



Risk Assessment for Municipal Waste Collection at Majlis Bandaraya Kuala Terengganu, Terengganu

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Abstract

This purpose of this study is to identify the health hazard, risk assessment and risk control (HIRARC) at the Municipal Waste Collection. The HIRARC was specifically performed at Kuala Terengganu City Council (MBKT). The objectives were to carry out workplace assessment at the municipal waste collections by applying hazard identification, risk assessment and risk control guidelines, followed by identifying at least six associated safety hazards and six health hazards at MBKT municipal waste collection facility and to determine the most critical safety and health hazard and then ultimately propose the appropriate recommendations, accordingly. Also, Job Hazard Analysis (JHA) was conducted for waste collectors to be cautious at the workplace while executing each job tasks. The quantitative and qualitative risk assessments data collection methods were used in risk matrix table including semi-quantitative risk assessment. Data was collected through inspections, observation, interview and record accidents review. A total of 22 hazards were classified into physical, chemical, biological, psychological, mechanical and ergonomic hazard categories. The most critical safety hazard is physical hazard while the most critical health hazard is ergonomic hazard. Hierarchy of control was used to control risk and prevent hazard from becoming serious problem in the future. The recommendation and suggestion were documented and forwarded to the management for reviewing.

Keywords: Municipal waste collection, workplace assessment, risk assessment, health hazard, ergonomic.

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INTRODUCTION

Kuala Terengganu Town administration, known as Kuala Terengganu Municipal Council since 1979 and then recognized as Kuala Terengganu City Council (MBKT) since 2008 (MBKT, 2019). Kuala Terengganu District combined with Kuala Nerus District is an administrative area of 60,528.60 hectares with a population of 406,317

In Malaysia, HIRARC guidelines were published by the Department of Occupational Safety and Health (DOSH). The guidelines explain a systematic approach to identify

hazards and assess their related risks to provide objective measures to control the hazards.

The functional elements in municipal solid waste management from the point of generation to final disposal are waste generation, collection, transportation, recovery/treatment and disposal. The flowchart of work process/work activity is shown in Figure 1.

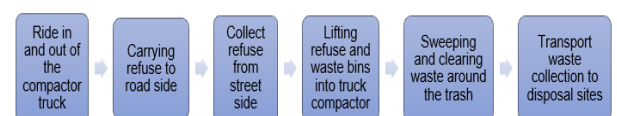


Figure 1: Work Process/ Work activity

The work process/work activity was discussed in detail in Table 1. These involve ride in and out of the compactor truck, carrying refuse to the roadside, collect refuse at roadside to load into compactor truck, lifting refuse and waste bins into compactor truck, sweeping and clearing waste around the trash and transport waste collection to disposal sites.

Table 1: Work process / work activity

Work Activity	Descriptions
Ride in and out of the compactor truck	Every truck has 1 driver and 2 or 3 crews. At 6.30 a.m., the workers heads to the field to perform the collection work. The workers ride on and out from compactor truck and stands on a footrest platform while holding onto a handhold bar.
Carrying refuse to the roadside	The workers pick up refuse from door to door then put on the roadside. Usually, wastes collection points are at road junctions.
Collect refuse from roadside to load into compactor truck	The worker collects refuse from collection point to load into compactor truck.
Lifting refuse and waste bins into compactor truck	The worker lifts refuse and waste bins into and out of compactor truck. During waste loading into compactor body, the worker uses the platen. The platen feeds wastes through the

	hopper opening, packing refuse into the compactor body.
Sweeping and clearing waste around the trash	Sweeping and cleaning around the trash bin within 5 meters radius of the roadside. All wastes should be collected.
Transport waste collection to disposal sites	After wastes were collected, the compactor truck will transport waste to the disposal site at Sungai Ikan Sanitary Landfill.

The purpose of this study is to carry out workplace assessment for municipal waste collection by using hazard identification, risk assessment and risk control guidelines at MBKT.

METHODOLOGY

Risk Assessment

Hazard classification was carried out through job hazard analysis (JHA) to identify the category and class of hazards. This was followed by quantitative risk assessment using a standard scale.

Job Hazard Analysis (JHA)

JHA is one of the methods used for hazard identification at workplace. It was conducted on tasks involving the waste collectors. Hazards were classified into two main groups as safety hazard and health hazard. Those hazards were then classified into types of hazard as follows: physical, chemical, mechanical, biological, ergonomic and psychological. Table 2 discussed JHA for waste collection activities.

