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Review of Solid Waste Management Practice, Handling and Planning in the Construction Industry

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The building and construction industry is a major contributor to the source of national economy. However, inappropriate construction waste management lead to various problems such as illegal dumping along the roadsides, demolition waste and disposal of construction at landfills that Malaysia is facing serious shortage of landfill space and recently the issue has become more serious throughout the country, which these have caused major government sources and environmental issue. Solid waste management is one of the environmental issues which always been a concerned to most governments. In urban areas, 46% of the population in the statistics that shows the world population has reached six billion. In 1997, generation of the municipal solid waste was about 0.49 billion tons around the globe with an estimated annual growth rate of 3.2-4.5% in develop nations and 2-3% in developing countries. The characteristics of solid waste generated were changed due to the rapid urbanization and industrialization.

***Keywords**: solid waste management, construction, disposal of waste, building*

1. Introduction.

What is solid waste? It is from all the wastes that is arising from human and animal activities that are usually solid and that are deserted as useless or unwanted. Nonetheless, those waste material can be reused, recycle and if they can be managed properly it can be the resource of the next industrial production or energy generation [1]. Any human being in this planet will produce tremendous amounts of waste which has become the most indicative issues of our time and most human want to protect their environment and public health which preserved their lifestyle. In order to reduce the growths of amount of waste and reused it or dispose of it safely and economically have been searched by industry, private resi-

dent and state legislatures. For many years, there are more laws dealt by the state legislatures with solid waste management.

In the primitive years, it was not a substantial problem regarding the disposal of human and other waste because of the small in population and the large amount of land untaken for the assimilation of wastes. While, emphasizing recycling the energy and fertilizer values of solid wastes was being placed, the farmer in obsolete times probably made a bolder attempt on that. In the primitive, indications of recycling still be seen and yet practical, many of the developing countries where the farmers uses fuel or fertilizer values from recycling those solid wastes as an agricultural practices [2].

In the era of technologies, generation, onsite storage, collection, transfer and transport, processing and discovery, disposal of wastes are the elements that are affected towards the solid waste management. Economics, urban and regional planning and the social sciences are also involves with engineering principles that act as the multidisciplinary activities in solid waste management. In the earlier period, a traditional engineering method was frequently being neglected or ignored public attitudes and concerns. Numerous important areas have been stress to the results advance of technologies. Environmental constraints have been a great emphasis while the public health and economics linger at the primary considerations. The disposals of solid waste have been analyzed in relation to resources depletion.

When the times humans first began to assemble in tribes, villages and communities and the accumulation of waste become the significances of life, the problem of solid waste have been found at the time. The factors that led to the breeding of rats, that carrying fleas which carrying bubonic plague are from the scattering of food and other solid wastes in barbaric towns and lastly the habits of throwing wastes into unpaved streets, roadways and vacant land [3].

It is quite clear that public health is related with the improper storage, collection and disposal of solid wastes. Inadequate construction and poorly maintained housing, in food storage facilities, rats, flies, and other disease vectors breeds in open dumps are shown by the public health authorities. Indecent management of solid wastes are always been contributed on the ecological occurrences such as water and air pollutants [4]. For example, contaminated surface waters and ground waters are the affected from the liquids dumps and poorly engineered landfills. Reducing the influences of unwanted residues in the atmosphere, waterways or on the land, nature has the ability to dilute, disperse, degrade, absorb or otherwise the ecological imbalances occurred where the natural assimilative capacity have been surpassed.

2. Development of Solid Waste Management

Human and animals have been using the resources of the earth to support life and dispose of wastes since the days of primitive society. Many technologies and disciplines is involved regarding the multifarious of solid waste management.

These compromised technologies with the control of generation, handling storage, collection, transfer, transportation, processing and disposal of solid wastes.

Solid waste management includes all administrative, financial, legal, planning, and engineering functions that are involves with solutions to all problems of solid waste. Such fields as political sciences, city and regional planning, geography, economics, public health, sociology, demography, communications and conservation are in relation to the complex interdisciplinary of the solutions [5].

