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Refuse as Usables in Civil Engineering Domains

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Abstract - **Wastes are the discarded materials which are thrown away after their utilization or simply the scrap material. Junk which are thrown away in every spot in and around us poses a major threat to our community as well as to the mother earth. There are several types of wastes which are classified based on their source of generation. It includes biomedical wastes, electronic waste or the e-waste, construction and demolition wastes, hazardous wastes, waste water etc., the wastes thus generated should be properly recycled and utilized or else discarded in a proper way without tainting the environment. Here are mentioned certain techniques from various papers which utilize the waste advantageously. Ash obtained from the incineration of biomedical waste can be valuably utilized in concrete making operations which satisfied the required compressive strength of normal concrete. E-waste aggregate can be made use in concrete as a replacement of coarse aggregate up to 20% which attain the strengths of acceptable limits. The debris from the construction and demolition can be productively implemented in construction of rigid pavements as base and sub base course which helps in reducing the cost. India generates about 141000 metric tonnes of waste per day. Mumbai and Delhi alone generate around 9000 metric tonnes and 8300 metric tonnes per day respectively. In this they collect around 127000 tonnes per day and treated is 34752 tonnes per day (27%) and land filled is 4515 tonnes per day. Thus the generated wastes poses a hefty problem to both human health and ecosystem we live in, which can be eliminated by recycled utilization of the refuse in various civil engineering applications.**

Keywords: **E-waste, Construction and Demolition Waste, Biomedical Waste, Ash**

I. INTRODUCTION

Wastes are unwanted discarded materials which are thrown away after their utilization or at the end of their lifecycle. Quantity of waste generation is generally in the rates of several billion metric tonnes per day of which the amount of wastes that are properly treated and disposed always remains a million dollar question. The waste generation rates are usually very high compared to the disposal rates. Wastes get accumulated in various places like landfill, open dumping as like in dump yards. Wastes can be of different forms solids, liquid, gas. The management and disposal also varies accordingly with respect to type of wastes being generated. Wastes are mostly the by products resulting from human, biological, chemical or industrial activity. They waste treatment and disposal methods are of more importance in under-developed and developing countries. Since there is less awareness regarding the 3R (recycle, reuse, recovery) policy, resource, recovery, refuse as reuse etc. The process of land fills dumping and incineration is generally adopted. Also most of the developed countries use the poor countries normally the African and Asian countries are used as a trash can for dumping and disposal of their garbage and other forms of waste. The developed countries being aware of the threats and hazards due to waste cleverly utilize the highly productive lands as like India as their junkyard, turning fertile lands into barren lands. Thus we are losing our valuable resource without the knowledge of divesting it. The land fill grounds of our country thus would become contaminated by various toxins and pollutants and would be a manufacturing ground of chemically active and biologically modified seeds, flowers, plants, etc. The waste generation levels are in the rates of 1.3 billion tonnes per year and are expected to increase approximately to 2.2 billion tonnes per year by 2025. Generally economic development is associated with rate of urbanisation greater the amount of economic development greater the waste generation.

India generates approximately 133760 tonnes of MSW per day of which approximately 91152 tonnes is collected and approximately 25884 tonnes are treated. MSW generation per capita in India ranges from approximately 0.17kg per person per day in small towns to approximately 0.62kg per person per day in city. Highest waste generation is in Maharastra accounting about 115364-19204 tonnes per day, whereas the lowest waste generation occurs in Jammu and Kashmir, Bihar, Jharkhand, Orissa, Goa, Manipur (less than 3841 tonnes per day). As per 2013 report from ISWA, the total garbage generation in 2013 was 1.84 billion tonnes per year around the world. The countries creating highest amount of waste include China, followed by United States and India. As richness develops 62million tonnes of garbage are generated every day by 377 million people living in urban India, now the world's third largest garbage generator. However the matter of issue is that more than 45 million tonnes or 3million trucks worth of garbage is untreated and disposed of by municipal authorities every day in unhygienic manner leading to health issues and environmental degradation. These 3 million trucks if laid end to end would cover half of the distance between earth and moon. Or to put it another way would cover the distance of 15trips between Mumbai and los angels. India at present around 62 million tonnes of solid waste is generated annually out of which 5.6 million tones is plastic waste, 0.17 million tonnes is biomedical waste, 7.90 million tonnes

