

## Implementing 3R Concept in Construction Waste Management at Construction Site

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### ABSTRACT

Nowadays it seems very important to manage different wastes in different parts of the industry. Most of the modern western countries all over the world set different regulations in order to decrease and also manage the amount of waste in different parts of their industries. However in the construction industry production of waste is unavoidable and no construction site is waste less. Malaysia has been considered as a very fast developing country which has several construction projects. It goes without saying that in such a country with high demand of construction activities the amount of the waste growing dramatically. Different types of the wastes in the construction sites can cause unlimited problems for the society and also environment. It seems crystal clear that in such a situation there is a great need of managing the wastes in this country. During the recent years, a new concept regarding the construction management waste has been proposed under the name of “3R” concept, which relates to three main concepts of waste management namely reuse, recycle and reduce. During the current paper “3R” concept and its applicability in the context of Malaysia has been discussed and some suggestions in this regard have been proposed. In the introduction section, the waste management in the Malaysian context has been discussed. Then Constructional type of the wastes has been reviewed, after that Managing wastes in the Malaysia has been reviewed, then different types of the waste in Malaysia presented, followed by how to do energy recovery by means of “3R” principles and finally how to implement energy recovery by means of “3R” principles discussed. Hopefully the content of this paper is beneficial for different people in charge with construction projects of Malaysia.

**KEY WORDS:** Construction industry, 3R concept, Reduces, Reuse, Recycle, Construction waste management, Malaysian construction waste management.

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### 1. INTRODUCTION

Solid waste is explained as thrown off and unwanted material. Global warming and environmental problems are caused by wastes. Wastes are categorized into several types such as commercial waste, solid waste, construction waste and medical waste. Waste management is currently one of the most important factors in each society that should be paid attention. In traditional concept waste has no value and is unavoidable (Shen et al., 2002). Growing population and rapid urbanization in each country, increases solid waste products. Basically, generated solid waste is related to the population’s lifestyle and the economic situation in which the people are engaged. Most of the people’s concept originated from this idea that it is the liability of the government to handle the waste cycle (Hezri, 2010). Each local authority should keep its area clean; for example, factories, municipalities and some other organizations have to offer some methods about the participation of people or other propose innovations for Reduce, Reuse and Recycle waste. Management method of generated waste is affected by solid waste generation(Serpell, 1998). Since the encouragement to response to sustainable development, traditional waste management system has changed to a new waste management system; that is, from singular selection support on the places of the waste to more concepts of waste arrangement which is called 3R concept. Reducing waste, Recycling and Reusing resources are three components of 3R concept. Reducing means choosing and utilizing factors to decrease the produced waste value. Recycling means using waste as a resource. Reusing involves using the waste that still has useable situation. Reduce is the most important factors compared to Reuse and Recycle for minimizing the waste (Yoshida, H. 2007).

In different countries all over the world energy has been considered as a very vital factor for different social and also economic developments in a country. Different people are concerned with the concept of the energy in their daily life. Malaysia as country which is located in the Equator area has different resources of renewable energies which have not been used yet namely solar, hydro, wind and also biomass. In the field of construction usually three different kinds of energy are concerned namely the energy that is used in the homes,

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embodied kind of energy in the materials, and finally inherent energy (Norman *et al.*, 2006). Usually energy in use relates to the type of energy that is going to be used by the inhabitants of the buildings like lights and heating the water. On the other hand embodied energy relates to the amount of energy which is essential for making the final product in the construction sites like gathering required raw type of the materials, producing and also processing the required materials in the site, carrying the materials to the site and also collecting different required items. And finally last category relates to the inherent type of energy in which, materials will have different combustion or different chemical procedures may happen which may release energy (Hammond *et al.*, 2008).