To describe the characteristics of the different classes of refuse, and to draw attention to the fact that, if a uniform method of nomenclature and record of quantities handled could be kept by the various cities, then the data obtained and the information so gained would be a material advance toward the sanitary disposal of refuse. Such uniformity would not put any expense upon cities, and direct comparisons and correct conclusions could be made for the benefits of others.

Dumping on land, dumping in water, plowing into the soil, feeding the hogs, reduction and incineration are the most commonly known methods of the final disposal of solid wastes. Although, the methods used not all are applicable toward the types of solid wastes. For foods and street sweepings the plowing into the soil are used whereas for food wastes the feeding the hogs and reduction was specifically used [6].

Dumping on Land - The reason was that it is easier to leave those wastes on land rather than drag or bring all the wastes to the edge of the town, in urban communities it is became the common method for disposal and common practice to do an open burning to these dumps. Open dumps can lead to attraction and growth of unwanted insects and can spread diseases. Public health authorities responsible for the control of solid wastes in order to overcome the problem occurred.

Dumping in Water- The consequences of dumping on water was all recognized by using this method in some coastal cities. The defacement of Coney Island Beach in New York City has become one of the case point. Nonetheless, in United States Supreme Court it was finally prohibited in 1933 and it was continued along the years.

Plowing into the Soil- food wastes and street sweeping was carried out by using this disposal method because of the high demand of land necessity and in the circumstances that food wastes had to be separated from other wastes, in the 1970's it then be rekindled due to unaccustomed widely [7].

Feedings to Hogs- Fogs in urban areas were frequently been fed close to farms, such as Los Angeles County and in mud flats of New Jersey. Sadly, contaminated pork scraps was feds to the hogs in recycled food wastes where the trichinosis was widespread because of this practices which affected other hogs and other people who ingested their meat. In the first third of this century, 16% from the United States population was infected by consuming the pork that was uncooked from hogs fed on food wastes. However, the practice was kept on going into the middle half of this century. In United States they are still used the method

in particular areas, but it is in under controlled environment of cooking and feedings.

Reduction Food Waste Reduction- A rendering process was a method that is no longer used by which the raw wastes were treated to separate them into solid and liquid portions and contained greased can be recover in one or both portions. Pomades and the cheaper grades of perfumery as well as wagon were benefitted from the recovered grease.

Incineration- Back in the earlier days, incineration was then considered as the final method of disposal, now considered as either volume reduction or an energy conversion processes.

3. Functional Elements of a Waste Management System

In former times civilization, the problems that being faced along with the solid waste management are more convoluted due to quantity and diverse changing in nature of wastes, the development of extensive urban areas, the funding curb for public services in many well-built cities, the controlling of technology, and the evolving limitations in both energy and raw materials. As a outcome, the fundamental aspects and relationship immersed can be classified, altered for uniformity of data, if then the solid waste management are accomplished. Waste generation, waste handling, separation, storage, processing at the source, collection, separation, processing, transformation of solid wastes, transfer and transport and lastly disposal, this is the six functional elements that have been group from the point of generation to final disposal which is associated with the management of solid waste. By doing some research and studies of those functional elements individually, it can be explained throughout Figure 1 to 6 [8].

Figure 1. Waste Generation

Figure 2. Waste Handling and Seperation

Figure 3. Collection

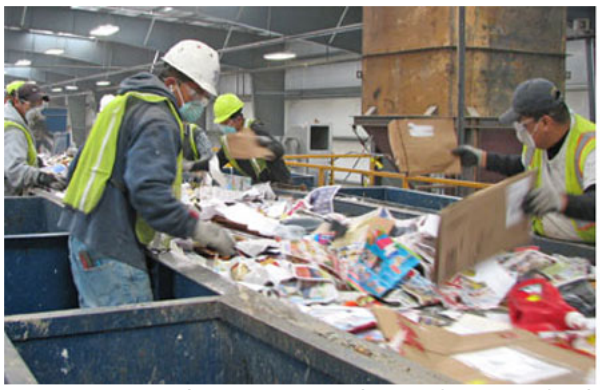

Figure 4. Separation and Processing and Transforming of Solid Wastes

Figure 5. Transfer and Transportation

Figure 6. Disposal

The purpose in the making of engineering differences, analyzes and evaluations needed to be develop and relationships that is quantifiable. Separation of wastes is the important factor in functional elements in order to consent on the development of framework within where impacts of proposed changes and future technological advancements [9].

