

Plastic waste management: Need for a paradigm shift in Malaysia

Agamuthu. P

Institute of Biological Studies, University of Malaya, Kuala Lumpur, Malaysia

ABSTRACT Over the last century, plastics have become a major new material used widely for a variety of products world wide, including replacements for human body parts, to the construction of supersonic aircraft and spacecraft. The growth of plastic production has taken place at the expense of more traditional materials, such as steel, aluminium, paper and glass. It is estimated that 30% of used plastics are eventually discarded into the environment, and since conventional plastics are produced from petrochemical compounds and are non-biodegradable it becomes an environmental hazard when land-filled. Plastic waste generated and quantity generated is a growing concern in many developing countries, including Malaysia. Plastic industry in Malaysia, which began in 1950, registered a 15% growth per annum. The plastics produced are mainly used by the packaging industry (35%), while electrical and electronic industry used 30%. Other users are households (12%), automotive industry (8%) and construction (7%). Concurrently, the total resin consumption has reached 1.20 million metric tons in 2000, while the per capita consumption increased from 20kg in 1989 to 55 kg in 1997. It is estimated to reach 60kg in 2003. The growth is expected to continue and the plastic industry is projected to achieve double-digit growth for the fourth consecutive year in 2002. In the year 2000, Malaysians used about 600,000 tonnes of plastics, while recycling was extremely low. Hence, 99.99% of the household plastics end-up in the 144 landfills. Plastic components in the Municipal Solid Waste (MSW) from urban areas average 18%, but in some areas (Labuan) it can go as high as 48%. Research in plastics is concentrated in the development of bioplastics using renewable resources and organic waste. Since the costs of bioplastics are currently much higher than conventional plastics due to raw materials costs and production expenses, hence the need to use materials that are available at low cost, such as palm oil mill effluent and kitchen waste. Biodegradability of degradable plastics (Environmentally Degradable plastic, EDP) is another area of scientific investigations. Results obtained from oxidative exposure, composting trials and microbial analysis showed positively EDP is biodegradable. Physical and chemical analysis, including Fourier Transform Infra Red (FTIR) spectrum confirmed the biodegradability.

(Plastic waste management, waste composition, Malaysia)

ABSTRAK Sejak seabad yang lalu, plastik telah menjadi satu bahan baru yang digunakan dengan meluas dalam pelbagai produk seluruh dunia, termasuk gantian organ bagi sebahagian tubuh manusia, sehingga kepada pembinaan kapal terbang supersonic dan kapal angkasa. Pertumbuhan pengeluaran plastik telah menggantikan tradisional yang bahan-bahan, seperti besi, aluminium, kertas dan kaca. Dianggarkan bahawa 30% daripada plastik yang digunakan akhirnya dibuang ke persekitaran, dan oleh kerana plastik konvensional dihasilkan daripada komponen petrokimia dan tidak boleh diurai secara semulajadi, ianya mendatangkan kemudaratan kepada alam sekitar bila dilupuskan. Sisa plastik yang dihasilkan dan kuantiti yang dijana semakin membimbangkan di kebanyakan negara yang sedang membangun, termasuk Malaysia. Industri plastik di Malaysia yang bermula sejak tahun 1950 didapati meningkat sebanyak 15% dalam setahun. Plastik yang dihasilkan kebanyakannya digunakan dalam industri pembungkusan (35%), sementara industri elektrik dan elektronik menggunakan 30%. Lain-lain pengguna ialah domestik (12%), industri automotif (8%) dan pembangunan (7%). Jumlah penggunaan resin telah mencecah 1.20 ribu tan metrik pada tahun 2000, sementara penggunaan per kapita meningkat dari 20 kg pada tahun 1989 kepada 55 kg pada tahun 1997. Ianya dijangka akan mencecah 60kg pada tahun 2003. Peningkatan ini dijangka akan berterusan dan industri plastik dianggar akan mencapai pertumbuhan yang lebih tinggi bagi empat tahun berturut-turut pada tahun 2002. Dalam tahun 2000, Rakyat Malaysia menggunakan sebanyak 600, 000 ton plastik, sementara kadar kitar semula masih sangat rendah. Oleh yang demikian, 99.99% daripada sisa plastik domestik akan berakhir di 230 tapak pelupusan sampah. Komponen plastik dalam sisa pepejal municipal (MSW) dari kawasan perbandaran mempunyai purata sebanyak 18%, tetapi bagi kawasan-kawasan tertentu (Labuan), ia boleh meningkat sehingga 48%.