is hazardous waste per annum and 15lakhs tonnes is e – waste. The biggest challenge is that about 70-75% of waste remains untreated. This untreated waste of 31 million is mostly dumped into landfills. The several type of waste generated are as follows e-waste, biomedical waste, construction demolition waste sludge etc. electronic waste accounts for approximately 40%of lead and 70%heavy metals found in land fill.

The pollutants thus emitted from heavy metals are toxic and leads to contamination of ground, air and water pollution. Ground pollution results in soil acidification. Also the chemicals ejected during the recycling will result in various health issues like respiratory disorder, skin disorder, bronchitis, lung cancer, etc. the main sources of e-waste generation in India are government and private industrial sectors which accounts for 75% total waste generation. Medical or clinical waste generally referred to biomedical waste are generated from hospital, nursing home, medical research laboratory ,etc. the quantum of waste that is generated in India is estimated to be 1-2kg per day in a hospital improper practices such as dumping in and around water bodies, open places etc would result in spread of diseases.

A. Source of Waste

In general waste categorized as solid waste, liquid waste and gaseous waste. The solid wastes are urban waste-industrial wastes, agricultural waste, biomedical wastes, radioactive wastes, which gets accumulated in land area. Liquid wastes are mostly sewage in which most common practices is to discharge it on the ground and mostly in water bodies like river, often without any treatment. Gaseous waste are released in form of gases from automobile factories, burning of fossil fuels etc and get mixed in atmosphere which includes carbon monoxide, carbon dioxide, sulphur dioxide, etc. the sources of solid wastes is mainly the house hold wastes, plastic bags from market, industries etc. the liquid wastes are generally the treated and untreated waste water from sewer, chemical industries, dying industries etc. gaseous waste accumulation is due to release of vehicular emissions, industrial giveaways which are ejected from their outlets like chimney.

B. Impacts of Waste Accumulation

The waste accumulation is the one of the greatest challenges in the present scenario. Due to the accumulated wastes several microbes grow which releases air-polluting gases. This wastes during rainy season are intermingled with water, are discharged into water bodies and the resulting contamination leads to spread of contagious diseases. The spoilage of landscape, pollution, health hazards etc. The leachate from the landfills which are harmful to health are usually generated. Burning of coal, petroleum or wood releases certain gases which combine with the gases in atmosphere to form acid rain. The acid rain causes damaging marks on monuments and statues. The unregulatory and uncontrolled burning of accumulated wastes creates smoke and other pollutants of air. Radioactive waste generated from thermal power plant, atomic power stations also poses a major problem in terms of physical health. Industrialization, urbanization, usage of fertilizers, pesticides, fungicides etc in the agriculture changing trends in life style has increased the amount of waste production. Accumulation of wastes in densely populated areas, discharge of industrial effluents into rivers affect the land and water ecosystem chemical, biological and explosive wastes poses a danger for their life's run. Nearly 25 human diseases are the result of dumping of solid waste. They also indirectly become the reason for the development of rats, insects, flies etc which are carriers of infectious micro organism causing communicable diseases. In other sense, it affects the aesthetic appearance.

