

## **A Survey Study on PET Recycling Problems in Qom City, Iran**

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### **ABSTRACT**

Recycling process is developed in communities to decrease the volume of high solid wastes and prevent environmental pollution. Plastic is one of the most recyclable materials in municipal solid wastes (MSW) with a high rate of application during the last decades. PET (poly ethylene therphtalate) is one of the basic plastic compounds which are used in a variety of products such as textile fibers, bottles and other containers. Methods for PET recycling include mechanical and chemical processes and PET incineration. In this study which was conducted on MSW analysis in Qom (a city in the central region of Iran, known for increase of population and high migration, environmental pollutions such as high quantity of MSW, industries and vehicle contamination, noise pollution and municipal sewage), physical analysis of MSW was carried out to four geographical sites and in different seasons of the year 2002. Results showed the rate of PET production to be 0.44% of the total MSW production, depending on site characteristics and area, time and cultural specifications. It is concluded that approximately 700 tons of PET plastics are buried per year.

**Keywords:** *Solid waste, Recycling, PET, Qom, Iran*

### **INTRODUCTION**

PET plastic waste is a large portion of solid waste. It is a strong but light weight form of clear polyester which is used to make containers for soft drinks, juices, mineral water, edible oils, and other food and nonfood applications (Lund, 2002).

Production of PET bottles and containers starts from the raw materials: ethylene glycol (EG) and dimethyl terphthalate (DMT) or terphthalic acid (TPA) (Nakarani, 1999).

The global annual consumption of PET in the world in 1990 was 12 and 23 million tons, respectively (Napcore, 2001).

Throughout the years with growing rate of PET consumption, environmental and health concerns have been simultaneously increased.

Increase in PET consumption not only increases the volume of municipal solid waste (MSW) inducing more problems in collection and sanitary landfill of MSW but also PET is a stable and non degradable compound in environment (Gradic, etc 2002).

The basic hazardous emissions from PET plastic are phthalate monomers which have been found in a number of leachate analyses with various concentrations on ground water resources (Scheirs, 1998).

Thus migration of phthalate monomers into ground water resources are the adverse health impacts of PET (March, 1999). Other studies have shown the migration of acetaldehyde from

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PET that used in food and water packaging. Full recycling is one of the most specifications of PET.

In case the PET recycling is not standard, some health hazard problems can be happened and therefore, prevention of such condition is suggested (Pruss, 1999). One of the most environmental health hazard prevention of PET waste management is soil and underground water pollution control (Yiyun Lu, 2001). PET recycling process includes: mechanical and chemical recycling, PET incineration and energy recovery (Gradic, 2002).

Mechanical recycling of PET bottles requires washing and grinding of recovered materials. Resulting flakes are then processed and blended with virgin polymers. Chemical recycling is the other method for the recovery of reclaimed post-consumer wastes, although the equipment costs are relatively high.

The various chemical recycling techniques are: glycolysis, methanolysis, hydrolysis, aponification process and pyrolysis (Tchobanoglous, 1994). The recycled PET materials can be used for manufacturing wide range of products such as fiber material in carpeting, textile, thermoforming of insulation materials, car flooring and various types of containers.

In Iran PET application is growing. Multiple industries import and use approximately 30000-40000 tones per year of PET granules as a raw material for making food and beverage packing as well as fiber production.

Although with developing and operation of petrochemical projects in Iran, the rate of PET use in 2004 has reached to about 80000 tones, the need for planning a comprehensive recycling program for all of the cities is to be more considered (Genra, 2003).

The main purpose of this study was to determine the feasibility of PET waste recycling problems in Qom.

## MATERIALS AND METHODS

This study was a cross-sectional one. At the first step of the study the rate of PET granular consumption by industrial units in Iran was determined and also the suitable methods for PET recycling in Iran were investigated compared to default and benefits of each method of PET recycling. At the second step, the city of Qom, which is located in the southwest of Iranian capital, Tehran was specifically considered. In order to identify the rate of PET in municipal solid waste (MSW), physical analysis of MSW was carried out.