4. Waste Generation

Waste generation include those activities in which material are identified as insignificant value and are either left or collected together to disposal. For example, a water bottle is usually considered to be of little further value to the possessor once the water is drank, and more often being left or thrown away, especially out-

doors. An identification step is an important note in waste generation and that this step different from each individual waste [10].

Nowadays, such activity that is uncontrollable although these generations of waste will be more controlled in the future. In states where waste diversion goals are set by law, and must be met under threat of economic penalty, it is necessary to put in place a manifest system to monitor waste diversion. Solid waste managers are not control those sources of reduction, although at the present time it is included in system evaluations as a method of limiting the quantity of waste generated.

4.1. Waste Handling & Separation, Storage & Processing at Source

Waste handling and separation include the activity that is correlated with waste management until they are consigned and located for collection in storage containers. Handling too comprehends with the movement of stacked containers until the point of collection. Handling and storage of solid waste at the source are important step in separation of waste component. For example, from the viewpoint of material characteristics and revenues from the sale of recovered materials, the best place to isolate those waste materials for reuse and recycling is at the source of generation [11].

4.2. Integrated Solid Waste Management

Solid waste management defined as the selection and applications of appropriate techniques, technologies and management programs to accomplish particular waste management objectives and goals. Integrated solid waste management incorporate with the direct impacts take into the transportation, collection, treatment and disposal of waste and indirect impacts such as the use of materials and energy outside the waste management system.

Hierarchy of integrated solid waste management can be used to grade measures to implement programs within the community. Based on U.S. Environmental Protection Agency (EPA) there are few elements that can be consider in the process of solid waste management such as source, reduction, recycling, waste combustion, and land filling. The local communities have been working and consulted by the local authorities in order to achieve commonly agreed to the outcomes for the facilities which every half hour of the major target was atmospheric emissions were monitored and transmitted to the local authorities. Whereby it was enabled a quick and fast response to excessive emissions and incentives were provided in order to not exceed the emission levels. TKS has been channeling waste heat from its operation to the district-heating network where it have been enhanced during the interrelationship with local community which combustion of fossil fuel and the resultant air emissions can be saved. IWM plan was used to minimize the water consumption and solid materials [12].

As a widest perspective towards hierarchy of integrated solid waste management, the ISMW programs and system should have cultivated in which the elements are interrelated with each other. For example, yard waste collection can be separated and used to affect positively the operation of a waste-to-energy combustion facility. After a maximum amount of recycling has been achieved then the waste transformation can only be considered.

There are other efficient ways than just the disposal options; IWM enables the waste generators to utilize their waste streams more efficiently. There is bigger scope for users to fully integrated media, agents and tools to offer a waste management system that diminishes the need for new materials, utilizes energy more proficiently; less emissions production thus has a lower environmental impact. Improvement of the sustainability can be achieved by considering applying the integrated solid waste management to a system. The identification and inclusion of appropriate stakeholders is one of the important issues in implementing of an integrated solid waste management. In order for the IWM to be success, it requires a broad participation. It means variety of things in different societal contexts, all of which are works of a wider, more complex picture [13].

Environmental concern increasing in the effective and efficient management of solid waste generated from these complexes. Environmental and resource management have been one of the holistic approaches in integrated solid waste management, which are emerging from applying the concept of sustainable development. In order to handle all materials in the waste stream in an environmentally effective, economically affordable and socially acceptable way where it takes an overall method to solid waste management and combines a range of collection and treatment approaches. Therefore, it must be advocated by the industrial park management facing increasingly severe solid waste challenges

4.3. Planning for Solid Waste Management

It is a complex issues when dealing with the decision making process over waste management where environmental influence, technical aspects implementation and operating costs needs to be evaluated and suitably taken into account which each specific treatment and disposal option as well as the social implications. The only way is to generate with a suitable combination of management tools in the long term planning at the local, state, and even regional level. It must direct to both environmental concern and economic limitations. A good data is essential in planning a solid waste management where the facts have long been recognized in fields such as transportation and health-care planning [14].

