OVERVIEW ON ENVIRONMETAL CONSEQUENCES TRIGGERED BY MOBILE PHONE WASTE IN MALAYSIA

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ABSTRACT: *As the technology advancing, industrial waste is increasing. Abundant reports have shown that the e-waste will soon be the most significant portion of the total waste. Among the e-waste categories, mobile phone component is the largest. The mobile phone is not only a normal waste but it also constitutes very toxic materials and heavy metals. This development can result in a serious hazard to human health and the environment. The United Nations, as well as other local government, have issued strict legislation to regulate this industry. However, awareness and regulation regarding this matter in Malaysia is still lacking. Serious steps in managing phone waste in regard to the collection, segregation, and recycling need to be taken. Best known practices on mobile phone waste management need to be studied. The best model should be adopted and adept to suite local requirement in Malaysia. Initiatives in awareness, technology used in collection centres, policies, and regulations regarding to mobile phone waste should be the area of focus. In this report, an overview that sheds light on the current situation in Malaysia regarding to mobile phone e- wastes is presented.*

KEYWORDS: E-waste, mobile phone, waste management, hazardous waste, regulation.

I. INTRODUCTION

The environment and technology appear at the opposite ends as the advancement in technology has severely continuously impacted the environment. The global warming, greenhouse emission, unprecedented hurricanes, and floods, emerging new diseases, and, most importantly, the accumulation of the waste are just examples of the technology or, more precisely, abusing the technology. It is true that human will not give up the benefits of using technology such as communication, transportation, availability of food, and many others; however, the time comes to re-think about finding a balance between the need and the relevant consequences. Based on the global competitive index, Malaysia is the 24th country in the growing economy [1] and jumped to the 18th only within two years [2]. The Malaysian advancement of technology is accompanied by the creation of an enormous amount of waste that originated from industries as well as the new lifestyle of people.

The definition of "waste" is based on the Malaysian Department of Environment as "any substance prescribed to be scheduled waste or any matter whether in a solid, semi-solid, or liquid form, or in the form of a gas or vapour, which is emitted, discharged, or deposited in the environment in such volume, composition, or manner as to cause pollution" [3]. The waste is regulated based on 2005-Regulation according to the toxicity and hazardous waste [4]. The solid waste generated in Malaysia was projected at about 30,000 tons per day by 2010 [5]. Meanwhile, another study has shown that this figure is underestimated and the real amount could be much higher [3].

Out of the e-waste, the mobile phones have the shortest life span which is estimated an average of 3 years in developed countries [6] and under 2 years in developing countries [7]. The higher life span in developed countries is primarily to the advanced technology and the regulations of these countries imposed on manufacturing companies [8]. Generally, mobile phone waste is the fastest growing global waste [8].

The environment, health, and Safety (EHS) estimated 3839 waste items [9] and classified into 77 categories and further, they were divided into five sector-groups including industrial, agricultural, health, commercial, and household. Generally, e-waste is categorized under three sections: large household appliances, IT and PCs, and monitors of computers, TVs, and mobile phones. This report focuses on waste sourced from mobile phones. The mobile phone waste can be originated from the whole phone or from some components that taken out of the phone in the repair shops. The classification of e-waste in Malaysia relies on the 2008-Guidelines for the Classification of Used Electronic and Electrical Equipment in Malaysia. Table 1 shows the gross quantity of e-waste from the industrial sector in Malaysia [10].

Table 1: Quantity of e-waste generated by the industrial sector in Malaysia.

Number	Year	Quantity of e-waste (metric tons)
1	2009	134,035.70
2	2010	163,339.80
3	2011	152,722.04
4	2012	178,278.05

Common sense indicates that the flow of the waste is very crucial in categorizing the waste. Hence, the flow of the IT-based waste is higher than the flow of electronics wastes from household devices due to the life cycle of each of these devices [11]. The first problem is the way the electronic wastes are collected. Figure 1(a) shows the first difficulty as very diverse phones not only due to various origins but also of various brands. In some countries, e-waste is treated by either melting or incinerating [12]. Either way, melting or incinerating, causes acidification, contamination, and/or vaporizing carbon monoxide in the air. There are some precious materials such as gold (0.14%), silver (0.4%, platinum (0.01%) and palladium (0.01%) which can be recovered and recycled again as shown in Figure 1(b) [8].