Table 2: Job Hazard Analysis for Waste Collection Activities

Job task	Type of hazard	Hazard classification	Hazard cause	Consequence	Existing (E)/ Potential (P)
Ride in and out of the truck compactor to collect waste	Safety	Physical	Trip and fall	Body injury	P
	Health	Ergonomic	Repetitive movement	Scrapes and bruises on leg	E
Carrying refuse from door to door and put to the street side	Safety	Physical	Sharp objects	Cuts and punctures	E
		Biological	Exposed to contaminated waste	Bacterial and viral infection	P
		Chemical	Exposed to chemical waste	Inhalation and direct contact	P
	Health	Biological	Exposed to bacteria and virus	Infection through sharp objects	P
		Ergonomic	Repetitive movement	Could result in musculoskeletal disorder	E
Carrying, lifting, pushing, pulling refuse and waste bin towards truck compactor	Safety	Physical	Sharp objects	Cuts and punctures	E
		Chemical	Exposed to chemical waste	Injection and direct contact	P
		Biological	Exposed to contaminated waste	Bacterial and viral infection	P
		Psychological	Workload	Mental stress	E

Job task	Type of hazard	Hazard classification	Hazard cause	Consequence	Existing (E)/ Potential (P)
	Health	Biological	Exposed to bacteria and virus	Infection through sharp objects	P
		Chemical	Spillages of chemical waste	Inhalation and direct contact	P
		Ergonomic	Manual handling	Could result in musculoskeletal disorder	E
Loading waste into compactor	Safety	Mechanical	Impact by bin	Bodily injury	P
		Physical	Caught by moving parts of hydraulic lift	Hand injury	P
	Health	Ergonomic	Heavy load	Could result in musculoskeletal disorder	P
Sweeping and clearing waste around the trash	Safety	Physical	Slip, trip and fall	Bodily injury	E
	Health	Ergonomic	Repetitive movement	Could result in musculoskeletal disorder	E
Transporting waste collected to disposal sites	Safety	Mechanical	Impact by vehicles	Bodily injury	P
	Health	Physical	Vibrations	Low back pain	P
		Chemical	Exposure to carbon dioxide	Respiratory problem	P

DISCUSSION

HIRARC for municipal waste collection in the field was conducted to identify the hazards and to improve the safety at the workplace. This particularly focuses on waste collectors at MBKT. The hazards were analysed to prioritize the risk and assess the existing control measures for better improvements. Identification of hazards was conducted using workplace observation, inspection, interview, job hazard analysis and incident/ accident review. Hazards occur for various reasons during the waste collecting at the field. NIOSH have reported that there are trash collectors dying after being caught in compactor on refuse vehicle in North Carolina (NIOSH, 2015).

The main objective was to carry out workplace assessment for municipal waste collection by using hazard identification, risk assessment and risk control guidelines at MBKT. Six (6) safety hazards and six (6) health hazards were identified through workplace observation, inspection, interviews and review of accident/ incident information. Basic information regarding the process flow or job activities was collected through interview with the supervisor and waste collectors. This helped to select the best method to identify the hazards at the field.

Finally, identified hazards were classified into 2 main groups, safety hazards and health hazards. These two main classes of hazards were categorized into 6 main types. The categories are physical, chemical,

biological, ergonomic, mechanical and psychological. The level of risks was determined as high, medium and low based on the likelihood and severity.

Literature review is used to gather up an information and data of the research study about the safety and health in municipal solid waste collection. The highlights are more on types of waste collection, safety and health hazards among waste collectors, hazard identification and risk assessment, and regulation on employees and employers. On the other hand, personal protective equipment will also be discussed.

According to Ministry of Housing and Local Government (KPKT), municipal solid waste is waste that includes predominantly household waste and commercial waste (Yahaya, 2012). The most common municipal waste collection includes plastic, rubber product, wastepaper, vehicles waste, sewage sludge, construction waste and household waste, medical waste and e-waste (GreenBeston, 2018). Waste collection process is the only instance where the inhabitants meet the waste collectors and representatives of the municipal council waste management. The method of waste collection significantly influences the quality and quantity of recovered material and mode of disposal.

The waste collected includes mixed chemical based product such as detergent, pesticide and pharmaceutical product. Generally, waste collectors were exposed to contaminated waste that pose biological hazard such as mould and fungi, sewage,

stinging insects, harmful plants and animal and bird droppings. Sources of biological hazard include microorganisms with bacteria, virus, and parasites. These sources may cause a variety of health effects ranging from skin irritation and allergies to infections such as Hepatitis B/C or tuberculosis.

The general injuries and mortality common among waste collectors are due to waste that's highly heterogeneous, sharp waste such as broken glass and injuring themselves by getting cut if not wearing proper PPE. Working conditions and environment also contribute in general injuries such as slippery surface, limited workspace and dim lighting. The waste collectors may have musculoskeletal disorder during lifting and carrying heavy loads and repetitive movement. Some of the general injuries may prove fatal such as vehicular accidents. Mechanical hazards may be in impact from bins or hydraulic lift on compactor truck. Working on or near hydraulic equipment and the present or potential of hydraulic failure should require an outline of safe work procedure (State of Queensland, 2017).

The most critical safety hazard was physical hazard where waste collectors tend to cut and injure from sharp objects such as broken glass, aluminium tin, razor blade, plastics and others. However, some chemical and physical hazards identified directly affects the waste collectors due to households not segregating their waste at the source. Moreover, waste collectors often slip, trip and falls at the field.