Kajian terhadap plastik tertumpu kepada perkembangan bio-plastik menggunakan sumber yang boleh diperbaharui dan sisa organik. Oleh kerana kos bioplastik pada masa kini adalah jauh lebih tinggi daripada plastik konvensional kerana kos bahan mentah dan perbelanjaan pengeluaran, keperluan menggunakan bahan sedia-ada yang lebih murah, seperti sisa pemrosesan kelapa sawit dan sisa dapur. Biouraian plastik yang boleh urai (EDP) adalah satu bidang dalam penyelidikan saintifik. Keputusan yang diperolehi dari pendedahan oksidatif, percubaan pengomposan dan analisa microbial menunjukkan bahawa EDP boleh diuraikan. Analisis kimia dan fizikal termasuk spectrum Fourier Transform Infra Red (FTIR) mengesahkan kebolehaiannya.

(Pengurusan sisa plastik, komposisi sisa, Malaysia)

INTRODUCTION

Over the last century, synthetic plastics have become the major new materials for everything from replacements for human body parts to the construction of supersonic aircraft and spacecraft. So much so, that plastic production has grown up to a point where the total volume of plastics produced worldwide now exceeds that of steel. The growth has also taken place at the expense of more traditional materials, such as steel, aluminium, paper and glass. The important points that need to be considered are the use of raw materials, energy requirements and pollution during production while generating industrial waste.

Plastic waste generation and quantity generated is a growing concern in many countries including Malaysia. Plastic waste contributes the third

highest waste volume in Malaysian Municipal Solid Waste (MSW) next to putrescible waste and paper. In the year 2000, plastic waste in MSW of Kuala Lumpur was 24.4% by weight and most of the plastic waste was dumped into landfills. Landfills in Malaysia are reducing in its useful life as the amount of waste generated is growing every year by 2% and they have become an undesirable option of getting rid of plastic waste because of the properties of plastics [1]. Thus, efforts are being made to divert some plastic wastes from landfills, or to use degradable plastics.

Plastic Usage

The plastic industry in Malaysia started in the 1950's and has since enjoyed tremendous growth, registering an average of 15% growth per annum over the last 10 years due to the increased applications, robust economy and increased

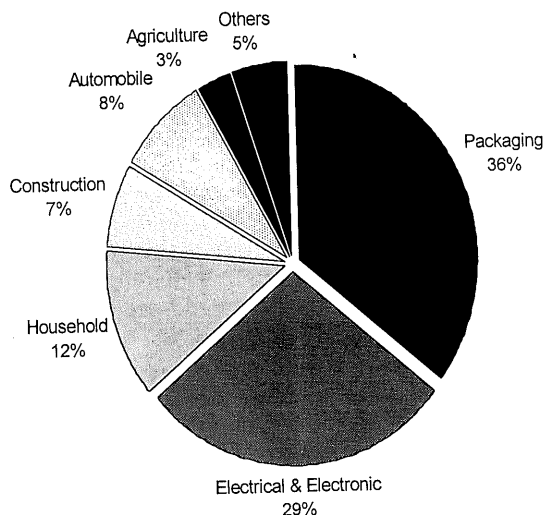


Figure 1. Market segments in Malaysia in the year 2000 (Source: Malaysian Plastics Manufacturers Association (MPMA), 2001).

demand [2]. In Malaysia the market for plastic is dominated by the packaging industry (35%) followed by the electrical and electronic industry (30%) (Figure 1). Whereas other market segments are households which used about 12%, the automotive industry used 8%, construction (7%), agriculture (3%) other sectors (5%) [3].

The relation between resin consumption for plastic production and per capita consumption of plastic is very close (Figure 2). In 1989, resin consumption was 300, 000 metric tonnes and it increased to 1.1 million metric tonnes in 1998. Recession in 1999 caused the consumption to

decline and it is estimated that it will rise up to 1.4 million tonnes in year 2003 [2]. From year 1999 to 2000, total resin consumption increased by about 13% from 1.06 million tonnes to 1.2 million tonnes. Similarly, the per capita consumption has increased from 20 kg in the year 1989 to 55 kg in 1997. During the economic downturn, the usage reduced by 5%. It is postulated that the per capita plastic consumption will increase to 60 kg per capita in 2003. This is not far from the developed countries per capita consumption, which is between 80 to 100 kg [2]. In year 2000, the per capita consumption for Malaysia was 55 kg [4].

