

Overview of Environmental Management Practice for Construction in Malaysia

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ABSTRACT: The surrounding environment plays an important role in communities as living in a good environment can improve the health cycle, increase the quality of life and provide sustainable development for the country. The rapid growth of the human population has led to the increasing demand for infrastructure development and the construction sector in Malaysia. This overview of environmental management practice for construction in Malaysia has reviewed the overall structure of environmental management for the construction site in Malaysia. Construction management is covered in this review report, including construction waste generation, construction waste management, government bodies, government policy, the current status of the environment in Malaysia, challenges, future prospects, and other environmental considerations of environmental management practice for construction in Malaysia. Besides, the detailed guideline and orders for construction waste, effluence discharge, noise pollution, vibration and emission release from construction in Malaysia have been reviewed and stated in this report. Lastly, a recommendation for strengthening the enforcement of law and regulation for environmental management practice to comply has been included in the conclusion of this report to overcome the challenges faced for sustainable construction development in Malaysia.

KEYWORDS: Construction; environmental management; environmental impact; solid waste

1. Introduction

The construction industry in Malaysia has been growing rapidly in the past two decades and contributed up to 5.9% of the Gross Domestic Product (GDP) in 2017 [1]. The construction industry in Malaysia can provide job opportunities to millions of people to reduce unemployment and improve the economics of the country. However, construction waste has caused a serious environmental issue in Malaysia for several reasons, including improper waste management practices in the construction projects, the attitude of the construction workers, and non-sustainable packaging of the construction materials [2]. In general, the construction industry is defined as the planning and construction of buildings or engineering projects such as building works, tunnel construction, road construction, bridge construction, and so on [3].

The growth in the construction industry in response to rapid development and urbanization in Malaysia has an impact on the environment with approximately 8 million tons of construction waste produced each year [2]. Poor management of construction waste can cause environmental degradation, destruction of the ecosystem and put public health at risk. For instance, dumping of the cement powders or dust from the construction waste has the potential to cause eye irritation, sensitive skin, and irritation of the respiratory system as the wet concrete and mortar include alkaline compounds, trace amounts of crystalline silica, and chromium, which are corrosive to human tissue, sensitive to skin, and can cause lung damage. Furthermore, cement dust is one of the major environmental pollutants in the construction industry. Cement dust has high calcium content, which leads to high alkaline in nature and causes potential harm to the environment by mixing with rainwater, infiltrating through the soil, and eventually contaminating the groundwater [4]. In 2012, the United States Environmental Protection Agency (EPA) reported more than 40% of the waste generated by the construction industry, and developing countries such as Malaysia are required to improve the comprehensive legal instruments pertaining to minimizing construction waste [2]. This is because the government of Malaysia has introduced the Solid Waste and Public Cleansing Management Act 2007 (Act 672). However, only 5% of the solid waste has been recycled successfully, and up to 36,000 tons of collected waste are being disposed of across 112 landfills each year. Therefore, the government in Malaysia is required to carefully review the existing environmental management strategies for construction waste, including the construction waste management policies, regional and national policies, laws, and regulations, to meet the future environmental challenges of the rapid growth of the construction sector in Malaysia [5]. In this case, proper environmental management practices for construction are important to minimize construction waste, achieve sustainable development of infrastructure, economic growth, and provide a clean environment for the communities in Malaysia.

2. Construction Waste Management

Construction waste is one of the major environmental and health issues that is generated on the construction site, mostly during demolition work or construction work that is hazardous to the environment and human health. Construction waste can be defined as unwanted materials generated from construction or demolition work and being abandoned by the user or contractors. There are several authors who have given definitions of construction waste but share a similar meaning as shown in Table 1. Construction waste will eventually end up in the landfill due to the poor management of construction waste and non-serious enforcement laws for illegal dumping of waste in most developing countries. Nevertheless, construction waste generation can be reduced by recycling or minimizing it at the source. The construction waste management at the construction sites, construction waste materials, demolition waste, and hazardous waste materials, which consist of oil and hazardous chemical substances, will be more focused in this section to provide an overview of the construction waste management in terms of environmental management practice at the construction sites in Malaysia [2].