During the current study, researcher attempted to investigate waste management application in the Malaysian context. To this aim different construction waste sources and the way of its management in the context of Malaysia has been reviewed. Usually the carbon footprint relates to the Greenhouse Gases (GHG) that has been distributed in the air by different people, factories and also products (Rahman *et al.*, 2010). The primary components of the GHG in the earth atmosphere consist of vapour of the water, dioxide of the carbon, methane, nitrous oxide and also ozone (Kasbon *et al.*, 2010). The most important GHG relates to the Carbon dioxide (CO<sub>2</sub>) which has more than 50% of the Greenhouse consequences (Vujatovic & Lai, 2003). Nowadays in order to decrease the amount of wastes in the construction industry, especially in the context of Malaysia, different new approaches of waste management has been considered to be applied. Among them 3R concept has been recognized as the most effective approach. In this approach, three main elements regarding the construction issues namely reuse, recycle and reduce has been considered significantly, and in comparison with old methods of waste management it seems to be more efficient in the construction systems especially in Malaysia. In Malaysia, construction industry creates total amount of 54% of carbon dioxide in the atmosphere (IEA, 2008). In different steps of the construction related activities, CO<sub>2</sub> usually releases. In Malaysia between the years 2001 to 2007 the number of the units has been increased about 38% and many contractors prefer to use concrete in different building construction which has embodied carbon (Fujita, *et al.*, 2009).

Hopefully the results of the current study seem to be useful for a number of people who can benefit from the findings of the study. The scientific contribution of the paper is: 1. Different people in charge with construction programming activities in the ministry of roads and urban development of Malaysia can use the findings of the current study in order to manage and also control wastes in the construction sites, 2. Contractors and developers can use findings of the current study in order to decrease the amount of waste in their construction sites and also help environment to be clean and 3. Different researchers in the field of sustainability can benefit the findings for doing supplementary researches in this field in near future in order to help increasing construction wastes in the context of Malaysia and also other parts of the world.

According to Guthrie, *et al.* (1995) it seems very important to minimize the waste in the construction industry in order to have more benefits in the economics and environment. Different economic advantages of decreasing the wastes relates to the selling of the waste materials and also moving those materials from the construction sites with the lowest prices (Snook, K, *et al.* 1995). So contractors would have different completions with each other by decreasing the production fees and also gaining better reputation in the society. On the other hand not much contractors attempted to focus on environmental issues and using different methods in order to reduce the wastes in the construction sites (Shen *et al.*, 2002). As different contractors consider timing as the most important item in their projects, most of the time they are trying to their programs in the shortest duration of time rather than doing useful activities for saving the environment (Poon, C. *et al.*, 2001a) (Poon, C. *et al.*, 2001b). According to Gavilan, E & Bernold, A (1994) by supervision of different wasted materials in the construction projects we may reach to a high level of productivity in the projects and also we can decrease the time of the projects as well as increasing the safety issues. On the other hand if the waste in the construction projects increases, we may have speed reduction in the construction activities. According to Sustainable construction waste minimization usually relates to the different techniques or different acts that different people in charge with the construction activities do in order to reduce or omit wasted materials or recycling the materials for further uses (Chan *et al.*, 1998). According to Peng, *et al.* (1997) in order to manage the waste in the construction sites several different activities may be done by the people in the construction sites namely recycling wastes, firing wastes or even landfills them. But the following six steps regarding the waste management have been considered as the most important steps namely reusing the wastes, recycling the wastes, dung the waste, incinerating and also landfilling the wastes (Skoyles *et al.*, 1987). Among the mentioned methods three of them are the most practical ones namely reuse the wastes, recycle and also reduce different construction wastes. During the current study, researchers attempted to evaluate different waste management issues in the construction sites. The context of Malaysia, as a fast developing country has been considered and also different resources of waste has been reviewed. Additionally different methods for waste management in Malaysia especially 3R concept has been reviewed.

**2. Constructional type of the wastes**

According to the Begum (2010) increasing amount of construction waste production in Malaysia considered as an important factor in the context of Malaysia. In different parts of the Malaysia huge amount of construction wastes have been created due to the significant improvement of construction related activities in this country. According to Nasaruddin et al. (2008) several demands of housing caused different people in charge with construction projects to be aware of the construction wastes and they should consider increasing amount of construction wastes in the buildings.

According to Yahaya& Larsen(2008) unlawful dumping have been increased significantly during the recent years in the Malaysia. In the study which has been conducted by Rahmat& Ibrahim (2007) shows that in the district of Johor Bahru, 42% of the 46 unlawful dumping settings have been located. Another study which has been conducted in Pinang shows that lots of unlawful construction sites exist near the roads (Faridah et al., 2004). Several news have been reported recently that 30 tons of construction wastes have been carried to Bandar Hilir, Melacca and different construction problems have been caused in the 17 section of Petaling Jaya, these kinds of activities can cause several kinds of health problems for the people of that region(The Star, 2011). Seow&Mohamad (2007) believe that, usually contractors avoid putting their trashes in the lawful places and they mostly try to put them in the nearest distances to the projects in order to reduce the costs.