Most of our junk which are thrown away either contain compounds of organic or inorganic nature. These compounds being malignant pollute the environment by land degradation, ground and surface water contamination, aquatic life destruction etc. large scale cutting of trees followed climatic change. Global warming are some of the unpleasant consequence that has adverse effort on human health. Hazardous air pollutants affect human health both directly and indirectly. A survey says nearly 80%of human diseases particularly in the developing countries are caused only due to polluted water alone. The building up of salts, chemical compounds in soil causes various problems like nausea, vomiting, diarrhoea, tremors etc. ethylene dichloride, ethylene di bromide etc, accumulate in liver, kidney, heart and cause degenerative lesions. Fresh water resources become unfit for the usage due to the mixing of large quantities of wastes in them. Then major means of disposal or dumping of solid waste always occur in the sea and oceans. Marine resources are always used as a major junk yard for throwing off wastes. In past, oceans were able to accumulate them without noticeable adverse efforts, but now the patterns have been ultimately changed. It is a matter of fact that mangrove forests are being damaged at alarming rate due to disposal of wastes along seashores and harbors.

II. WASTE GENERATION GROWTH

A. Waste Generation Rates in India

India as a developing country is experiencing tremendous changes in various sector which includes urbanization, industrialization etc. as mentioned earlier the waste generation rates is directly related to urbanization, below is given a table which represent waste generation rates of various cities in India.

B. Across World

OECD countries produced almost half of the world's waste, while africa and south Asia region produces least amount of

waste. Current global MSW generation levels are around 1.3 billion tonnes per year and are expected to increase 2.2 billion tonnes per year by 2025. This represents a siginificant increase in per capita waste generation rates, from 1.2 to 1.42kg per person per day in next 15 years.

TABLE I WASTE GENERATED DAILY IN INDIA

State	Biomedical Waste Generation and Disposal (kg/day)	
	Waste	Disposal
Karnataka	62,241	43,971
Uttar Pradesh	44,392	42,237
Maharashtra	40,197	40,197
Kerala	32,884	29,438
West Bengal	23,571	12,472
All India	4,05,702	2,91,938

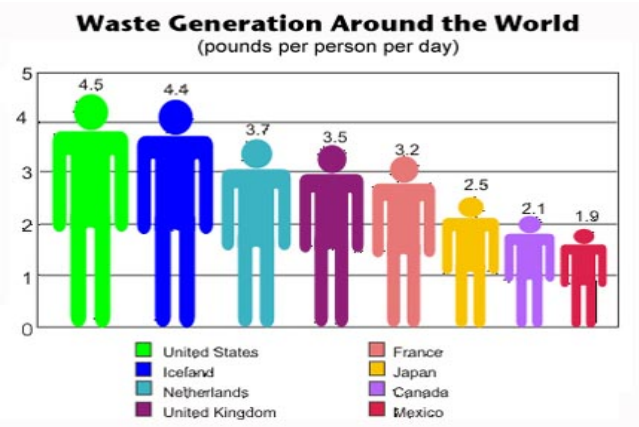

Fig. 1 Waste Generation Around the World

III. CURRENT WASTE MANAGEMENT IN INDIA AND OTHER COUNTRY

A. Waste Collection

The first step involved in the waste management process is collection of wastes. They are collected from various places of waste generation. The process of waste collection also involves curbside collection. Usually wastes collected in household are left over in municipality wastebins and removed by garbage collecters who are employed by municipality. For commercial waste collection commercial waste can be removed primarily using dumpsters, trash trailers, hoist trucks etc.

B. Waste Transport

The transport of wastes is usually cried out by trucks or other vehicles. In cases of different wastes involved, various modes of traansport like boates, rail or air depending upon the nature of waste being generated. Usually the wastes are tranported to nearby transfer stations where the local waste collection vehicles deposit their waste cargo prior to the loading of waste into larger vehicles. The larger vehicles will transport waste to end point of disposal local bodies spend around Rs.500 – 1000 per tonne on solid municipal waste with 70% of this amount being spent on collection and 20% is spent on transport.