The construction industry has grown rapidly in Malaysia for the past two decades and played an important role in the social and economic development of the country which helps to solve unemployment issues. However, this has increased the construction waste generation

in Malaysia and eventually lead to illegal dumping at the sites from the construction company to save cost. Base on the study, it just a state Johor in Malaysia has 46 illegal dumping sites for construction waste [10]. This has shown the construction waste management in Malaysia is required to be reviewed to reduce the increasing amount of construction waste generated in Malaysia. The illegal dumped sites for the construction waste are varied including mangrove swamp and along the roadside which is hazardous to human health and the environment [10,11]. Furthermore, some of the illegal dumping sites consist up to 30 tons of construction waste with six different types of waste including concrete metals, bricks, timber and plastics which slow down the clearing and recycle process of the construction waste. The improper management of many construction companies in Malaysia has led to the increasing rate of illegal dumping of construction waste. One of the main reasons for illegal dumping is the long travel distance between the legal disposal site and the project location. Therefore, the contractor intends to maximize the profit by dumping construction waste at the illegal landfill which allows them to save transportation costs and payment charges to the landfill [10]. Another reason is the weak law enforcement control of construction waste in Malaysia. The Construction Industry Development Board (CIDB) has introduced guidelines on Construction Waste Management in Malaysia but lack of enforcement practice and irresponsibility of government authorities have caused the failure for the contractor to follow and implement the guideline on Construction Waste Management in Malaysia [11].

Table 1. Definition of construction waste from varies authors.

Definitions	References
Construction wastes are any buildings materials including concrete, steel, timber and other materials arising from various construction activities	[6]
Unwanted products from the construction, renovation and demolition works.	[7]
Any waste related to design changes, unused materials, packaging waste and errors in designs.	[8]
Activities such as construction, renovation or demolition of structures generate an inert and non-inert material defined as construction wastes.	[9]
Materials with no remaining values.	[10]

The waste management hierarchy shows in Figure 1 suggested the construction waste shall follow the up to bottom method of the hierarchy to reduce the waste generation at the construction site [12]. The first two terms of the Hierarchy, avoid and minimize are the actions that shall be taken to reduce the construction waste generation. The construction company can focus more on reducing construction waste generation by reducing or replacing the source of construction materials. For example, lightweight concrete blocks selected by some construction companies for the construction of the building. Lightweight concrete blocks are made by expanded clay to create more porous in the aggregate particle to reduce the amount of cement and aggregate resulted in lower density when compared to traditional concrete blocks. Furthermore, a low amount of aggregate and cement in the concrete blocks can help to avoid or minimize the concrete waste generation at the construction site. In addition, lightweight concrete blocks can be cut into smaller sizes and reused at different locations unlike traditional concrete blocks which cannot be cut into different sizes and unable to be used in different aspects during the construction work. Construction waste such as wood, steel and plastics can be sorted for recycling purposes which can sell it to the recycling facility to collect some

incentives and benefits for the company. In the worst cases, construction waste that is not able to reuse or recycle is required to be treated or disposed [13]. The most practical way to dispose of the construction waste is to hire skips from the construction waste removal company. However, construction skips are required to be replaced or clean regularly to avoid overloading of the skips and removal of construction waste each time required to pay to the construction waste removal company result in most contractors are not willing to practice the waste management hierarchy in Malaysia [14]. Therefore, it is important to classify the construction waste before dumping to the skips to reduce the amount of construction waste and ease the process of construction waste management before disposal.



Figure 1. Waste Management Hierarchy [12].

3. Classification and Key Environmental Impacts of Construction Waste

General construction waste can be found in the construction industry includes plastic, timber, steel, concrete and cement. Construction waste can be classified into direct and indirect waste. Direct waste is defined as construction materials which are completely loss value or damage after used while indirect waste refers to the inaccurate design of the construction works, for instance, the construction of concrete slab is inconsistency due to non-specified measurement or design result in an extra part of the concrete slab require to be removed result in an increasing amount of construction waste. Construction work is one of the most high-risk occupations in the industry fields, this is because construction work has to deal with the harsh environments such as working at high rise buildings, a construction site with nails that might cause penetration through the foot, heavy machinery, handling sharp blades and hazardous chemicals substances. Construction in Malaysia requires to comply with government policies that are set by government bodies to ensure the surrounding environment and the health safety of the communities are protected. For instance, government bodies such as the National Resources and Environment Board Sarawak (NREB), Department of Environment (DOE), Department of Irrigation and Drainage (DID) and Occupational Health and Safety (OSHA) have stated rules and regulations for the construction project to comply. This section has outlined the key environmental Factors of the construction project and the government policy stated for environment management practice at the construction site in Malaysia to comply. The most common environmental impacts identified for general construction project has shown in Table 2.