Faridah et al. (2004) studied about different types of construction wastes in the context of Malaysia, and categorized them into six main sections. The first type of the wastes related to the concrete which was 12.36% of the total waste, metal wastes was 9.62%, bricks wastes was 6.54%, plastics wastes was 0.43%, wood wastes was 69.10% and other types of the wastes was 2% of the total wastes. The results of the mentioned study indicate that wood has been considered as the most waste in the construction industry of the Malaysia.

According to Begum, et al. (2010) 38% of the whole wastes in the context of Malaysia relates to the construction and also demolition activities. By analysing different types of the wastes in the context of Malaysia, we may understand that metals in the construction wastes consists 45.5% of the total wastes with total amount of 803,193 tonnes while wood and paper comprises 37.7% with the total amount of the 665,539 tones. From the above discussion we can see that 83.2% of the recyclable, materials in the context of Malaysia relate to the wood, metal and paper, and special attention should be given to these materials and also their recycling procedure.

**2.1 Managing wastes in the Malaysia**

Construction waste management should be done after passing different stages. As it has been shown in Figure1, waste management should be done based on the hierarchy model which has been suggested by Penget. al., 1997. According to his recommendation, the process of waste management should be done by reducing, recycling and also reusing the trashes. Furthermore Wolsink (2010) has been suggested a hierarchy model for waste management which has been presented in Figure number two.

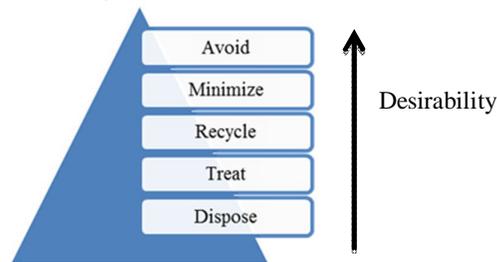


Figure1. Waste management hierarchy model

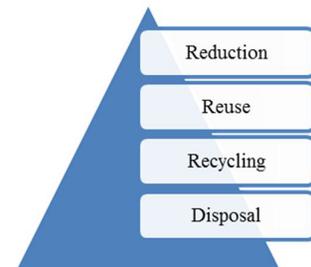


Figure 2. Wolsink waste management hierarchy model

According to the Ingenieur (2009) one of the most common approaches for the disposal of the construction wasted materials relates to the landfill dumping. In order to achieve better goals in the sustainable projects in Malaysia the people in charge should focus more on the sustainable issues in the context of Malaysia.

The current methods that the contractors are using for waste disposals are not in line with sustainable criteria that must be considered by the government of Malaysia. Additionally Malaysian contractors should be trained to reduce, reuse and also recycle wastes, before disposing them into the landfills (Periathamby *et al.*, 2009).

**2.2 Different types of the waste in Malaysia**

Based on the environmental quality report which has been published in 2005 the categorization and also quantity of waste in the context of Malaysia has been reported in table1&2.

Type of Industry	Quantity of wastes (Metric Tonnes/Year)	Percentage (%)
Electronic	12986183	23.7
Chemicals	12428557	22.6
Automotive/ Workshop	6725912	12.2
Others	5823160	10.6
Metals	5410002	9.9
Industrial Gas	4216114	7.7
Pharmaceutical	3323881	6.1
Petroleum	2328381	4.2
Wood Based	832094	1.5
Rubber& Plastic	553446	1
Printing &Packaging	263936	0.5
<b>Total</b>	<b>54891611</b>	<b>100</b>

