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Importance of Civil Engineering in Recycling of Waste Products

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Abstract: Civil Engineering is the important aspect of life since the beginnings of human existence. The oldest practice of civil engineering may have commenced between 4000 and 2000 BC in Ancient Egypt and Mesopotamia (Ancient Iraq) when humans started to live in civilized society, creating a need for the construction of shelter. Civil Engineering is the second oldest branch after Military Engineering. It is also useful to utilize various waste materials to recycle them. The paper is based on the comprehensive review of available literature on the construction materials including different kinds of solid wastes in construction material and in land filling, use of waste water in irrigation and in production of mass concrete and use of waste plastic materials in pavement construction.

Keywords: Civil Engineering, solid wastes, water wastes, plastic wastes, recycling.

1. Introduction:

Environmental pollution is the biggest problem associated with modern industrialization, urbanization and rise in living standards of people. For developing countries, industrialization was important and very much important for the economical growth of country. However, industrialization has also caused serious problems relating to environmental pollution which is one of the biggest problem of any country. The wastes like solid waste, water waste needs a specific method of recycling or disposing. Therefore, wastes seem to be a by-product of growth. The country like India has an ill afford to lose them as normal waste. On the other hand, raw materials are required for industrial production; the non-renewable resources are dwindling day-by-day. Therefore, efforts are to be made for controlling pollution arising out of the disposal of wastes by conversion of these unwanted wastes into utilizable raw materials for various beneficial uses. The problems relating to disposal of industrial solid waste are associated with lack of infrastructural facilities and negligence of industries to take proper safeguards. The large and medium industries located in identified (conforming) industrial areas still have some arrangements to dispose solid waste. Industries generating solid waste have to manage such waste by themselves and are required to seek authorizations from respective State Pollution Control Boards (SPCBs) under relevant

rules. However, through joint efforts of SPCBs, local bodies and the industries, a mechanism could be evolved for better management.

2. Types of wastes and their disposal problems:-

There are basically three major types of wastes creates lots of problem on their disposal. So to overcome this problem some specific recycling methods are required which are discussed in further section. The wastes are:-

i) Solid wastes.
ii) Water Wastes.
iii) Plastic wastes.

i) Solid wastes:

The major generators of industrial solid wastes are the thermal power plants producing fly ash, the integrated Iron and Steel mills producing blast furnace slag and steel melting slag, non-ferrous industries like aluminum, zinc and copper producing red mud and tailings, sugar industries generating press mud, pulp and paper industries producing lime and fertilizer and allied industries producing gypsum[1]. From Civil Engineering point of views the solid wastes are generated from stone cutting units, dismantling of buildings etc. Some of the quantities of solid waste in India are provided by National Waste Management Council- Ministry of Environment & Forests-1990/1999) are tabulated below:-

S.No	Name	Name Quantity (million tones per annum)	Source/Origin
1.	Agro-waste (organic)	50.00	Baggage, rice and wheat straw and husk, saw mill waste, ground nut shell, jute, sisal, cotton stalk, vegetable residues[2]
2.	Industrial waste (inorganic)	68.8	Coal combustion residues, steel slag, bauxite red mud, construction debris[4]
3.	Mining/mineral waste	4.5	Coal waste; mining waste tailing from iron, copper, zinc, gold and aluminium industries
4.	Non hazardous waste	65	Waste gypsum, lime sludge, lime stone waste, broken glass and ceramics, marble processing residues, kiln dust
5.	Hazardous waste	7.2	Contaminated blasting materials, galvanizing waste, metallurgical residues, sludge from waste water and waste treatment plants, tannery waste Boards

Table 1 : Solid wastes with their source of origin

ii) Water wastes:

Wastewater is any water that has been adversely affected in quality by anthropogenic influence. Waste water is mostly occurred from industries and in the form of sewage obtained from cities which is sometimes referred as municipal waste water. Municipal wastewater is usually conveyed in a combined sewer or in partially combined sewer including rain water, and treated in a wastewater treatment plant. Treated wastewater is discharged into receiving water via an effluent sewer. If wastewater directly disposed into any stream or river, it will disturb the whole aquatic life of river as well as polluted the particular region. This water may be treated and should be recycled which is discussed further.

iii) Polymer wastes:-

A plastic material is any of a wide range of synthetic or semi-synthetic organic solid polymers that are mostly indestructible. Plastics are mostly organic polymers of high density and mass, but they often contain other substances like inorganic matters to impart other desirable properties like color and strength. The waste generated from plastic has biggest disposal problem because it cannot decomposed easily, so recycling it is the only method to reduce the concentration of waste plastic which is discussed further.

