

Plastic Solid Waste Assessment in the State of Kuwait and Proposed Methods of Recycling

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Abstract: A proper assessment of Solid Plastic Waste (SPW) in Kuwait will provide a greater understanding to the industry of plastic manufacturing and manufacturers as well as direct the strategic future plans proposed into execution. This research show the results obtained after a years survey and study of plastic solid waste in the state of Kuwait and the surrounding region in order to create a database that can be used in future plans and research projects. Major manufacturers in the area were asked to complete a questionnaire to create a complete database. Recycling methods were studied and tested in order to evaluate the best solutions and schemes available to overcome the increasing rate of municipal plastic waste. From the current study it, Kuwait ranked in second behind Qatar in plastic waste but land filling rates in Kuwait are almost double than any other oil dependant country in the west Asia region.

Key words: Municipal plastic waste, database, Kuwait, recycling

INTRODUCTION

SPW is rapidly growing in the world in general and the region in specific. In the year 2000, SPW was estimated at around 13.4% of the solid waste in the country which corresponds to 15,000 ton/year. Many researchers propose degradation and or biodegradation schemes to reduce this amount of SPW. UV and Light Transforming (LT) additives are two additives that increase the photodegradation and enhance properties. UV stabilizers prevent degradation caused by UV radiation; these UV rays are absorbed by polymers that contain chemical groups called chromophores^[1-4]. When chromophores absorb this energy, if its not dissipated, bonds are broken, which leads to free-radical chain reaction. Worldwide consumption of performance additives (excluding plasticizers) grew from just over 2.7 mt in the 1996 to 3.6 mt ion 2001^[5]. The demand for additives was built on meeting the market demand on changing and enhancing existing plastics. A large body of information exists on stabilizer technology aimed at extending the service life of plastics exposed to outdoor environment. Stratospheric ozone depletion and the ensuing increase of UV levels in terrestrial sunlight will tend to reduce the service life of plastic products used outdoors^[6-8] in regions where climatic changes such as in Kuwait, the hot summer is

the longest season starting from late April to late September.

From the light of the previous, the importance of establishing a database that was concerned with SPW in the state of Kuwait came through. No such database to our knowledge was created in the region.

MATERIALS AND METHODS

Questionnaire: A questionnaire that presented the contact information, amount of SPW registered and produced, number of KUEPA officers' visits was distributed on all local and regional plastic and/or plastic related companies. Also if any recycling schemes preferred by the company or factory to reduce their plastic waste.

Materials: Linear Low Density Polyethylene, High Density Polyethylene and Polypropylene films were gathered from different companies and factories in Kuwait to study the types and properties variation with the markets availability.

Mechanical Properties Measurements: Tensile, %stress, %strain and elongation measurements were performed using a Testometric machine. The Testometric (Testometric Company Ltd., DBBMTCL-

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250 kg model) test was conducted according to ASTM D-882. Five samples of each additive concentration were tested for tensile properties.

RESULTS AND DISCUSSION

The major properties (physical) were analyzed in the PC lab, KISR. A database of these properties that include stress, strain, elongation of samples was created. Total solid waste produced in Kuwait annually is 887,500 tons annually, corresponding to a daily solid waste of 2500 tons, or 7500 tons monthly. The plastic solid waste within the solid waste produced amounts to 13% originated from household only. The sorting done in the process is entirely voluntary, where by then it is taken to a landfill: the methodology adopted to manage solid waste in Kuwait. Only two studies have been carried out to evaluate the solid waste in Kuwait, in December 1995 and another in November 2000. Table 1 provides monthly estimates of solid household waste land filled, provided by Kuwait municipality (Questionnaire results). The growth in waste could be seen clearly after the year 2001. By the end of year 2000, a total of 825,959 tons were being dumped in land filling sites in Kuwait. Total solid wastes in 2004 was in an enormous excess by the year 2004, were it was reported to be 8,000,500 tone. The fluctuation could be easily noticed (Fig. 1) were the 2004 line exceeds in the beginning and the end of the year all the previous years. In 2001, the first four months of the year were growing in an almost multiple fashion, but a reduction period was established in the mid months to average the year out.

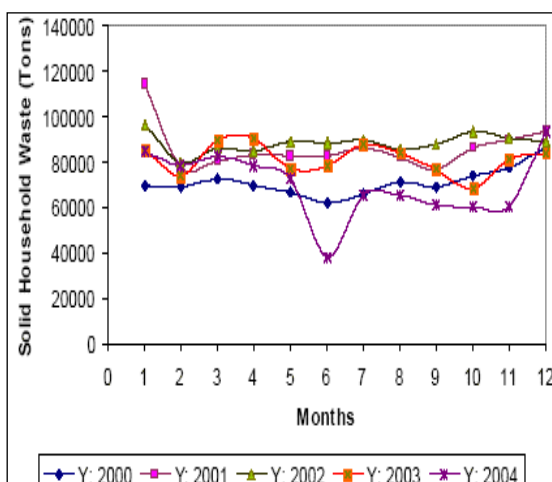


Fig. 1: Month by month quantity for the period of 2000 - 2004

Table 1: Household Solid Waste Dumped in Landfill Sites in Tons

Month	2000	2001	2002	2003	2004
January	69495	114340	96305	85785	84820
February	68655	77450	79415	73640	78235
March	72540	80755	86190	89580	82470
April	69824	83580	84580	90490	78065
May	66535	82585	89030	76635	72595
June	61965	82695	88070	78240	38255
July	66075	86425	90100	87440	65425
August	71170	81915	85475	84320	65300
September	69055	76515	87530	77000	60795
October	74140	86130	93655	68015	60415
November	77470	90100	90205	80890	60180
December	86035	93645	89325	84150	93450
Total	852,959	1,036,135	1,059,880	976,185	8,000,500

