Occupational Safety and Health in Waste Management

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Abstract
With the global growth in economy, urbanization, population and living standards, industrial, household and medical wastes have started to cause serious environmental problems. For a sustainable environment, this waste must be removed or recycled with the minimum possible effect on the environment. In hazardous waste recycling facilities, there are predictable and unpredictable hazards and risks considering the elements such as human-machine, machine-human harmony. As in many sectors, there are many case studies in the field of occupational health and safety in the waste sector. The aim of this study is to give information about occupational health and safety studies in the waste sector.

1. Introduction
The population increase and industrialization accelerated by technological improvements result in the excessive consumption of natural resources and the formation of waste. Thus, recycling valuable waste helps with the effective usage of natural resources. Additionally, effective waste management helps save energy, improve the economy, decrease the waste and prevent environmental pollution. Waste is classified into different categories such as household, medical, hazardous and industrial waste. Hazardous wastes are known to have bad effects on human health, and influence to air/water/soil pollution, global warming and other environmental problems. To protect human health and the environment, the environmental effects of these wastes should be evaluated carefully and the removal should be done within a well-organized and carefully controlled system.

Companies are required to identify and take necessary actions to prevent hazards for the workers that can arise during the removal or recycling of the wastes mentioned above. The work accidents statistics for 2014 show that 1967 insured labor days were lost due to workers having accidents and becoming incapacitated during the removal and recycling of waste (sgk.gov.tr, 2018). In order to increase both productivity and worker safety, one of the first steps that companies should take is risk analysis. Risk analyses have the common goal of preventing accidents or reducing their incidence rates and impacts (Ersoy, 2015:2101). Risk analysis is the key procedure in hazard evaluation and safety administration and it has three

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focal points: (1) the probability of a calamity occurrence; (2) the effect of the calamity; (3) the outcome of the calamity (Andrić and Lu, 2016:102).

A risk assessment matrix is a risk analysis tool that is very popular, easy to use and constitutes the base of many other methods. The hazard evaluation matrix permits the arrangement of various types of mistakes as indicated by their significance. This grouping can help in decision making about the most vital one (Pérez-Fernández et al, 2015:68).

2. Waste Management

Waste is characterized as any lingering material from mechanical and human exercises that has no leftover value (Sukholthaman and Shirahada, 2015:231). Different types of waste can be classified into the basic categories of household, clinical and industrial. Waste can also be classified as either hazardous waste or non-hazardous waste, with regard to the presence of toxic, corrosive, explosive and/or radioactive characteristics. The term “hazardous waste” is typically applied to a substance that contains two or more of the hazardous properties listed in the European Waste Catalogue (Couto et al., 2013:607). Hazardous waste is an important environmental problem since it results in significant pollution of the air, water, soil, as well as radioactive pollution. Hazardous wastes cause environmental problems not only when they are first formed but also when they are collected, carried, recycled and removed, and even after removal. Thus, hazardous waste should be controlled tightly and according to an organized plan. However, currently, these types of waste are not controlled and treated with the required level of care.

Waste administration is, alongside water and energy administration, one of the key issues encompassing any municipality. Undoubtedly, municipal solid waste (MSW) has turned into an issue of expanding worldwide worry, as the world population keeps on developing, prompting more prominent levels of utilization, and the resulting need to discard nourishment squander, bundles, paper and different components that make up the different waste streams (Filho et al., 2016:1481). In spite of advances in technological improving for waste treatment and administration, we fall a long ways behind in accomplishing the extremely major objectives of reasonable waste administration. Worldwide waste output rate is always expanding and it is anticipated that the output of waste will keep on increasing until 2100, unless any forceful manageability measures are actualized (Zaman, 2016:41).

Improper waste management causes long-term impacts on the environment, such as pollution of the air, soil, surface and ground water. One common example of improper waste management, the landfill, is particularly problematic. To begin, landfills take up a lot of space, reducing the amount of land available for other, more productive uses. In addition, the decomposition of MSW in landfills leads to the generation of methane (CH4) gas; CH4 contributes to about 21% of all global greenhouse gasses (GHG), and is thus a pressing issue in the fight against climate change. The negative results of landfill are the main impetus that pushes governments and municipalities to detect better remedies for waste administration arranging. Apart from disposal, MSW can be turned into valuable
products through recycling, energy recovery, and biological recovery as suggested in the importance of waste administration (Ho et al., 2016:1482). Recycling and reusage of the wastes prevent the depletion of natural resources. Table 1 summarizes the data related to the waste removal and recycling facilities in Turkey.