3. Role of Civil Engineering in recycling or re-use of waste materials:

As we know that Civil Engineering is the oldest branch in engineering field. The above mentioned materials are frequently used in manufacturing of construction materials, land filling and in irrigation projects. The materials mentioned in **Table no. 1** are used in manufacturing of bricks; cement etc. similarly solid wastes are quite useful in land filling. Similarly waste water treatment is the oldest subject in Civil Engineering field and frequently used in irrigation and in manufacturing of mass concrete. Similarly plastic wastes are quite useful construction of flexible pavement. By using these recycled materials problem of disposal is overcome and economy is also maintained.

4. Use of Solid wastes in Constructional material:

The recycling of solid wastes in civil engineering applications has undergone considerable development over a very long time. The utilization of fly ash, blast furnace slag, phosphogypsum, recycled aggregates, red mud, Kraft pulp production residue, waste tea, etc., in construction materials shows some examples of the success of research in this area. Similarly, the recycling of hazardous wastes for use in construction materials and the environmental impact of such practices has been studied for many years (Cyr et al., 2004). The recycling and utilization potentials of different kinds of solid waste are shown in Table 1. In fact, there is a great scope for setting up secondary industries for the recycling and use of huge solid wastes in construction materials, as can be understood from Table 1. The uses of different types of solid waste in construction materials are shown in **Table 2**.

S.No	Name of Waste	Type of Waste	Use in material
1.	Fly ash, bottom ash, rice husk ash, palm oil fuel ash, organic fibers	Agro-industrial	Aggregate, concrete, supplementary cementing materials, blended cement, bricks, tiles, blocks, particle boards, insulation boards, cement boards, wall panels, roof sheets, reinforced polymer composites
2.	Phosphogypsum, waste glass, granulated blast-furnace slag, waste steel slag, rubber tire	Industrial	Fine and coarse aggregates, blended cement, concrete, bricks, blocks, tiles, ceramic products
3.	Quarry dust	Mining/mineral	Fine and coarse aggregates, concrete, bricks, tiles, blocks, surface finishing materials.
4.	Construction and demolition debris (concrete rubble, tiles, waste bricks, etc.)	Industrial	Fine and coarse aggregates, concrete, bricks, blocks, sub-base pavement materials.

Table 2 : Solid wastes used in manufacturing of constructional materials.

5. Use of Plastic waste in construction of Flexible pavement:-

In general there are two types of road rigid pavement roads and flexible pavement roads. For rigid roads material used is concrete and for flexible roads bitumen is used. In India mostly the flexible pavement roads are available. And for economical road construction new techniques, new material is used. The significant variation in daily and seasonal temperature demand improved road characteristics. Any improvement in the property of the binder is needed. Bitumen is a useful binder for road construction. Different grades of bitumen like 30/40, 60/70 and 80/ 100 are available on the basis of their penetration values. It also improves the strength of flexible pavement but it has low resistance against water. A common method to improve the quality of bitumen is by modifying the rheological properties of bitumen by blending with organic synthetic polymers like rubber and plastics. The softened plastics have a binding property. Hence, the molten plastics materials can be used as a binder and/or they can be mixed with binder like bitumen to enhance their binding property. This may be a good modifier for the bitumen, used for road construction [4]. This method is quite useful because disposal of waste plastic is a major problem. It is non-biodegradable and burning of these waste plastic bags causes environmental pollution. So by using plastic in flexible pavement, a considerable reduction in the plastic waste is occurred.

Fig. 1 Shredded plastic waste

6. Use of Waste Water :

As we know that waste water treatment is included in public health and engineering field of civil engineering. In this method waste water is initially collected and treated to reduce its harmful effects. So that it may be easily disposed off. After treating almost 90% of impurities can removed and this water may be used for growing crops and in manufacturing of mass concrete.

7. Conclusion:

It is clear from the above study that Civil engineering plays an important role in recycling the waste products and also by using waste products economy will maintained that should be beneficial for us as well as for the society and will helpful to provide ***green and clean environment*** to our future generation.

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