2.25	21	1.5	0	1.95	62.4	34.35	51.75	1867.5	578.4	
May	57.15	4.65	34.35	2197.5	655.2	4.95	6.6	10.35	0	3.3	1.95	18.9	1.35	0	1.5	64.05	30.15	46.05	2197.5	660	
Total	748.35	73.35	411	21685.5	9197.6	69.9	105.15	154.2	0	29.25	27.9	260.1	18	0	14.85	846.15	438.6	583.2	21685.5	9241.7	
Total per month	62.363	6.113	34.25	1807.13	766.46	5.825	8.763	12.85	0	2.438	2.325	21.675	1.5	0	1.238	70.513	36.55	48.6	1807.13	770.14	
Per Month/Shop	12.473	1.223	6.85	361.425	153.29	1.165	1.753	2.57	0	0.488	0.465	4.335	0.3	0	0.248	14.103	7.31	9.72	361.425	154.03	
Total per day	2.079	0.204	1.142	60.238	25.549	0.194	0.292	0.428	0	0.081	0.078	0.723	0.05	0	0.041	2.35	1.218	1.62	60.238	25.671	
Per day/Shop	0.416	0.041	0.228	12.048	5.11	0.039	0.058	0.086	0	0.016	0.016	0.145	0.01	0	0.008	0.47	0.244	0.324	12.048	5.134	
A.V.	62.363	6.113	34.25	1807.13	766.46	5.825	8.763	12.85	0	2.438	2.325	21.675	1.5	0	1.238	70.513	36.55	48.6	1807.13	770.14	
S.D.	5.334	2.66	6.702	606.36	158.91	1.07	2.081	3.239	0	0.752	0.545	2.842	0.438	0	0.448	5.269	6.363	8.71	606.36	158.45	

A.V. -Average
S.D.- Standard Deviation

Table-5 Showing total average solid waste(Kg/ shop/month) generation and composition at study area (commercial) from June, 2007 - May, 2008

Quality of Waste	Zone-I		Zone-II		Zone-III		Zone-IV		Total		%age	
	A.V.	S.D.	A.V.	S.D.	A.V.	S.D.	A.V.	S.D.	A.V.	S.D.		
Biodegradable Solid waste	616.631	5.410	540.373	2.800	507.899	4.170	535.263	5.200	550.042	4.395	6600.504	97.090
Non-Biodegradable Solid waste	8.705	0.069	8.635	0.036	6.529	0.049	5.975	0.048	7.461	0.051	89.532	1.310
Inert Solid waste	6.885	0.029	17.978	0.080	5.683	0.028	5.347	0.029	8.973	0.042	107.676	1.600
Total Solid waste	632.221	5.508	566.986	2.916	520.111	4.247	546.585	5.277	566.476	4.488	6797.712	100.000

A.V. -Average
S.D.- Standard Deviation

An overall study has revealed maximum percentage of biodegradable solid waste (97.09%) followed by inert solid waste (1.6%) and non-biodegradable solid waste (1.31%) which is in accordance with the finding of Rampal et al (2002), Kour (2004), Rampal et al. (2005), Gupta et al. (2008), Jaswal (2008) and Kewal (2010) who also recorded highest percentage of biodegradable waste. On making a comparative study of solid waste generated at all the four study zones, it was recorded that the total average solid waste generated (Kg/shop/month) was found to be maximum in Zone-I (632.221±5.508Kg) followed by Zone- II

(566.986±2.916 Kg), Zone-IV (546.585±5.277 Kg) and Zone-III (520.111±4.247 Kg). The minimum value (520.111±4.247 Kg) of waste generated was exhibited by Zone -III. Although the results have shown a variation in the solid waste generation in the study area during different months of the year, yet no set pattern of waste generation was observed. It has been recorded from the studies that people (shopkeepers) don't dispose off the waste properly in the area rather throw it in open or vacant land on roadsides, streets or nallahs. Moreover, for the final disposal of wastes, open dump method is generally followed by the municipality and for this purpose,



two dump sites are there in the area. One dump site is near the river Chenab and another in the outskirts of Akhnoor Town.

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