Table1. Quantity of waste in the industry of Malaysia, 2005

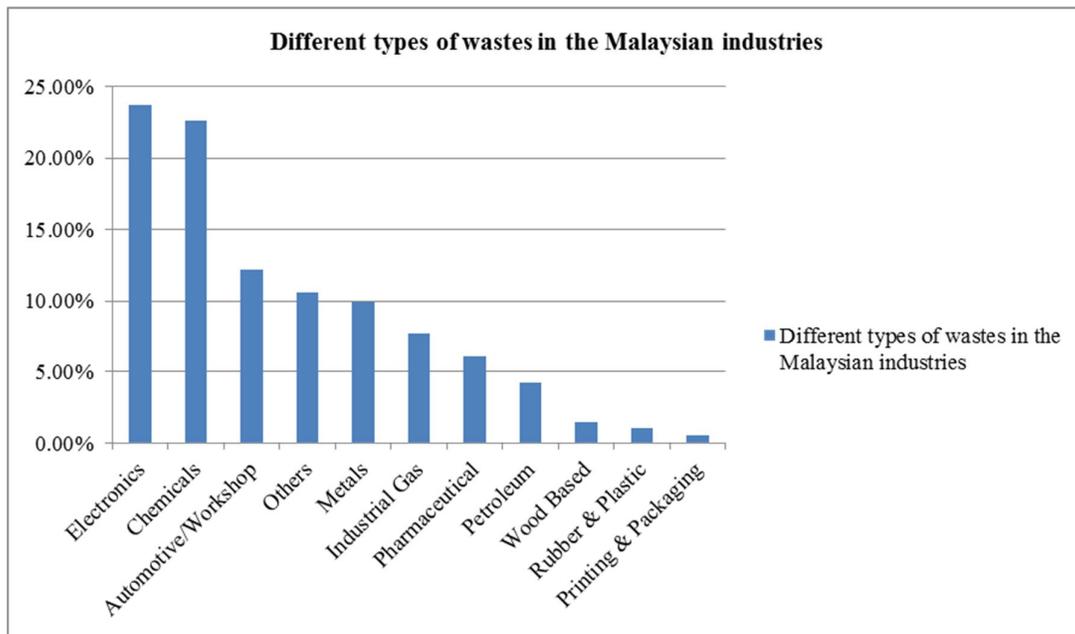


Figure 3. Quantity of waste in the industry of Malaysia, 2005

Based on the above table and figure 3 and through the percentages which has been shown above Electronics, Chemicals and Automotive have been caused high rank of the wastes in the industry of Malaysia, if we pay attention to the above table Metals by 9.9% of the total wastes has been considered as the fifth waste causing factors in the industry of Malaysia which directly relates to the construction industry and wood by 1.5% of the total wastes has been considered as the ninth waste in Malaysia. So the managers, contractors and administrators in the related ministries should pay more attention to the management construction wastes like wood and metal in Malaysia.

Waste Category	Quantity of wastes (Metric Tonnes/Year)	Percentage (%)
Oil & Hydrocarbon	12278305	22.4
Mineral Sludge	8600731	15.7
Dross/Slag/Clinker	8303059	15.1
Heavy Metal Sludge	7365484	13.4
Clinical	3750757	6.8
Batteries	3332411	6.1
Spent Solvent	2644997	4.8
Used Containers	2500932	4.6
Acid & Alkali	1788445	3.3
Mixed Wastes	1108668	2
Paper & Plastic	996884	1.8
Others	943176	1.7
Catalyst	657231	1.2
Ink & Paint Sludge	246517	0.4
Rubber Sludge	203115	0.4
Phenol/Adhesive/Resin	170899	0.3
Total	54891611	100