**Table 1. Information on waste disposal and recovery in Turkey (tuik.gov.tr, 2016)**

<table>
<thead>
<tr>
<th>Facilities Type</th>
<th>Number of Facilities</th>
<th>Amount of waste treated (ton/year) 2012</th>
<th>Number of Facilities</th>
<th>Amount of waste treated (ton/year) 2014</th>
</tr>
</thead>
<tbody>
<tr>
<td>Disposal Facilities</td>
<td>83</td>
<td>24.224.635</td>
<td>117</td>
<td>41.324.637</td>
</tr>
<tr>
<td>Regular Storage Facilities</td>
<td>80</td>
<td>24.174.502</td>
<td>113</td>
<td>41.281.755</td>
</tr>
<tr>
<td>Incineration Facilities</td>
<td>3</td>
<td>50.133</td>
<td>4</td>
<td>42.882</td>
</tr>
<tr>
<td>Recycling Facilities</td>
<td>589</td>
<td>10.229.133</td>
<td>868</td>
<td>19.724.241</td>
</tr>
<tr>
<td>Compost facilities</td>
<td>6</td>
<td>158.922</td>
<td>4</td>
<td>94.019</td>
</tr>
<tr>
<td>Co-Incineration Facilities</td>
<td>32</td>
<td>538.916</td>
<td>39</td>
<td>532.343</td>
</tr>
<tr>
<td>Other Recovery Plants</td>
<td>551</td>
<td>9.531.295</td>
<td>825</td>
<td>19.097.879</td>
</tr>
</tbody>
</table>

The statistics related to waste removal and recycling facilities prepared by the Turkish statistics institute show that there were 985 facilities consisting of 117 waste removal facilities and 868 recycling facilities operating in Turkey in 2014. 41 million tons of waste were removed to 113 regular storage facilities that had a collective capacity of 610 million m³. In addition, 67 thousand tons of medical waste were sterilized in 2014 in 45 sterilization facilities with a collective capacity of 192 thousand tons/year. 68% of this medical waste was removed to regular storage facilities while 32% was sent to the municipal dumpsite. 43 thousand tons of waste, including 40 thousand tons of hazardous and 3 thousand tons of non-hazardous waste, were removed to 4 incineration facilities with a 111 thousand ton/year capacity. 94 thousand tons of waste were processed in 4 compost facilities that have a 310 thousand ton/year capacity. Furthermore, 532 thousand tons of waste were burned and energy was recycled in 39 co-incineration facilities that hold a waste recycling license. In the other 825 licensed waste recycling facilities, 19 million tons of metal, plastic, paper, minerals, etc. were recycled.

This expanding waste, alongside more attention to human wellbeing, ecological effects, social issues, and decreasing natural resources has made the goals for systems and procedures to eliminate (Sukholthaman and Shirahada, 2015:232). Moreover, waste decrease and descending resource have critical monetary advantages (Ajayi et al., 2015:101). The financial advantages of the waste administration frameworks rely on upon the sorts of resource gain from the waste administration frameworks. (Zaman, 2016:42).

In industrialized countries, occupational health and safety (OHS) is considered a public health priority as it is a social and societal necessity. Although the country has an important legislative and regulatory framework on which is based the
national policy on the prevention of occupational risks (Rachid et al., 2015:146), there is more that must be done in the field of Occupational Health and Safety.

3. **Occupational Health and Safety**

OHS is related to employees' health, safety and welfare issues. Eliminating or decreasing work accidents are the main motivators of OHS (Gul et al., 2017:187).

In recent years, as the number of occupational diseases increases, the interest in occupational health is also increasing (Ng and Hassim, 2015:92). The benefits of creating a healthy and safe working environment in the workplace are widely known. Many studies show that good working conditions provide to improve labor productivity and the operational performance. Apart from improving working conditions, recruiting skilled workers and removing social and economic costs of occupational accidents are other important benefits (Antão et al., 2016:267).

Since health and safety of workers are directly related to human life, companies should pay much more attention to this issue than the value given by a simple cost-benefit ratio (Sousa et al., 2015:185). According to the World Health Organization, directing healthy behavior at the workplace makes the working environment safe and healthy. In addition to this, self confidence, moral strength and job satisfaction increase while work stress is reduced. For companies, well-managed health and safety programs reduce absenteeism, health spending, and various litigation, while increasing productivity (Ulutasdemir et al., 2015:504).

Despite the need to manage health and safety, many organizations do not recognize the priority for these issues. Lack of knowledge, skills and motivation, or limited staff resources are some of the reasons for this issue. Some firms perceive OHS as bureaucratic operations. In addition to this, companies pay great attention to cost items. For this reason, they may have the perception that they do not have the capital necessary to invest in health and safety (Haslam et al., 2016:100).