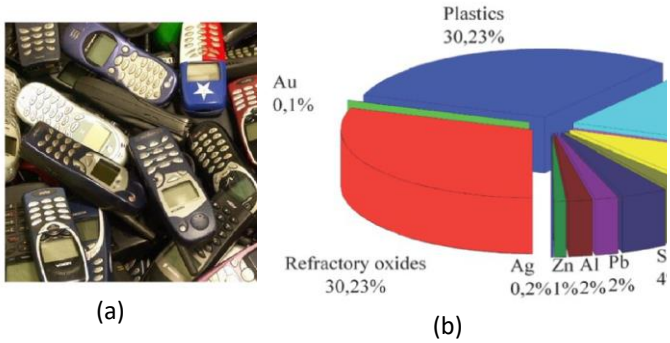

Figure 1. (a) Thousands of various mobile phones collected for recycling and (b) Percentages of e-components [13]

II. MALAYSIAN CURRENT SITUATION

The situation in Malaysia is alarming and it requires an urgent remedy that includes setting a structural-mechanisms fortified by the adequate framework. The method of collecting the e-waste has not yet up to the level needed. In Malaysia, for instance, there are 122 partial recovery facilities and only 16 full recovery facilities [13]. This number of recovery facilities is not enough for a country in size of Malaysia and, the country is progressing to be one of the developed countries where the waste is one of the natural consequences of such development. Secondly, in Malaysia, the current focus is only on several materials which are inclusively classified as lead, mercury, and cadmium [13]. Meanwhile, there are tons of hazardous material in the e-wastes of computers and mobile phones. Thirdly, the statistics have shown alarming news where Malaysian e-waste in 2012 has reached only approximately 10–15% of the total generated scheduled waste and expected to gradually increase in the future. The fourth issue is about the level of awareness among people about the danger of the e-waste especially the mobile phones which is at a very low level [14]. The fifth issue is the lack of legislation the mandates big companies to pay for the cost needed to save the environment by investors [15]. The sixth issue is showing that there is no program of monitoring the e-waste in general nor the mobile phones waste, in particular.

As a result, the current collection rate of obsolete mobile phones in Malaysia is still very low which requires special attention to this drawback. The department of environment Malaysia (DOE) tried to provide special pins at convenient locations to collect mobile phones but, the results are still not encouraging [15]. In addition, a plan between DOE and big companies such as NOKI to encourage people to use special pins for mobile collection, this plan was also not very successful [16] 16]. Research has shown that the reason behind such a failing plan was mainly due to the level of the awareness among Malaysians regarding the e-waste and the weakness of enforcement of regulations imposed on industrial sectors [17]. From an economic point of view, the investment in treating the phone waste is very limited. Additionally, the high cost of labour made repairing electronic devices undesirable and, instead, replacing these devices seems much easier.

Having identified the most important conditions of the current status of the mobile phones collection, this study will use the gaps of the arisen from the collection to study the most important and the effective methodologies to make the first step of treating mobile phone waste successful.

III. MANAGEMENT OF MOBILE PHONE WASTE

The first step for achieving the best methodology of mobile phone management is to estimate the flow of the waste, the quantity, and the means of reaching the waste. Previous studies conducted in different countries have been providing answers to each of these concerns with emphasis on local waste generation rather than at international level. The generation of the mobile phone waste was studied in the Czech Republic using the life span as an indicator to make the proper methodology of predicted waste [18]. A similar methodology was conducted in developed countries such as Japan, China, US, UK, and Korea and in developing countries such as Nigeria [19]. Another approach for the prediction of the mobile phone waste was studied based on comparing the market supply method and consumption [20]. Despite the fact that both methods rely on considering the current consumption of the mobile phones, the two methods showed different results and, as such, the selection between the methods becomes very important. The purpose of these studies is simple to better manage the mobile phone waste intended to reuse, reduce, or recycle.

The management of the mobile phone waste is tightly related to the knowledge of the consumers regarding the contents, hazard, and the impact on the environment. The low recycling rate of mobile phones is indicative of the type of attitude of the customers towards the importance of recycling. As an example, it was reported that 80% of a very diverse population in Nigeria are will to pay a certain amount of money for environment recovery due to mobile phones [21]. The study was also concluded that the majority is willing to send their spoiled phone to the recycling centers. The attitude towards recycling mobile phones seems to depend on culture, age, sex, and profession. The youngsters in Germany do not pay much attention to their old phones [22]. The Chinese are reluctant to pay for phone recycling; however, on the contrary, they tried to keep their phone for a longer time which is estimated at more than three years [23]. The overall conclusion by various studies has suggested that phone recycling is generally low in both developing and developed countries [19].

The recycling consists of many phases which start with a phase called the end-of-life (EOL). In EOL, the toxic materials are exposed making this phase the most dangerous state as the toxic materials impose the highest risk on health and the environment [7]. At EOL stage, the toxic materials are recovered by extraction these materials using suitable technology which should be available at the recovery facilities. The recovery process is very expensive and without the government interference, the process will not succeed mainly due to the financial sector is not willing to take part in the process which, in advanced, does not show profit [24].

IV. CONCLUSION AND FUTURE WORK

It is a fact that the waste caused by the mobile phone is growing and it has become a very serious problem. Despite the effort performed by the department of environment, the overall effort still below the required level to address such monumental problem. Currently, there are enormous issues that have not been considered, such as setting a program for awareness, creating monitoring system, enhancing the process in recovery centers, improving the segregation of the phones, and providing recycling centers with sophisticated scientific program and capabilities. Having these issues administered, the treatment of phone waste should be built on strong foundations. The most important steps that could be considered for future work are the holistic waste management plan for the entire mobile phone life cycle from design to disposal stages. The plan should put back the responsibility of waste management not only to the end users, but also to all the stakeholders throughout the mobile phone supply chain.