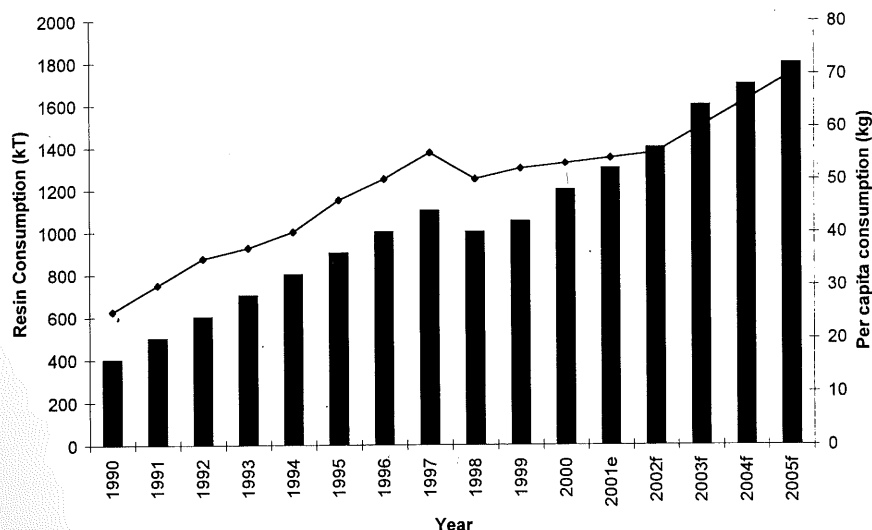


Figure 2. Resin consumption and per capita consumption in Malaysia (Source: MAPA, 2001).

Performance of the Plastic Industry

As a result of the country's economic improvement, the turnover of plastics industry grew by 15% from RM 6.3 billion in 1998 to RM 7.2 billion in 1999 (Figure 3). The robust growth resulted in strong expansion in export by 20% from RM2.46 billion in 1998 to RM 2.97 billion in 1999. The turnover in 2000 was also impressive at 20% growth, from RM 3.5 billion (first half of 1999) to RM 4.2 billion (first half of 2000).

Again the export sector was the main contributor for the robust growth, recording 25% jump [3]. Besides the strong surge in exports, the recovery of the worlds electrical and electronics industry has stimulated the demand for the plastic parts

and components. The demand from this sector increased by about 25% during the first half of 2000. Based on a recent report, the electronic industry is expected to grow by double-digit because of the worldwide embrace of the Internet and exponential growth in e-commerce.

The export sector performed extremely well in 1998 and 1999 (Figure 4). Throughout the crisis period, external demand for Malaysian-made plastic products was favourable. Despite the global financial crisis, external demand by major trading partners such as Japan, USA, EC and Singapore was able to support not only exports from Malaysia but also from other crisis-hit economics as well.

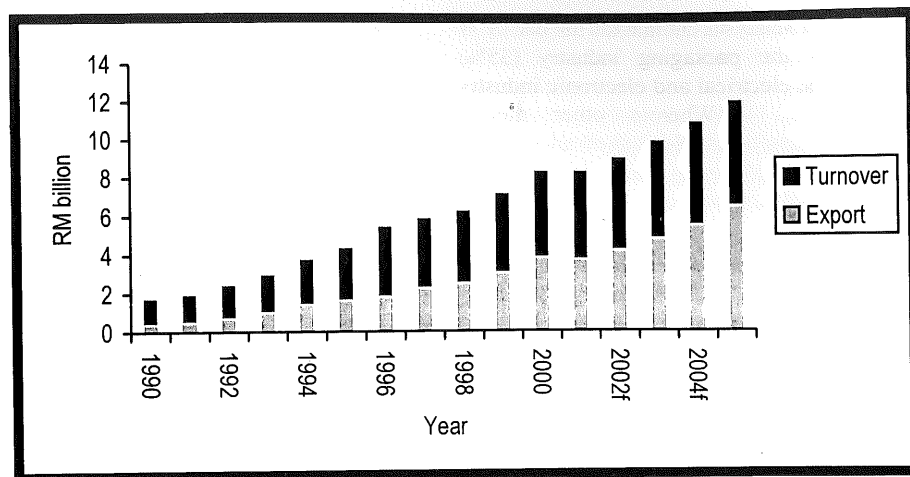


Figure 3. Turnover of the plastics industry.