Accidents originate due to unidentified triggering actions and insufficient preventative measures (Ersoy, 2015:2102). Leading indicators are assumed to be early warning signals of potential hazards and risks; This provides organizations with the opportunity to identify and reduce risks before an occupational accident or occupational disease occurs (Shea et al., 2016:294). The OHS issue also has a significant importance as it has the effect of increasing or decreasing the reputation of a company and its image among stakeholders (Battaglia et al., 2015:56).

Work accidents and occupational diseases worldwide cause a serious and costly burden and are considered to be a major threat to managers, governments and especially workers. It is estimated that over 1.2 million workers have died as a result of workplace accidents and illnesses, while possible hazards and risks in the workplace cause 160 million workers to In Turkey, the number of work accidents in 2013 was 191,389, which increased by 15% to 221,366 in 2014. Among these 221,366 accidents, 1,626 of them resulted in death and 1,421 resulted in permanent loss of work abilities (10% or over loss of ability to work). In 53% of work accidents, workers continued working on the same day while 34% of workers took a break of 5 or more days.
Table 2. The effects of the number of work accidents on labor utilization

<table>
<thead>
<tr>
<th>Continue to work on the day of the accident</th>
<th>1 day break</th>
<th>2 days break</th>
<th>3 days break</th>
<th>4 days break</th>
<th>5 or more days break</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of work accidents</td>
<td>117.892</td>
<td>5.233</td>
<td>8.639</td>
<td>11.855</td>
<td>3.446</td>
<td>74.301</td>
</tr>
<tr>
<td>Percentage</td>
<td>53%</td>
<td>2%</td>
<td>4%</td>
<td>5%</td>
<td>2%</td>
<td>34%</td>
</tr>
</tbody>
</table>

The importance of process safety is obvious considering the work accidents and effects which are presented on Table 2. “Risk” is a measure of how safe the process is and can also be defined as a combination of the severity and likelihood factors of possible hazards in the workplace. In the risk analysis, the risks involved in the system are composed of qualitative and quantitative factors. Risk management uses risk estimation, risk assessment, risk-based decision making and design development methods to manage existing and possible risks (Khan et al., 2015:120).

By complying with regulations and methods, the likelihood and severity of incidents can be avoided or reduced (Bagherpour et al., 2015:2224). In a study using leading indicators to measure organizations’ OHS performance, metrics such as being achievable, meaningful, transparent, easy to communicate, valid, useful, and timely have been identified as leading metrics. Among these, the most important point is that it includes the steps necessary to remove or reduce the risks and hazards of the leading aims of the leading indicators, in other words, it is applicable (Sinelnikov et al., 2015:241).

One-third of the world's population provide economic and financial support to society by working. As a result of the complexity of working conditions and the uncertainty of the interaction between the worker and the environment, it has become difficult to estimate all of the human behaviors through training or procedures. As a result of injury or death in the workplace, work safety conditions have gained great importance in terms of employees, employers and governments.

Risk assessment refers to analyzing the current situation, assessing the risks arising from the hazards and determining whether the risks are acceptable (Ozdemir et al., 2017:896) Risk assessment is one of the methods to identify and test the effects of the risks and the evaluation of any preventive action to bring the existing risks into the acceptable levels.

There are three stages of risk assessment as identification of potential hazards and risks, calculation of risks and the identification of preventive measures. One of the main objectives of OHS programs is to prevent fatal accidents at workplaces. (Melemez, 2015:370)

There are several safety assessment methods that have been developed to identify and evaluate potential process hazards. Different safety assessment methods are suitable for different stages of process development such as conceptual, design and operation. (Ee et al., 2015:140)
Below, some methods used in risk analysis are presented.

- Preliminary Hazard Analysis – PHA
- Job Safety Analysis - JSA
- Preliminary Hazard Analysis – PHA
- What if?
- Risk Assessment Decision Matrix
- Failure Mode and Effects Analysis – FMEA
- Hazard and Operability Studies – HAZOP
- Fault Tree Analysis – FTA
- Event Tree Analysis – ETA
- Preliminary Risk Analysis
- Preliminary Risk Analysis Using Checklists - PRA

4. Conclusion
The expanding world population, unorganized industrialization and urbanisation and increase in the usage of chemicals result in many environmental problems. Waste management issue is considered as an important environmental problem. Considering that Turkey has the highest population increase rate among the Organisation for Economic Cooperation and Development (OECD) countries, the carriage, storage, controlling and removal of the wastes are faced as crucial environmental tasks. When these activities are realized, several foreseen and unforeseen hazards and risks appear. To identify these risks, measure their effects and minimize these effects, risk evaluation approach is used. Risk analysis can be defined as a process management that contains scientific studies based on taking necessary cautions and identification of potential hazards. Risk evaluation should not only be a legal requirement but also be part of enduring improvement efforts. In this study, waste disposal and recycling statistics are given in Turkey. And also information about occupational health and safety studies including risk assessment studies in waste management is given and an overview has been established.
References