C. Waste Disposal

Out of the total wastes generated in India, more than 90% of the total trash is dumped in undesirable manner. Most commonly adopted techniques for discarding the wastes are incineration, landfills, open site dumping etc., Incineration is a treatment which involves the combustion of substances contained in the waste materials. Incineration involves high temperature burning and is referred to as the thermal treatment. Landfill site is literally a dumpsite where waste are disposal by burial. It is one of the oldest techniques. Open dumps are piles of garbage where they are not mean to be thrown off. Thus the efficient method of waste disposal always remains a question of research.

IV. VARIES TECHNIQUE WASTE MANAGEMENT

A. Reduce of Waste Materials

Reducing the amount of waste generated in the source itself will be the best approach to waste management. By lessening the energy consumption and resource utilisation we can reduce the amount of waste generated.

B. Reuse of Waste Materials

1. Biomedical Waste

Wastes which are generated from hospitals, nursing homes etc., are usually disposed off simply and accounts for about 72% and about 28% of waste is not given more importance. The bomedical wastes are subjected to incineration. The ash obtained as a result of incineration can be utilized as a raw material for making of concrete. However the ash cannot be utilized in larger amounts. Vikas srivastava and his two students conducted experiment on different percentage replacement levels of biomedical waste ash in concrete making operations and results were obtained.

In general, it is found that upto 15% replacement levels of biomedical waste ash gave desirable properties. Also the 7 and 28 days compressive strength is increased upto 5% replacement levels and shows same strength upto 10% of referral concrete. The workability of concrete decreased with increase in replacement levels, thus gave lower values than the normal conventional concrete. The same experiment were conducted in our lab and the properties of concrete were biomedical waste ash were added in various percentage as partial replacement of the cement. The characteristics and results observed are as follows, Specific gravity of biomedical waste – 2.34 Moisture content – NIL Water absorption – 2.3% Fineness modulus – 3.20 Bulking – 17.5% 10% replacement gave higher compressive values. Also the following values were observed during 10% replacement levels Split tensile strength in 28 days 3.71

MPa, Flexural strength in 28 days was 4.09 MPa, Density 2542.22 kg/m^3, Modulus of elasticity (experimental value) 28667.69 MPa, Modulus of elasticity (calculated value) 30458 MPa and Compressive strength in 28 days = 40.11 MPa.

2. Industrial Waste

Industrial waste can be processed and used in various ways. The industrial wastes which are made used in construction industry includes Flyash, slags obtained from various process, sludge etc. Hassan hoveidi and his team of 4 researchers (Iron) experimented with the industrial waste sand which is manufactured from ferrous and non ferrous metal by products of silica their study made a conclusion that industrial waste sand can be resourcfully utilized in soil stabilization process. Seyyeden Fatemah Seyyedalipour and her crew (Iron) conducted a experiment on the utilization of pulp and paper industry wastes in concrete and conclude that the use of these industrial by products in the concrete making operations will be advantageous from the viewpoint of economy energy efficiency durability etc., It also helps in production of greener concrete .

M. Najimi, J. Sobhani, A. R. Pourkhorshi di (Iron) researched with copper slag contained concrete from their study it was found that copper slag can be used as a replacement of cement upto 15% which reduced the deteriorative sulphate expansions and also prevents the formation of ettringnite crystals although they had lower strength values granular slab can be used upto 50% replacement in cement mortar which gave water results on compressive and split tensile strength. This work was done by Hohammed Nadeem and A. D Pofale of Nagpur, India Tarasen and Umeshmitra conducted experiment and found that Flyash can be used in Portland cement manufacture. Research work carried out by NKS Pundhir, C Kamaraj P.K Nanda in New Delhi found that copper slag can be used in construction of bituminous pavements. Replacing can be done upto 80% crushing strength is less so lifetime will be higher and thus can be made use in construction of national and state highways.