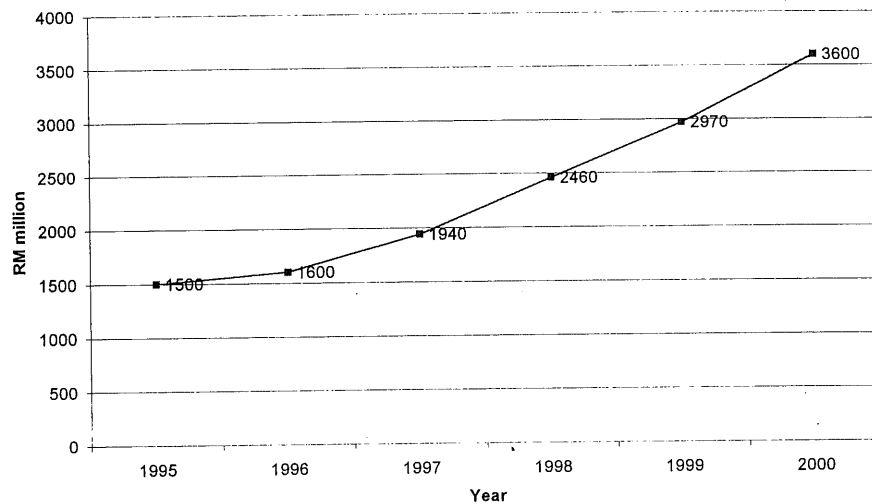


Figure 4. Export performance.

The types of plastic product exported in 1999 are shown in Figure 5. Films, sheets and foils were the major components exported (Figure 5).

The estimated consumption of plastics in 1999, by resin type, is shown in Figure 6.

Polyolefins (PE and PP) still dominate the country's usage. The materials are mainly used in the consumer packaging industry and household products.

Plastic Waste Generation

In year 2000 Malaysians used 600, 000 tonnes of plastic. This is an increase of 7% compared to 1999, when about 560, 000 tonnes of plastic waste was generated. This trend will continue because plastic consumption in our daily lives will increase and plastic waste produced will increase too. A report from the Ministry of Housing and Local Government (MHLG) revealed that only 8,613 kg of plastic was collected for recycling in year 2000 [5]. Therefore, about 99.99%, of plastic waste

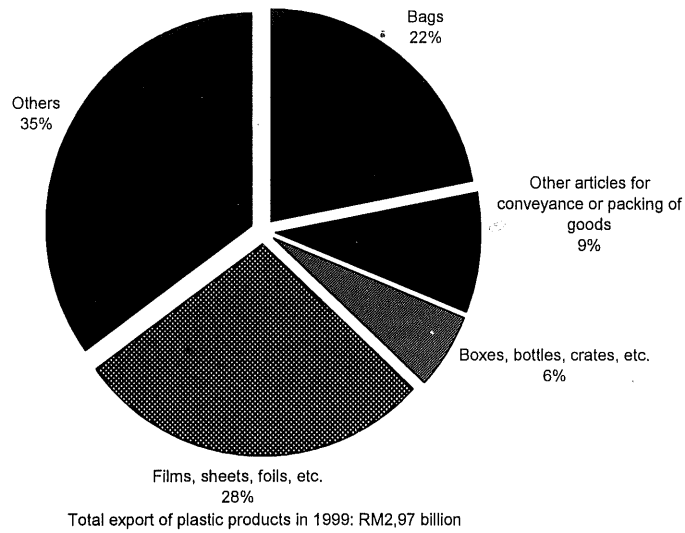


Figure 5. Export of plastic products by types in 1999.