The process always includes the accurate and inaccurate or missing data, professional evaluation and changing public thoughts which sometimes it is followed by preconceptions for against specific waste management solutions, usually based on perception rather than objective scientific evidence. Due to the developing generation and complexity of municipal solid waste and the far reaching differentiation that constantly occurred in their management were become increasingly compli-

cated the framework in the last decades. Within this complicated framework, the decision making does not appear adequately supported by the existing regulations.

There are guidelines that should be embrace by the planners. First of all, it is crucial to manage a plan to the longer term. A symptom of the predicament conditions in which the new facilities are simply not being sited is one of the instability of recent market prices. Current prices are significantly reduced from their highs as new capacity options have emerged were the examples that have already existed in those locations. Second, all costs must reflected in each option which is important for the planners to ensure it. Sometimes there are hidden costs in municipal accounting practices. For example, the machinery department must purchase all the machineries while other department pays for the real estate and so on. It is essential for accurate accounting. Third, short term cost savings brought to skimping on environmental controls with possibility greater liability down to the road. Especially for recycling and composting facilities, it is always better to do it right for the first time as well as for incineration facilities and landfills. Lastly, planners should ensures that the availability of efficient facilities permitting waste facilities using recycled materials input and for facilities that needs permit change to implement source reduction [15].

The basic of an extensive utilization of materials and substance flow analysis are develop on the waste management planning which a series of life cycle assessment studies are taken into account on the solid waste management system and the exact technologies options. Although, the results that have been obtained were just part of the input data to the decision making process, an approach needs to be present where it is able to compare the alternatives waste management technologies and scenarios which varieties of economics and social aspects needed to be taken further in actions. In order to complete the set of input data, a future work need to investigate all the possibilities for the scenarios to be selected and assessed by the proposed approach [16].

By sending the unsorted waste, the importance of reduction in the requirement of landfill volume need to be achieved waste reduction occurs through design, manufacture, and packaging of product with minimum toxic content, minimum volume of material or a longer useful life. In order to be familiar with the program objectives and goals such as diversion goals are being achieved it is require for the monitoring and evaluation to be continuous where it were being implemented on integrated solid waste management.

Planning becomes more important due to the solid waste reduction and management become more complex and a management option becomes more sophisticated. It is complicated and difficult in planning for the integrated solid waste management. It constantly changes for the infinite numbers of combinations and interactions of programs. Due to the fact that the integrated solid waste management strategy is more appropriate to refer as the process of the product rather than planning of the integrated solid waste management. It is important to recognize with the importance process of planning itself in the development of a worth-

while widely acceptable and applicable plan. All of the approaches, actions and strategies that the plan purpose, it is must be clear, explicit and logical rationale.

5. Generation and Types of Solid Waste

Solid wastes is defined as all solid or semisolid unwanted or materials that have no value to maintain it. It is fundamental in relation to the activities that cover the management of these waste materials. It is difficult to know the amount of solid waste produced in the construction site which the variables are grouped such as dirt, stones, concrete, bricks, plaster, lumber, shingles and plumbing, heating and electrical parts.

Annually in construction industry only had generates 25% of virgin wood and 40% of raw stone, gravel and sand globally. There are different types of construction solid waste other than solid wastes such as rework, material double handling, scheduled delays, commuting within the job, waiting decision and poor constructability. Construction wastes can be classified into two standardization components which are [17]:

1. Time Waste: Waiting periods, stoppages, clarifications, variation in information, rework, ineffective work, delays in plan activities and abnormal wear of equipment.
2. Material Waste: Cooperation of ordering, over-production, wrong handling, wrong storage and manufacturing defects.

Burning of solid wastes produces more than 200 different dioxin compounds and released a huge amount of CO_2 emission. Other groups such as demolition, wreckage and package can be classified as the construction process.