Table 2: Type and Amount of Solid and Semi Solid Waste Expected to be Generated from the Shuaiba Industrial Area and Abdullah Port in a Projection to Year 2020 at of 1000tons/year Estimation

Waste Type	1995	2000	2005	2010	2015	2020
Paper	10	11	11	12	12	13
Wood	8	8	8	9	9	9
Minerals	4	4	4	4	5	5
Household waste	5	5	6	6	6	7
Plastic	3	3	3	4	4	4
Fabric	1	1	1	1	2	2
Used tires	1	1	1	1	1	1
Used oil	3	3	4	4	4	4
Construction waste	140	147	153	160	169	177
Used catalysts	8	9	9	10	10	10
Chemicals	3	3	3	3	3	3
Industrial waste	68	71	75	78	82	87
Total 254	266	278	292	307	322	

Table 3: Type and Amount of Solid and Semi Solid Waste Expected to be generated from KOC Facilities in Ahmadi and Wafra in a Projection to Year 2020 at of 1000tons/year Estimation

Waste Type	1995	2000	2005	2010	2015	2020
Paper	48	50	53	55	58	61
Wood	2	2	2	2	2	2
Minerals	10	10	11	11	12	12
Household waste	80	84	88	92	97	102
Plastic	2	2	2	2	2	2
Fabric	2	2	2	2	2	2
Used tires	-	-	-	-	-	-
Used oil	2	2	2	2	2	2
Construction waste	780	820	861	905	950	998
Used catalysts	-	-	-	-	-	-
Chemicals	-	-	-	-	-	-
Industrial waste	669	703	738	776	814	855
Total 1595	1675	1759	1847	1939	2036	

From the contact information in the KUEPA, CC countries tabulated statistics were provided. In plastic waste Kuwait ranks in the top three, coming in second behind Qatar. Plastic solid waste in Kuwait represents 12.6%, which is equivalent to almost 150,000 tons of plastic. Other wastes, excluding organic materials do not pose a series threat in terms of comparison with the

GCC countries. That of course doesn't give the rest types of waste any less importance. GCC numbers can be clearly viewed in Table 2. In a more general view, a country like Egypt with a population exceeding 75 million has a 1.5% plastic solid waste. India, Yemen and Nigeria all give fewer percentages than the state of Kuwait.

By comparison with much more advanced industrial countries (European Union), Kuwait exceeds the EU at least six times more. With a 0.15% of plastics compared to a 1% for Kuwait. Not counting the rest of the solid wastes like sand, wood and minerals. At 1000 ton/year estimation from Mina Abdullah (Abdullah port) and Shuibah industrial area, the growth projection of Kuwait in the year 2020 is almost a third more. Areas like Shuibah with its cottage industries and oil related ones produce plastic a product, by product or a wasted material. Table 2 represents the growth of these two areas in terms of primary solid waste pollutants. Used catalyst, minerals, paper and wood all grow relatively fast. The only stability pattern appeared in this estimate is in regards to chemicals. Kuwait Oil Company, KOC waste estimates are in Table 3. The total amount of the year 2020 is estimated to be 322 tons, compared with almost three quarters the sum in the year 1995.

Table 2: Type and Amount of Solid and Semi Solid Waste Expected to be Generated from the Shuaiba Industrial Area and Abdullah Port in a Projection to Year 2020 at of 1000tons/year Estimation.

The transportation system that exists is under the jurisdiction of Kuwait municipality. The firms that operate the different routes are contracted and supervised by KM. 13 separate contracts with a total of 7 carriers for the collection and transport of municipal waste. Organic wastes are well known for being the primary hazardous ones on the environment. Organic wastes rank in number one in Kuwait with almost 50% of the total wastes. Plastics pose a direct threat to humans too. By reducing the plastic wastes others will follow. It is estimated that the total quantities will be 120% relative to the 96% of the year 1995. The organic materials and the plastic waste are increasing rapidly. The inventory also revealed the company's numbers that are responsible for solid plastic waste in Kuwait. The packing industry comes with 10 companies and agriculture with 4.

CONCLUSION

The state of Kuwait comes in second behind Qatar in SPW, which is also predicted to increase rapidly

within the next decade. The number of land filling sites are increasing but with no concern to the citizen welfare. From the inventory and the database created, all companies were registered and asked to participate in this study to propose a better scheme of PSW reduction. KUEPA must be more directly involved in the future step by step with other governmental sectors.

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