Table 2. Activities and key environmental impacts of construction project

Activities	Environmental aspect	Environmental impact
Heavy machinery washing/ Spray water dust removal	Cleaning agent in wastewater Using water spray	Potential water pollution Impact to natural resources
Heating	Emission from boiler	Air Pollution
Cutter/Pour concrete slab/Blender/Mixer	Flying dust or sand/Ash/ PM10	Air Pollution/ Contamination of soil
Storage of fuel/Coating or Painting materials/Storage of potential hazardous chemical substances	Potential of leakage or spill	Contamination of soil and groundwater
Septic tank or sewage pipe leakage		
Drilling/operation of heavy machinery	Nosie measurement/Time Schedule for operation	Potential noise pollution

Table 3. List of regulations and orders enforced under the Environmental Quality Act, 1974 by The Department of Environment [15]

No.	Regulations/Order	Effective Date of Enforcement
1	Environmental Quality (Licensing) Regulations 1977	1st October, 1977
2	Environmental Quality (Clean Air) Regulations 1978	1st October, 1978
3	Environmental Quality (Compounding of Offences) Rules 1978	1st October, 1978
4	Environmental Quality (Sewage and Industrial Effluents) Regulations 1979 (Revoked by PU(A) 432/2009)	1st January 1981
5	Environmental Quality (Control of Lead Concentration in Motor Gasoline) Regulations 1985	1st August, 1986
6	Environmental Quality (Motor Vehicles Noise) Regulations 1987	1st July, 1987
7	Environmental Quality (Prescribed Activities) (Environmental Impact Assessment) Order 1987	1st April, 1988
8	Environmental Quality (Scheduled Wastes) Regulations 1989 (Revoked by PU(A) 294/2005)	1st May, 1989
9	Environmental Quality (Prescribed Premises) (Scheduled Wastes Treatment and Disposal Facilities) Order 1989	1st May, 1989
10	Environmental Quality (Prescribed Premises) (Scheduled Wastes Treatment and Disposal Facilities) Regulations 1989	1st May, 1989
11	Environmental Quality (Prohibition on the use of Chlorofluoro-carbons and other Gases as Propellants and Blowing Agents) Order 1993	25th October, 1993
12	Environmental Quality (Prohibition on the Use of Controlled Substance in Soap, Synthetic Detergent and other Cleaning Agents) Order 1995	15th April, 1995
13	Environmental Quality (Control of Emission from Diesel Engines) Regulations 1996	1st September, 1996
14	Environmental Quality (Control of Emission from Petrol Engines) Regulations 1996	1st November, 1996
15	Environmental Quality (Declared Activities) (Open Burning) Order 2003	1st January 2004

Pursuant to the orders, an Environmental Impact Assessment (EIA) is required by the Natural Resources and Environment Board Sarawak (NREB) for construction projects prior to commencement. EIA is to ensure the establishment of the construction project does not give an adverse impact on the surrounding environment, EIA shall be undertaken in strict

accordance with the guidelines and environmental standards established by NREB, DOE, DID and OSHA. Most importantly, EIA is required to be done before the establishment of any construction projects that fall under the orders stated in the First Schedule of the Natural Resources and Environment (Prescribed Activities) Order, 1994 mentioned above. The application procedure for the environmental requirements in Malaysia can be explained in 3 major steps. The first step is to go through site suitability evaluation for the construction project that falls under the categories of non-Prescribed activities while going through EIA approval for construction projects that falls under the Prescribed activities. The second step is to subject to air and water pollution control with written permission to air, written notification to sewage, industrial effluent, leachate and written approval to the prescribed premises including crude palm oil mills, raw natural rubber mills and scheduled wastes facilities. The third step is to apply for license from the DOE state offices to occupy prescribed conveyance, scheduled waste treatment and disposal activities before the project operation [15]. Lastly, a list of regulations and orders enforced under the Environmental Quality Act, 1974 established by the DOE for environmental management practice of construction in Malaysia to comply is stated in Table 3.