Table 1. Percent distribution of municipal solid waste from different sources in KMC

Sources of waste	Percentage (%)
Household waste	34.20
Street Sweeping	22.80
Institutional waste	6.32
Commercial and market waste	36.37

Source: Master Plan on Solid Waste Management.

Table 1 shows the amount of MSW generated from various sources in Kolkata Municipal Corporation. Residential areas, commercial and market areas, and institutions are the major factors of MSW in the KMS areas. Construction and demolition waste were considered as the top concern in Greece. There are several places that commonly C&D wastes can be found which is demolish and clear sites where sites obtained infrastructure or structure that going to be demolished, although in a short term there is no new construction were planned and other were prior to the erection of new ones. Furthermore, renovation sites, undeveloped sites, road

built sites and also refurbishment sites are also generation of C&D waste in Greece. C&D waste can be characterized as hazardous waste. The most frequently cited is asbestos-based insulation due to the toxicity and flammability. Paint and plastics were the least amount of material found in C&D waste. Wastes that are originally contain lead, tar, asbestos, paint and preservatives residue can be the factors in C&D hazardous waste material. Furthermore, materials becomes hazardous where it was a direct results of the environment and also if the C&D wastes are contacted with the hazardous material or mixed with them [18].

Solid waste was becoming a critical issue in China whereby 10% of industrial waste and 15% of municipal waste increased per year. Tianjin Economic Development Area is a special development zone in which can be classified as an outer suburban estate with comprehensive functions. There are 99,800 tons of industrial waste and 32,000 tons of municipal waste which the total amount of 132,000 tons of waste produced in China in 2003. The flow of solid waste within TEDA can be explained through Table 2.1 where 60,000 tons of industrial waste is reused and recycled which the 42,000 tons of waste are recycled or reused within one company or other different tenant companies and 18,000 tons will be collected, treated and will be sent out to the park for reuse and recycle by licensed recycling companies [19]. Furthermore, 35, 000 tons of waste will be collected and disposed to the landfill which 20,000 tons still have the ability to be reused or recycled and Environmental and Sanitation company were the one handling the transportation. Local scavengers will collect the 40,000 tons of wastes while 18,000 tons of municipal waste will be sent to the landfill including the 13,000 tons of organic waste suitable for composting and 5000 tons reusable pr recyclable waste, accounting for 40% and 15% of the total amount of municipal waste respectively which corresponds to 9.7% and 3.7% of the total amount of solid wastes produced in TEDA.

Reliable data were very important regarding waste generation in order to design a waste management planning which influence the factors on waste generation and forecasts of waste quantities. Information about important impacting elements is crucial for evaluating the outcomes of changes when in general conditions such as economic system and demography domestic heating system, approach measure such as expanding the rate of home fertilizing the soil on future waste amount. Along these lines, conjecture models should incorporate various elements and expectations according to social and economic changes. Urban or municipal solid waste is usually explained as the waste that is produced from human settlement small industries, commercial and municipal activities. Malaysian economy has been increase rapidly, the increasing of population as well as the influx of foreign workers which also contribute to the increasing of solid waste generation. Agricultural activities that is generate solid wastes such as crop residues and animal excreta need to extra attention for disposal as it is rich organic matter and recyclable plant where it can be useful for supplying nutrients to plants after bio-processing improve the physic-chemical and biological properties of soil and enhance its fertility.

