Hazardous and industrial waste composition and associated management activities in Caspian industrial park, Iran

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ABSTRACT

The aim of the present study was to investigate the waste composition and related management practices in Caspian industrial park. In the first step, all the industrial processes, the types and quantities of products, waste generation, management activities and other general data were obtained by means of a structured questionnaire. In the next step, a total number of 20 industries were selected and their wastes were manually sorted and then weighed to determine physical composition of the waste generated. In addition, detailed information about the waste in all industries was identified through interviews and observations. Based on the results, total generation rate of waste in Caspian industrial park was 3890.4 kg/day. Metals, organic waste and paper and cardboard constituted about 80.9% of total waste generated. On the other hand, all other components were responsible for only 19.1% of the waste. It was also indicated that the majority of industrial wastes came from metallic industries (31.2%) and food and beverage industries (26.4%). In addition, total hazardous waste accounted for nearly 6.85% of total waste generated. In order for the best management of industrial wastes, it is very important to increase motivation for waste recycling and reusing among employees and managers.

1. Introduction

Recently, the character of domestic economy has changed from agricultural to industrial because of rapid economic growth and industrial development (Thomanetz, 2012). This industrial development has resulted in generating high amount of complex and hazardous industrial wastes (Fathima et al., 2012; Salihoglu, 2010). The term industrial waste refers to all wastes produced by industrial activities and manufacturing processes (Lei et al., 2015; Thai, 2009). One of the main challenges of rapid industrial development is how to reduce the negative impacts of these industrial wastes. Application of integrated waste management programs complied with environmental regulations is a good solution (Del Borghi et al., 2009; Bain et al., 2010). Suitable management of industrial wastes is very important because the quantity and complexity of hazardous materials that need to be treated and disposed of in a safe and economical manner (Kikuchi and Gerardo, 2009). In the absence of an integrated waste management program, severe environmental issues such as soil, water and air pollution may occur (Zhua et al., 2014; Redmond et al., 2014). As well, acute and chronic exposures to hazardous chemicals of industrial waste can cause adverse health effects in human (Botelho, 2013; Islam et al., 2016).

In the past, generators of industrial wastes disposed their wastes into the environment without any treatment. Today, industries and other generators are legally responsible for managing their waste. (Thandavamoorthy, 2016; Musee et al., 2008). Therefore, the manufacturers should manage the wastes themselves, or contract with qualified companies to collect and dispose of the wastes. In order to preserve the environment, waste minimization, separation and recycling processes should be developed and applied as much as possible (Koolivand et al., 2013; Wagland et al., 2012). On the other hand, interest in industrial waste as an important source of energy and material has increased during recent years. Thus, most industries need detailed analysis of their waste at all stages of management activities. Many economic and environmental bene-

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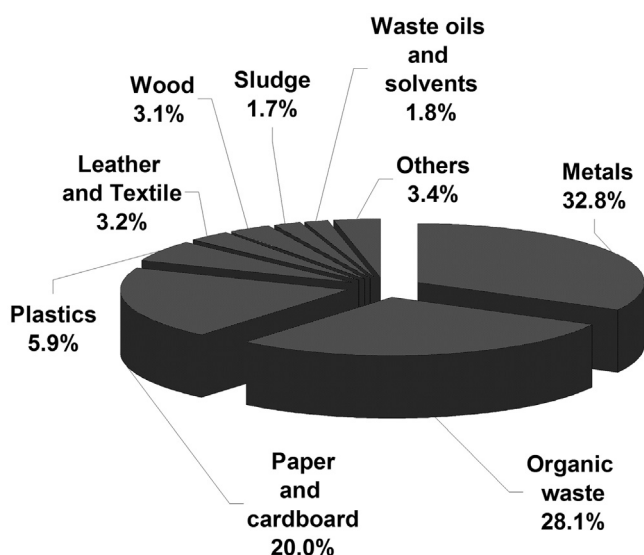
Fig. 1. Composition of the total waste generated in Caspian industrial park.

fits have resulted for the industries that have evaluated and altered their own waste management system (Nasrullah et al., 2014).

Many studies on hazardous and industrial waste from specific industries have been concentrated on waste characterization and management activities (Curran and Williams, 2012; Das et al., 2012; Mmereki et al., 2014). In fact, the first step for planning and developing a more adequate system of waste management is to study the quantity, type, and composition of industrial waste. However, there is limited data on industrial waste generation in Iran and it has, until now, been only roughly estimated. Since a characterization and analysis of waste in the Caspian industrial park had never been studied, this research was carried out to survey the total waste generation and characterization and the related management activities in this area.

2. Materials and methods

2.1. The situation

This descriptive study was conducted during 2014. Most of industrial areas in Iran are located in the outskirts of large cities. One of the most important industrial cities in Iran is Qazvin. Qazvin with a population of 620000 has various industrial parks. Caspian industrial park which is the largest of them is located in the vicinity of the city. In this industrial park, there were 58 active industries including 10 electricity and electronic industries, 3 cosmetic and medical industries, 4 wood, pulp and paper industries, 13 chemical industries, 10 food and beverage industries, 14 metallic industries, 3 textile industries and 1 machinery and equipments industry.

2.2. Data collection

Analyzing the waste stream at the plants was conducted in two steps. First, all the industrial processes, the types and quantities of products and other general data were identified. Next, the wastes generated by each industrial process were characterized. Three general methods were used to study the composition and management of industrial wastes generated: the questionnaire survey, observation & interviews, and sampling & analysis.

Table 1
Composition of the waste generated in Caspian's electricity industries.

Waste category	Generation rate (kg/day)	Percentage
Organic waste	37.17	12.23
Metals	72.33	23.81
Paper and cardboard	150.48	49.53
Leather and textile	0.50	0.16
Wood	18.33	6.03
Plastic	22.36	7.36
Waste oil and solvents	1.17	0.38
Others	1.45	0.48
Sum	303.79	100

2.3. Questionnaire survey

On the basis of the studies carried out in other countries as well as in Iran, a structured questionnaire was prepared. The questionnaire included some general information on the items such as industrial group, number of employees, industrial processes, the types and quantities of products and other functional elements and organizational structure of the industry. It also contained some questions on generation of different fractions of the waste as well as management activities. This questionnaire was sent to the company managers for completion.

2.4. Observation & interviews

Detailed information about the industry and the waste was obtained through interviews and observations. The whole business activity of manufacturing processes, waste generation and existing management system were observed and recorded. In addition, employees and managers were interviewed using interviewing techniques.

2.5. Sampling & analysis

Specific sampling and analysis were carried out to obtain sufficient information on the waste generation and its composition. Out of the 58 industries, 20 were selected for sampling since they generate large amounts of waste. The contents of each waste container were examined before being taken to the landfill. The procedures included detailed analysis of the contents of each container in terms of weight and characteristics. Then, the containers were emptied and their wastes were manually sorted and then weighed. The waste was sorted into the following categories:

- Organic wastes from restaurants and food sector industries as well as garden and pruning wastes.
- Plastics including nylon, packaging materials and various other similar wastes
- Wood and wood products including splinters, sawdust and other residues from the wood sector activities.
- Metals such as iron, steel, aluminum, lead, copper and brass from packaging, construction and transformation processes
- Paper and cardboard
- Leather and textiles, including clothing and upholstery industry wastes.
- Waste oils and solvents including car oil, printing ink, paint and disinfectant
- Sludge
- Other components such as sand, gravel, ash and other similar wastes.