Flyash is used in manufacturing of Portland cement. It is also used in soil improvement techniques in laying of asphalt pavement. Blast Furnace Slag can be used as cementitious binder in laying of sub base course. Cement kiln dust can also be used. Other operations involving the utilization of blast furnace slag is soil stabilization techniques and from study it is found that it can be used as mineral filler in asphalt pavement. Steel slag and natural stone can be used in asphalt production. Study on ferrochromium slag was conducted by Megahit Suteu and their team and found that they can be used in construction of road pavement and foundations. Marzena smol and his team in New Delhi experiment of on sludge utilization in construction and found that can be used in amount brick ceramics and glass production. Mehmet Canbax, Turkey wrote that glass powder replacing can be done in concrete operations as a replacement of fine aggregate to about 40%.

3. Construction and Demolition Waste

Demand of aggregates of good quality, availability of materials and transportation costs are high. Monalisa behera, S K Bhathacharya, A K Minacha, R Deoliga, S Mait India in their research used different types of brick aggregate, glass aggregate, asphalt, bitumen aggregate, concrete aggregates, tiles and marbles recycled and used in flooring, finishes and ceramic products brick tiles. Metal and other miscellaneous such as glass, wood, paper, plastic and other wastes are used in recycled reinforcement. Wood, plastic are removed using different stage of screening and sorting higher quality aggregate. The process of removal includes stock piling, crushing, per sizing, sorting, screening and elimination of materials and is utilized in various domains. Physical and mechanical properties of normal concrete are nearly obtained when replacement levels are about 25% to 60% according to the size of aggregate. Sizes ranging from 20 - 30 mm of crushed waste concrete can be replaced up to 65% - 70% natural coarse and fine aggregate. About 30% - 35% replacement in the cement mortar can be done by powder obtained from the crushing of concrete. The disadvantage is that the water absorption capacity of this is 2 to 3 times higher than natural aggregate. Compressive strength, spilt tensile strength and flexural strength, drying shrinkage, creep and modulus of elasticity, bond strength, durability properties and strength of concrete using construction and demolition waste strength equals or nearer to the normal concrete strength value.

Ashraf M Wagih, Hossam Z, EI Karmoty, Magda Ebid, Samir H, Egypt in the journal wrote in concrete making operations waste crushed concrete is replaced instead of coarse aggregate in varying sizes from 4.75-20 mm which is obtained by sieve analysis test. The various tests of aggregate like bulk density, compressive strength, and modulus of elasticity and aggregate test of particle size distribution, specific gravity and water absorption, abrasion index and impact value are studied and workability of fresh concrete is also done. The test results showed that the replacement about 25%- 50% gave overall good performance. Whereas 50% replacement gave high compressive strength and 7%-13% replacement gave better split tensile strength values. Vikas Srivastava, Moha Monish, Raushan Ranjan and P.K Mehta in India wrote in their paper the demolition waste or concrete waste is recycled or reused for concreting operations. Demolition waste, demolishing waste aggregate and demolition waste powder is replaced in concrete. Bleeding of concrete obtained by using de C&D waste was found to be less than normal control mixes. The recycled concrete contains 20% replacement of demolition waste which gave high workability test results, 30% replacement by demolition waste gave higher compressive strength. Demolition waste powder replacement was done to about 10% of cement content, demolition waste aggregate replacing 20% of fine aggregate and 30% of coarse aggregate gave good bond strength and workability.