It is important part of the municipal solid waste stream for household waste. For the last few decades, MSW has been increased several times in developing countries. The important factors of this biggest growth in MSW quantity in developing cities of Asia and Africa where rural migrants led to the high population growth in urban areas, changing lifestyle in urban population, economical growth and social improvement in urban areas which are variety of wastes of different chemical and biological nature in household waste due to it is heterogeneous type of stuff. For example, biodegradable, non-biodegradable, biologically contaminated hazardous type, solid, semi-solid, inert and etc. informal practices of reuse or recycling of household waste is in practice in many parts of the developing countries. The household wastes are generally lower in developing countries than developed nations mainly due to the segregation of recyclable items from household wastes. It was noticed that few reusable or recyclable things such as daily papers, cardboards, woody things, plastics holder, vacant refreshment and wine bottles, metal holders and etc, that is generally isolated by the households for the reason for offering to street hawkers or waste retailers in the business sectors. Biodegradable stuff was the biggest component in household wastes based on the study that have been made in Dehradun city of Uttarakhand regarding the solid waste generated from households where it is mainly contain of vegetable or food waste and paper waste. The part of reusable or recyclable things in household wastes was similarly less than MSW composition of other metro/little urban areas of India [20]. It could be attributed because of in-house screening of recyclable or reusable waste articles from household wastes. Thus, the household wastes which spans to secondary wastes collections points does not contain a good amount of such items of reusable or sellable values such as plastic, metals, glass containers, cardboards, fresh paper and etc. the study also revealed that inadequate facilities at secondary waste collection points in majority of blocks or colonies in the city have been making a few wellbeing and natural contamination issues. The greater parts of segments of household waste are of biodegradable nature accordingly can be efficient for era of included worth items such as fertilizer/excrement, and bio-gas for practical urban environment advancement and area rebuilding program.

Malaysia have an overall waste composition where it was dominated by municipal solid waste (64%), industrial waste (25%), followed by commercial waste (8%) and 3% consist of construction wastes ((EA-SWMC), 2009). Municipal solid wastes are disposed at landfills which also can be recyclables about 80% and furthermore, under the class of municipal solid waste, the commitment of household waste is the most highest among sources comprising of recyclables almost 70–80% of aggregate solid waste generated as discovered set in the landfills.

Household is one of the fundamental essential sources of municipal solid waste in Malaysia, other than institutional and business waste. Municipal solid waste by and large comprised of around 20 distinct classifications which are food waste, paper (mixed), cardboard, plastics (rigid, film and froth), material, wood waste, metals (ferrous or non-ferrous), diaper, newsprint, high grade and fine pa-

per, natural product waste, green waste, batteries, development waste and glass; these classifications can be assembled into organic and inorganic. Despite its arrangement or type, wastes are essentially dumped in an open zone of ground with no endeavor for recovering or recycled.

Increasing in economic growth and business activities, it will accelerate the daily generation and volume rate of municipal solid waste. Collecting, processing and transmitting waste were the objectives for MSW in Kuala Lumpur which it not really can be recycled into the location or the last shelter system. The solid waste total in 2001 is 2,500 tonnes per day and equal to 912,500 tonnes in a year based on Kuala Lumpur State Territory [21]. The average total of solid waste produce by a person is 1.7kg per day where there are 1.5 million population estimated. Solid waste that has been gathered then transported utilizing three sorts of lorries and roll-on-roll-out lorries. Solid waste generated from the whole region of Kuala Lumpur state domain picked and sent by lorries owned by the private contractual workers such as the Alam Flora Sd. Bhd. to Taman Beringin exchange station in transfer station, the entire municipal solid waste and compacted to encourage the move into bigger lorries which then transfer to Bukit Tagar landfill. According to Board of Government of Kuala Lumpur, the composition of municipal solid waste should be aware of the condition where the plastics components in its total solid wastes at Kuala Lumpur in a high level of composition and it takes a lot of time to be degradable natural it needs to take a further actions in order to reduce the possibility of plastic mountain in Kuala Lumpur city area at the next few years.

6. Summary

Economic growth, higher industrialization, rise in population and higher standards of living are always associated with the increasing of waste generation. Rapid increase in waste generation, the lack of effective and sustainable waste management strategies have always been the constant problem in SIDS which can be classified in four main characteristics which are institutional, financial technical, and educational amongst others. The challenges that involves in generation and separation of solid waste are most of the people need to be influence or attract to the aware campaign in order to segregate waste due to their environmental concern and the need to participate in solutions. Furthermore, the awareness of citizens determines the efficiencies of the separation of waste and the impacts of waste management system by municipal leader in the city. The availability of equipment and machinery to manage and recycle waste plays a major role and the key factors that promote separation of waste at the household level.

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