At the time of the incident, PPE such as safety boots, glove and safety vest were not worn. The employees were unprepared for any kind of splashes and did not protect themselves. It is the responsibility of the employer to provide the PPE, and the employees should be receiving proper training for the usage of PPE. Based on OSHA 1994, section 24 states that general duties for employee at work state are to take responsibility on PPE, co-operate with employer, use PPE properly and comply with instructions and measures. They are prohibited in the job task to cling on platform near hydraulic lift and jump out of the compactor truck. It may prevent hazards such as tripping and falling to the workers during waste collection.

Commonly observed health problems among waste collectors in municipal solid waste collection include fatigue, headache, skin irritation, eye irritation, gastrointestinal problems, psychological problems, allergies, dermal injuries and musculoskeletal disorder (Bogale, Kumie, & Tefera, 2014). The implementation of HIRARC found the most critical

health hazard was ergonomic hazard during manual handling and load waste collection that may lead to musculoskeletal disorder including shoulder, arm, hand and back pain. Household collection is mainly a job which requires repeated heavy physical activities such as lifting, carrying, pulling, and pushing (Bogale *et al.*, 2014).

Periodic workplace inspection and supervision play an important role to ensure appropriate occupational safety and health administration. This process should be systematic and be recorded for reliability result and complete analysis regarding legislation requirement. The risk assessment process should be continuous to improve safety and health of the workers at the workplace (Ahmad *et al.*, 2016).

Awareness among waste collectors on health risk associated with hazards found at workplace is still lacking. This was found through interviewing the workers during workplace inspection. Training to employees was inducted only once during employment is considered not enough.

RECOMMENDATION

This recommendation is to implement risk control to the hazards in order to prevent any accidents at the workplace. Elimination is the most effective way to destroy hazard. However, all the hazards were using administrative control which is risk control method to reduce risk. This is a method with management in provision work procedure in a proper way or safe work procedure.

Moreover, this includes supervision and training to the workers. Engineering control also can be utilised to prevent cuts and injury to the waste collectors. The workers should use Litter Picker Trash Tools Garbage to collect waste. The last method is compulsory use of personal protective equipment.

The most critical safety hazard is physical hazard. The workers tend to cut and injure from the sharp objects such as broken glass, aluminium tin, razor blade, plastics and others. Also, there have been slips, trip and falls at the workplace. Hierarchy of control as a system used in the workplace to minimize or eliminate exposure to hazards has been suggested to overcome the serious problem (NIOSH, 2015). The most critical health hazard is ergonomic hazard. The workers complaint about their back pain and may cause Musculoskeletal Disorder (MSD) if not prevented. Table 9 explains risk control for the most critical safety hazard while Table 10 is for the most critical health hazard.

Table 9: Risk control for the most critical safety hazard

Hierarchy of Control	Control Measure
Elimination	NIL
Substitution	NIL
Isolation	NIL
Engineering Control	-Use Litter Picker Trash Tools Garbage to collect waste
Administrative Control	-Change work shift -Safe work procedure -Training -Supervision
PPE	Gloves, Safety boots, Safety Vest, Long Sleeve shirt, Long Pants

Table 10: Risk control for the most critical health hazard

Hierarchy of Control	Control Measure
Elimination	NIL
Substitution	NIL
Isolation	NIL
Engineering Control	NIL
Administrative Control	-Change work shift -Manual Handling Training
PPE	Safety boots, gloves, safety vest, long sleeve shirt, and long sleeve pants

Based on Table 9 and Table 10, hierarchy of control method is used to prevent hazard reoccurrence. The elimination, substitution and isolation were not applicable to risk control for safety hazards.

CONCLUSION

The recommendation for the most critical safety hazards were to provide the proper preparation procedures or secure system of work (administrative control) by having a shift for the workers. Then the suggested measure was using a tool to pick up garbage instead of using bare hands (engineering control). And finally, is using a proper or suitable glove such as HYFLEX® 11-500 that could prevent hand from cuts and injury from sharp object (personal protective equipment). Furthermore, the recommended step for health hazard was ergonomic hazard during manual handling and load waste collection with the suggested measure was providing proper work procedures or secure systems of work and training for employees (administrative control).

The back belt or spinal support back brace to support back bone from harm was not PPE. It is for avoiding musculoskeletal disorder among waste collectors. All of these control methods need to be assessed through a review of its effectiveness by daily or periodical inspection, appointing external auditors to monitor and inspect all the control measures, step

that have been made and proposing any improvement from time to time that aims to identify the existing shortcomings. Subsequently amendments or corrective action were made so that there was continuous improvement in risk control management in the workplace. Reviewing the suggestion on control measure should also be practised.

Finally, the employer should convey HIRARC to the employees, monitor the follow up action and keep the records. The person-in-charge in the departments should be responsible for the hazards and their control and they required to maintain all records of assessments for at least 3 years.

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