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REFERENCES

[1] WEC, W. E. F. (2013). "The Global Competitiveness Index 2013–2014," Geneva, Switzerland.

[2] WEC, W. E. F. (2015). "The Global Competitiveness Index 2015–2016," Geneva, Switzerland.

[3] Fazeli, A., Bakhtvar, F., Jahanshaloo, L., Che Sidik, N. A. and Bayat, A. E. (2016). Malaysia ′s stand on municipal solid waste conversion to energy: a review," Renewable and Sustainable Energy Reviews, vol. 58, pp. 1007–1016.

[4] Kamarulzaman, T. and Abdul Aziz N. A. (2012). "Environmentally hazardous substances notification and registration scheme," in Asia-Pacific Economic Cooperation – Chemical Regulators' Forum, Singapore.

[5] Aja, O. and Al-Kayiem, H. (2014). "Review of municipal solid waste management options in Malaysia, with an emphasis on sustainable waste-to-energy options," Journal of Material Cycles and Waste Management, vol. 16, pp. 693–710, 2014/10/01.

[6] DOE. (2009). Perunding Good Earth Sdn Bhd, Department of Environment, Malaysia, Ex-Corporation, Japan. The E-waste Inventory Project in Malaysia. 2009

[7]. Srinivasan, S. S. N. (2008). Mobile Phone Waste - Current Initiatives in Asia and the Pacific. Tech Monit 32–8.

[8] Soo, V. K., Featherston C, Doolan M. (2013). E-waste Assessment in Malaysia. In: Nee AYC, Song B, Ong S-K, editors. Re-Eng. Manuf. Sustain., Springer Singapore; p. 389–95.

[9] DOE, M. (2012). "Guidance for the industry on the notification and registration scheme of Environmentally Hazardous Substances (EHS) in Malaysia," D. O. Environment, Ed., ed.

[10] Ibrahim, C. A. (2013). E-waste management in Malaysia: current status. Presentation Slides for Bengkel Kajian Penyediaan Garis Panduan Mengenai Kriteria "Environmentally Sound Management" Ke Atas Kemudahan Pemerolehan Kembali E-Waste Di Malaysia," Palm Garden Hotel, Putrajaya, November 2013.

[11] Coleman, A. (2017). Reducing environmental hazard caused by disposed mobile phones in developing countries. Environmental Economics, Volume 8, Issue 2, 92-99.

[12] Pinto, V. N. (2008). E-waste hazard: The impending challenge, Indian Journal of Occupation and Environmental Medicine 12920, 67-70.

[13] Jaibee, S, Abd Rahim, A, Mohamad, F., Jamian, S., Kiong, S. C., Seiji, Y. and Muhd Nor, H. (2015). Review on Current Status of Waste Electric and Electronic Product in Malaysia. Applied Mechanics and Materials Vols 773-774, pp 898-907.

[14] Gatke, P. (2003). Future Management of Hazardous Household Waste in Petaling Jaya, Roskilde University Centre.

[15] Ahmad Kalana, A. (2010). Electrical and electronic Waste Management practice by Household in Shah Alam, Selangor, Malaysia, International Journal of Environmental Sciences 1(2), 132-144.

[16] Ongondo, F. O. and Williams, I. D. (2011). Mobile phone collection, reuse and recycling in the UK. Waste Manag 31:1307–15.

[17] Chibunna, J. B., Siwar, C., Mohamed, A. F. and Begum, R. A. (2010). Bridging the Gaps: An E-waste management and recycling assessment of material recycling facilities in Selangor and Penang. Int J Environ Sci 1.

[18] Polák, M., Drápalová, L., 2012. Estimation of end of life mobile phones generation: the case study of the Czech Republic. Waste Manage. 32, 1583–1591.

[19] Sarath, P., Bonda, S., Mohanty, S. and Nayak, S. K. (2015). Mobile phone waste management and recycling: Views and trends. Waste Management, 46, pp. 536-545.

[20] Li, B., Yang, J., Lu, B., Song, X., 2015. Estimation of retired mobile phones generation in China: a comparative study on methodology. Waste Manage. 35, 247–254.

[21] Nnorom, I. C., Ohakwe, J. and Osibanjo, O. (2009) Survey of willingness of residents to participate in electronic waste recycling in Nigeria – A case study of mobile phone recycling. J Clean Prod 2009;17:1629–37.

[22] Welfens, M., Nordmann, J., Seibt, A., Schmitt, M., 2013. Acceptance of mobile phone return programmes for increased resource efficiency by young people—experiences from a German research project. Resources 2, 385–405.

[23] Yin, J., Zhan, S., Xu, H., 2014. Comparison of leaching processes of gold and copper from printed circuit boards of waste mobile phone. Adv. Mater. Res. 959, 2743–2746.

[24] Soo, V. K. and Doolan, M. (2014). Recycling Mobile Phone Impact on Life Cycle Assessment. Procedia CIRP 15, pp 263-271.