The city of Qom was divided into 4 geographical sites. Sampling of MSW was carried out on consecutive three days of each season of the year in each site. Samples of domestic waste were collected and transported to the transport station. The volume of sampling container was 250 liters. For determination of the number of

samples the equation of  $n = \frac{\delta^2 \cdot Z^2}{d^2}$  was used,

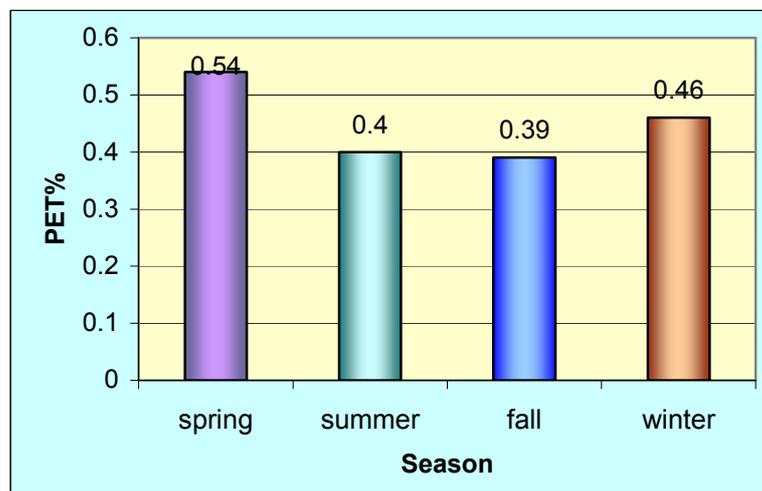
where in this equation:  $\delta = 100$  grams,  $Z_{0.95} = 1.96$  and  $d = 40$  (Mohammad, 2003).

## RESULTS

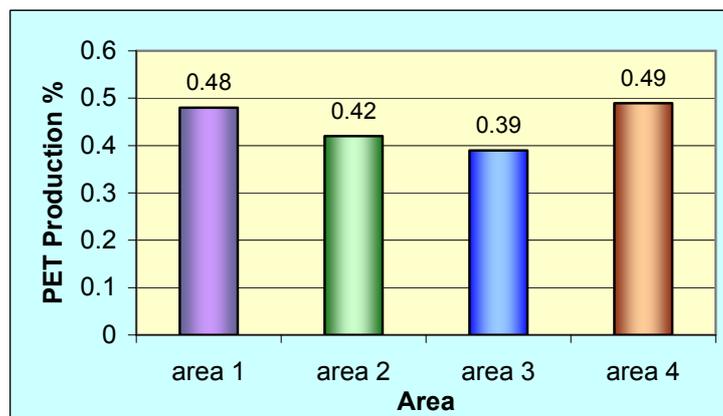
The rate of PET use in 2002 in Iran was estimated as 40000 tons. The most sharing of use of PET was related to washing and cleaning solution industrials. Table 1 shows the results of physical analysis of MSW in the city of Qom. Figures 1 and 2 show the variation of PET production according to the seasons and areas. The rate of PET production was 0.44% of MSW. Daily production of PET was reached to 2.22 tons. Figure 3 shows the rate of PET and other materials according to the rate of MSW in Qom. The results of this survey show that approximately 700 tons of PET plastic per year will be removed from the solid waste stream currently going to the landfill in Qom.