4. Current Status

4.1. Illegal Dumping

Construction development in Malaysia has shown a significant contribution to the economy of the country and a good investment in Malaysia in the past decade. The increasing development of construction has led to an increasing amount of construction waste generation in Malaysia. Therefore, illegal dumping activities have been directly affected by the increasing population growth and demand in infrastructure in Malaysia as the growing number of waste generation is due to several factors including the economy, urbanization, living standards and the population growth of a country [16]. Solid Waste Corporation Malaysia (SW Corp Malaysia) has reported several factors that may cause an increasing number of illegal dumping activities and a simple mind map stated the factors that might affect illegal dumping activities has shown in Figure 2. Illegal dumping has contributed significant impacts to the environment including land degradation, groundwater and surface water pollution due to the leachate, soil pollution and odour pollution which can attract stray animals leading disease spread [17].

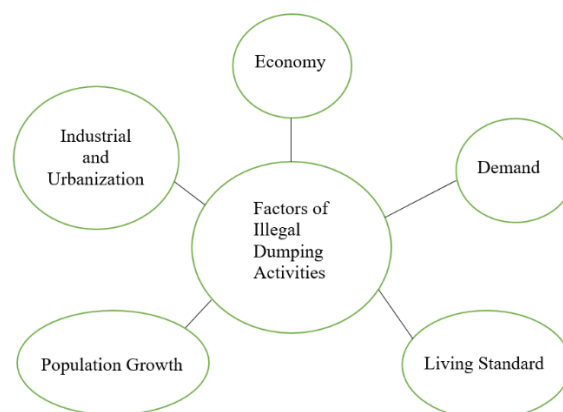


Figure 2. Factors of illegal dumping in Malaysia [18].

The SW Crop Malaysia has implemented the action plan to cover 100% illegal dumping activities at different states in Malaysia by the year 2020 to reduce environmental impacts from the illegal dumping sites and build a sustainable development country. However, the illegal dumping site has been covered in Malaysia is only 32%, while the other 68% of the illegal dumping site remaining unknown or hidden. Unfortunately, Malaysia does not achieve 100% covered of all illegal dumping site and activities by 2020 and this requires more concern from the communities and government parties to reduce the illegal dumping activities from all development company in Malaysia. Government parties such as Construction Industry Development Board (CIDB) can reduce the illegal dumping activities by doing a regular inspection at the construction site in progress while the communities can report on illegal dumping activities being found which allow CIDB to take immediate action [18].

4.2. Water Pollution

Discharge of the construction contaminants directly into the open water surface can contaminate the water and give a serious impact on the biotic environment. Potential hazardous construction contaminants including VOCs, paints, glues, diesel, oils and cement are commonly found at the construction site that can affect the turbidity of the water eventually release to the nearest natural water bodies and polluted the water. Furthermore, soil erosion is difficult to control and the occurrence of soil erosion at the construction site can turn water to be murky which gives a negative effect to the fishes in the rivers [19]. In addition, construction activities such as earthworks and land clearing can contribute a significant number of suspended solids (SS) into the river water. Moreover, huge construction projects can also give a significant impact on water pollution due to the improper management of wastewater discharge from the workers. This is because a huge construction project generally consists of many workers and no sewage system was built during the beginning of the construction phase result in the direct discharge of the wastewater or sewage into the nearby water body. Therefore, a temporary treatment plant is required to be designed and calculated based on the duration of the project to comply with the requirements established by DOE. The number of clean rivers in Malaysia is decreasing from 338 clean rivers at the of 2005 to 278 clean rivers at the year of 2012 while the rest of the 195 rivers tested in Malaysia is classified to be Class III to Class IV polluted rivers which followed the standard set by DOE [20]. Therefore, the developer is required to conduct regular inspection to avoid sewage pipe leakage and wastewater runoff at the construction site to pollute the nearby water bodies.