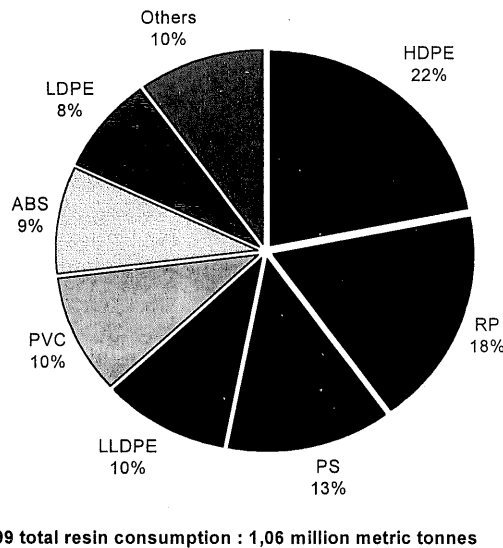


Figure 6. Resin consumption by types.

generated are being discarded into landfills or worse still, some end up in rivers or seas. The bulk of the waste disposed on land, which includes plastic wastes, are dumped into 144 landfills in Malaysia. Most of the plastic wastes discarded are plastic bags and household containers [2].

A recent study done by MHLG showed that the composition of plastic waste in Kuala Lumpur's Municipal Solid Waste (MSW) in the year 2000 was 24.4%. This study was done on middle income residential areas. The same study also showed that in Labuan the plastic waste composition was even higher, 48.0%. Table 1

shows the MSW composition in Kuala Lumpur and Labuan in year 2000 (MHLG). The most probable reason why Labuan's plastic waste was higher than Kuala Lumpur is because of its status

as a duty free port. Residents and visitors to Labuan have higher spending power to shop, hence more grocery bags and plastic based apparatus are discarded.

Table 1. Municipal solid waste composition in Kuala Lumpur and Labuan (% weight).

Waste Type	% Solid Waste	
	Kuala Lumpur	Labuan
Vegetable & putrescible garbage	45.7	19.1
Paper & paper products	7.1	11.4
Plastic	24.4	48.0
Textile	2.1	4.8
Rubber	1.4	0.8
Wood	0.7	0.8
Yard trimmings	3.8	0.6
Glass	3.3	8.0
Metal	6.6	6.2
Others	4.9	0.3

In Malaysia, the average amount of plastic in urban waste was about 18%. Table 2 shows the plastic contents in a few locations in Petaling Jaya. From here it can be concluded that the more affluent areas produce more plastics wastes. This was most probably because the ability of occupants to spend more in supermarkets and department stores. Table 2 also shows that even

though weight wise plastic wastes are low, by volume the wastes occupied more space. This is because plastics have lower density and take up more space for relatively little mass as compared to other household and industrial waste components. As space for landfill is dwindling, the growing amount of plastic waste is a major concern for authorities.

Table 2. Plastic component in wastes from a few locations in Petaling Jaya, Malaysia.

Location	Plastic component in waste	
	By Weight	By volume
Kampung Tunku	7.5%	16.7%
Section 17	8.1%	18.1%
Section 12	14.0%	31.4%
Sg Way Low Cost	6.6%	14.7%
PKNS Low Cost	4.8%	10.7%
Pantai Dalam (KL)	20%	-

CONCLUSION

The need to use biodegradable plastic is due to new environmental regulations, societal concerns and increased environmental awareness. Composting is one of the waste management options that are most environmentally friendly and it is able to divert some waste from landfills. Since more than 60% of average Malaysian's MSW is organic in nature and potentially compostable, composting is one good option.

Thus, using biodegradable polymers in the packaging of organic or biodegradable materials, such as kitchen waste, enables this waste to be directly composted without the need to separate the contents from the packaging. For example biodegradable plastic garbage bags can be directly composted. Consequently, this can take off some of burden from landfills.

REFERENCES

1. Agamuthu, P. (2001). *Solid Waste: Principles and Management*. University of Malaya Press, Kuala Lumpur.
2. Agamuthu, P. (2000). Trends in plastics production, consumption and associated waste management in Malaysia. *Proceedings of the ICS-UNIDO International Workshop, Environmental Degradable Plastics: Industrial Development and Application*, Seoul, Korea, pp. 422-433.
3. MPMA 2001/2002. MPMA Malaysian Plastics Industry Directory 2001/2002.
4. Malaysian Plastics Manufacturers Association (MAPA) (2002) Opportunities and Challenges of the Malaysian Plastics Industry. *Proceeding of the 1st Malaysia-Japan Plastics Conference*.
5. The Star, 8 April 2002, *Getting into the 3Rs*. pp. 7.