**Table 1:** Results of physical analysis of municipal solid waste in Qom (%) (Year 2002)

Area	Organic Matter	Paper	Rubber	Plastic	PET	Textiles	Glass	Metals	Others	Density (kg/m <sup>3</sup> )
1	74.11	4.55	0.9	8.97	0.39	4	1.57	1.64	3.7	241.65
2	73.75	4.21	0.39	8.32	0.36	5	1.52	2.26	3.63	226.43
3	75.86	4.39	0.44	9.53	0.46	3.04	1.6	2.03	3.48	222.2
4	74.8	5.45	0.06	9.04	0.55	2.69	1.98	1.92	3.24	229.5
Average	74.63	4.65	0.45	8.97	0.44	3.68	1.67	1.96	3.51	229.95



**Fig. 1:** The variation of PET production (%) according to the season of year in Qom



**Fig. 2:** The variation of PET rate production (%) in areas

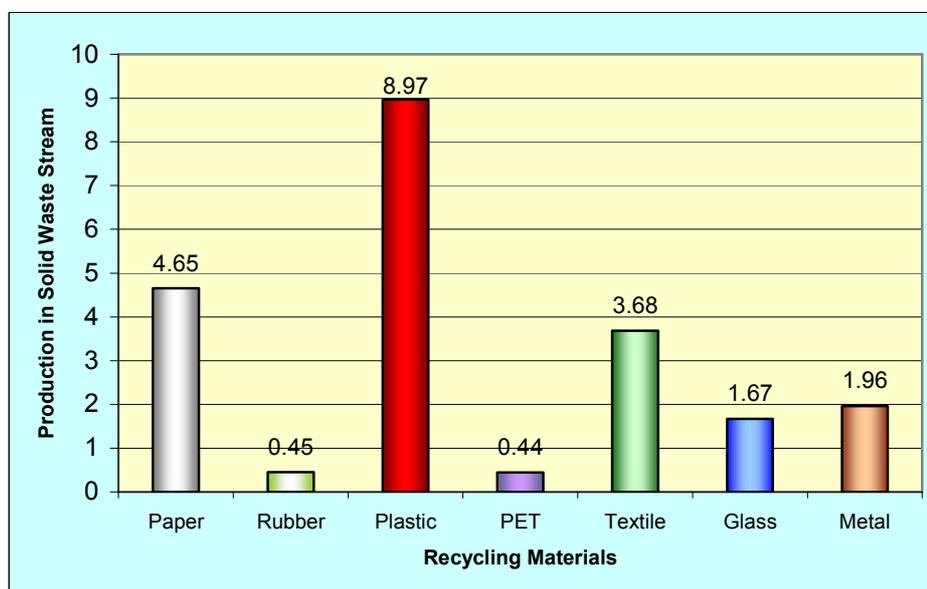


Fig. 3: Physical analysis of municipal solid waste in Qom (%) (in year 2002)

## DISCUSSION

Iran is among many countries which are involved in PET recycling subject. In this regard, the feasibility of such an activity for municipalities to central and reduce environmental health hazards is clearly obvious. Since there are about 80,000 tone of PET materials to be recycled in Iran, attention to this problem is important. Although the total percentage of PET recycling in Iran is not known definitely, but from figures of Qom city which is around 700 tone per year, it can be estimated that PET recycling in Iran lays over 70%. This figure is close to PET recycling reported for European countries with 65%.

The lack of an organization in Iran to handle PET recycling material in municipalities is obvious. In Italy, "COREPLA" as a company is responsible for collection, recycling and production of some plastic sheets from used PET materials (NAPCOR, 2002). In Japan, there are 3 PET recycling centers with over

20,000 tones which supply the raw materials for textile industries for production of shopping bags and etc (Hyan-Seob Song, 1999).

Similar to these countries and many others, Iran can make some efforts to establish a better way of organizing overall PET recycling problem including collection, recycling, grinding and production of new materials. Although, this is done in a very limited condition in south of Tehran and some of these grinded materials are exported to nearby countries, which has shown to be environmentally friendly and also very economical, it should be extended and developed over all in Iran.

The space needed for sanitary landfill of PET wastes because of very low density of these materials is very high, at least 30 m<sup>3</sup> of space or 10-15 m<sup>2</sup> of land is need for 1 ton of PET waste, and since, in many cities of Iran, sanitary landfill is adopted for solid waste materials, and the share of PET production in MSW is growing fast, and in some cities of Iran there is a shortage of land for solid waste land filling,

PET recycling program is a relief.

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