4.3. Air Pollution

Dust, fly ash and small particular matter are commonly found at the construction site in Malaysia. Heavy machinery, trucks and vehicles at the construction site can produce a huge amount of Carbon monoxide (CO), Particulate matter (PM), Nitrogen oxides (NO_x), Sulphur dioxide (SO₂), Volatile Organic Compounds (VOCs) and other greenhouse gasses [21]. Therefore, heavy-duty vehicles and machinery are critical for reducing global warming emission as old vehicles or machinery generally produce a higher amount of emission which can be replaced by lower emissions vehicles to improve the air quality in the country.

5. Challenges and Prospect

There are several challenges and opportunities associated with the implementation of sustainable construction in the industry. Indeed, it is difficult to balance economic and sustainability especially in developing countries such as Malaysia. Generally, the significant challenges for implementing environmental management practice for the construction industry in Malaysia including the increase in cost, lack of environmental education or training for both technical and managerial, immature development of green materials used for construction, lack of commitment and poor environmental law enforcement to the contractor. To overcome the challenges, it is important to understand the sources of construction waste generated. Construction waste is generated from different construction processes which can be classified into 4 main sections including Construction technology, management, method, materials and workers [22]. It makes environmental management practice easier to be implemented at the construction site due to the less changes in management strategy is required to be made at each construction process. For instance, construction technology such as the in-situ casting of the concrete slab can generate wastage of rebar and concrete at the construction site while prefabrication technology can generate almost no construction waste due to the better accuracy of the measurement casting of the concrete slab in the factory before sending to the construction site. Moreover, less environmental management work is required such as classify usable construction materials, control waste generation, hire skips to remove construction waste and educate or inspect workers' behavior towards construction operation and construction waste generation. Despite several challenges, the prospect of environmental management at the construction site is optimistic due to the increasing awareness from communities toward sustainable development and improving living standards in Malaysia.

There are many other environmental considerations associated with environmental management practice at the construction site including climate change, land use, bad odour, noise and vibration. Climate change can give impact to the construction industry on building materials that are used for construction, extreme changes in temperature can cause building materials such as wood or steel to decay faster [23]. This can be explained by the increase in greenhouse gases that causes extreme weather condition and eventually lead to increase in global temperature as greenhouse gases act like a blanket that absorbing IR radiation and preventing it from escaping the outer space. For instance, a wooden door is commonly used in most of the houses today and the strong sunlight with humid weather in Asia country such as Malaysia can cause crack or expanded of wooden door to occurs easily. Another environmental consideration is noise pollution especially during night-time, designated industrial zones is limited to 70 dBA (7am to 10pm) and 60 dBA (10 pm to 7 am) stated at The Planning Guidelines for Environmental Noise Limits and Controls established by DOE [24]. The construction site can generate impulsive noise from piling, intermittent noise from heavy-duty machinery and vehicles. Contractors are required to do noise mapping at the assessment of the planning stage or establish noise measurements at the construction site such as background (ambient) sound pressure levels at the receiver real property boundary of a noise source to ensure the sound level is within the ranges of requirements established by DOE. Vibration is another environmental consideration that is important to be considered, similar to the noise pollution as vibration can also be classified into continuous, impulsive and intermittent

vibration. The Planning Guidelines for Vibration Limits and Control in the Environment stated vibration with the range between 5 to 30 (mm/s) (0 to Peak) (10-100 Hz) is classified as dangerous which can cause damage to the nearby building leading to glass or brick wall cracking [25].

6. Conclusions

In conclusion, the environmental issues in Malaysia have received special attention as the number of populations in Malaysia is still growing result in increasing demand for infrastructure and living standards. It is important to implement environmental management practices in all kinds of industries especially the construction sector has been a hot topic for researchers and communities to review and study. Construction projects can give a serious impact on the environment by generating construction waste, release hazardous substances to the nearby water body, and release emission or greenhouse gasses to the environment. Construction waste management and government policies have been stated in this overview report and show Malaysia has a complete structure of environmental management for the construction company to comply with. However, the government agency in Malaysia is lacking the commitment to enforce rules and regulations for environmental management practice at the construction projects which has led to an increasing rate of illegal dumping activities and construction waste generation. Lastly, the prospect of the environmental management practice for construction in Malaysia is optimistic as the rapid development in construction technology, building materials and increase awareness to the community can overcome the challenges of implementing environmental management practice for construction in Malaysia.

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Conflicts of Interest

The authors declare no conflict of interest.

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