Table2. Categorization of the waste in the Malaysian industries, 2005

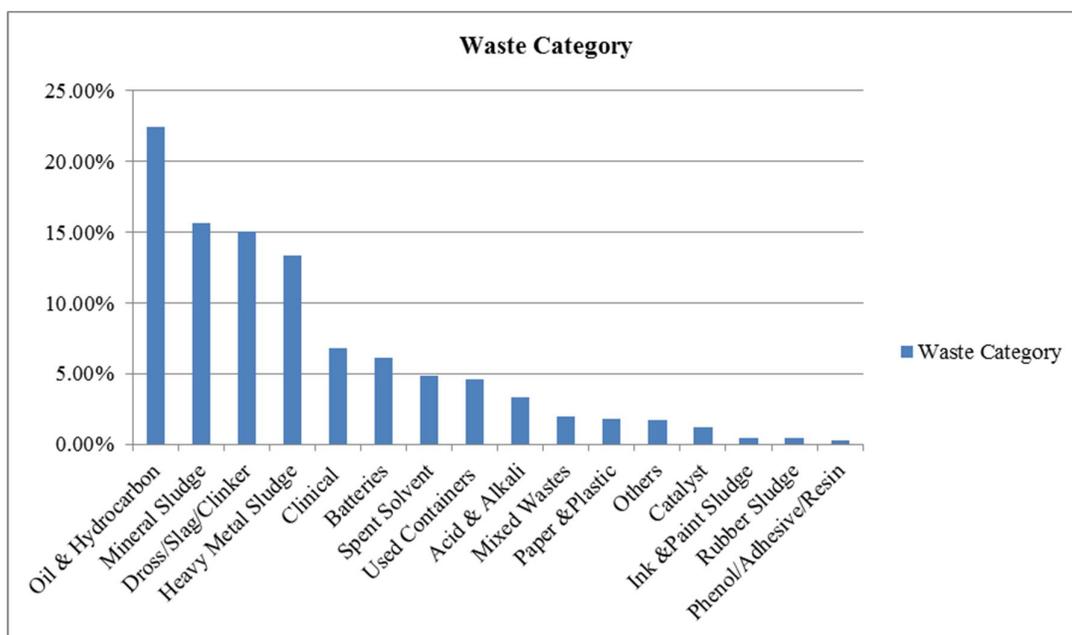


Figure 4. Categorization of the waste in the Malaysian industries, 2005

As it has been shown in the above table and figure, oil & hydrocarbon, mineral sludge and also cleaners have been considered as the high ranked pollutants in Malaysia. As it has been shown in the above table paper and plastic and also metal sludge have been located in the above table and both of them are used in the construction industry and it shows the importance of paying attention to the constructional activity wastes.

### 2.3 How to do energy recovery by means of “3R” principles

Shuanggui, et al., (2011) proposed a model for recovering the energy based on the 3R principles which has 5 stages that have been discussed in this section.

#### The foundation of “3R” principles

The concept of “3R” principle has been proposed in order to do some activities regarding the reducing, reusing and also recycling wastes in the construction industry. All different processes of construction projects involved namely designing, production and also manufacturing of the construction sites directly relate to the waste creation so it seems very essential for a green economy to follow “3R” principles in the construction projects. “3R” principles are the principles that are related to all parties concerned with construction management activities namely people, society and also natural resources.

## 2.4 How to implement energy recovery by means of “3R” principles

During the implementation of and also application of “3R” principles different people in charge with construction activities, usually should do some tasks for making balance between sustainable improvements and also different improvements in the environment. By using reuse, recycle and also reduce principles we can collect different scattered energies in the environment in order to achieve better sustainable buildings.

### *Reduce*

The term reduce has been used for decreasing the unnecessary type of the energy. In order to reduce different types of the wastes in the construction projects, we have to create good habits of energy use among different energy users especially in the construction industry field.

### *Recycle*

It seems very important for the construction activities in order to use recyclable materials in the construction activities. As an example by using cycling energy wasted heat of air conditions can be used for heating home and nowadays they made it possible do some creative activities in the construction sites.

### *Reuse*

Usually the term reuse relates to converting energy to another type, in different steps of the constructional activities. Generally we can change the energy from one type to another type. As an example we can collect the waste materials in the construction sites and change them to another type of energy in the related factories.

## 3. Conclusion

During the recent years in many developed countries all over the world lots of activities have been done in order to manage different types of the wastes in different industries. Many countries in the Europe and also United States do several activities in order to motivate the people in charge with construction projects to manage their wastes. Also in different countries, different contractors are obliged to use recyclable materials in their buildings and also the people who are using those materials in their buildings have been exempted from different taxes and those who do not use recyclable materials will be penalized by the government in different ways. Malaysia has been considered as a very fast developing country and with increasing demand of home. As it has been mentioned in this paper, the amount of the wastes in the construction sites of the Malaysia have been increased dramatically. It goes without saying managing different types of the wastes in the context of Malaysia seems to be important for different parties of construction industry in this country. It is a twofold concept by managing the wastes, environment of the country would be kept clean and on the other hand it has several advantages for the economic situation of this country. As it has been explained in this paper by means of “3R” concept namely recycle, reduce and reuse principles different advantages would be gained for the Malaysian society and government. Hopefully the content of the paper seems to be beneficial for different people namely contractors, developers, Malaysian citizens and administrative executers in the ministry of way of Malaysia to read the article and incorporate the principles in their jobs.

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