TABLE II BIO MEDICAL WASTE IN INDIA

Category	Waste content	Components	Method of treatment and disposal
Category No. 1	Human Anatomical Waste	Human tissues, organs, body parts	Incineration /deep burial
Category No. 2	Animal Waste	Animal tissues, organs, body parts carcasses, bleeding parts, fluid, blood and experimental animals used in research, waste generated by veterinary hospitals colleges, discharge from hospitals, animal, Houses	Incineration /deep burial
Category No 3	Microbiology and Biotechnology Waste	Wastes from laboratory cultures, stocks or specimens of micro- organisms live or attenuated vaccines, human and animal cell culture used in research and infectious agents and industrial laboratories, wastes from production of biological , from research toxins, dishes and devices used for transfer of cultures	Local autoclaving/ micro waving/ incineration
Category No. 4	Waste sharps	Needles, syringes, scalpels, blades, glass, etc. that may cause puncture and cuts. This includes both used and unused sharps	Disinfections chemical treatment/autoclaving/micro waving and mutilation shredding
Category No. 5	Discarded Medicines and Cyto toxic drugs	Wastes comprising of outdated, contaminated and discarded medicines	Incineration / destruction & drugs disposal in secured landfills
Category No. 6	Solid Waste	Items contaminated with blood, and body fluids including cotton, dressings, soiled plaster casts, lines, beddings, other material contaminated with blood	Incineration , autoclaving/ micro waving
Category No. 7	Solid Waste	Wastes generated from disposable items other than the waste sharps such as tubing's, catheters, intravenous sets etc	Disinfections chemical treatment/ autoclaving/micro waving and mutilation shredding
Category No. 8	Liquid Waste	Waste generated from laboratory and washing, cleaning, house-keeping and disinfecting activities	Disinfections by chemical treatment and discharge into drains
Category No. 9	Incineration Ash	Ash from incineration of any bio-medical waste	Disposal in municipal landfill
Category No. 10	Chemical Waste	Chemicals used in production of biologicals, chemicals used in disinfection, as insecticides, etc	Chemical treatment and discharges into drains

In India only 10% of demolition wastes are utilized in concrete works. Fatih ozalp, Halit dillsad Yulmaz, Mustafa kara, Omer kaya, Aylin sahin in Turkey team recycled paving stone, kerb, concrete pipes, ready mix concrete waste in construction and demolition are used in constructions. Paving stone production can be done by utilization of the above mentioned waste materials to about 20% replacement of aggregate of sizes 0-5 mm and 5-12mm. Kerb production using recycled aggregates were done by using it as fine and coarse aggregate in the concrete and the split tensile strength, water absorption and wear resistance test results gave good values. Replacement levels up to 25% of both aggregates are suitable in obtaining better strength values. Concrete and reinforced concrete pipes wastes were used as replacement of coarse and fine aggregate in concrete works. 10% and 20% replacement of FA and SA gave suitable strength. 300mm and 800mm diameter concrete pipes using recycled aggregates were manufactured and basics tests were conducted. The results showed that water absorption value is higher than the normal concrete. Los Angeles wear test results gave 43% higher values than the normal concrete values. Vivian W.Y. Tam, C.M Tam in Australia others says waste should be reused, recycled and reduced.

The various technologies includes (i) Investigating the waste management in the construction (ii)Examining the importance on materials recycling (iii) Reviewing the viable technology for the construction waste recycling which are (i)asphalt (ii)brick (iii) concrete(iv) ferrous metal (v) glass (vi)Masonry (vii) non-ferrous metal (viii) paper and cardboard (ix) plastic (x) timber. For material, three major areas need to be taken into account (i) economy (ii) compatibility with other materials (iii) material properties. Materials such as paper, plastic metals and glass are recycled in Hong Kong, Australia, Japan, USA, Germany, United Kingdom and other countries. Recovery rate of C&D is 88% in Hong Kong which is the highest percentage of construction and demolishing waste utilization in the Asian countries.

Asphalt sheet or any other asphalt waste materials are recycled and utilized in asphalt sheet production. Ash obtained from burning of asphalt sheets and the crushed asphaltic materials are used as replacement of cement and sand respectively in concrete making operations. Crushed asbestos aggregates mixed with sand and binder can be used as cement or liquid form of bituminous emulsion or as a liquid binder. Many methods used in other countries for aggregate materials recycling include i)Cold recycling ii) Heat generation iii) Minnesota process iv) Parallel drum process v) Elongated drum process vi) Microwave asphalt recycling system vii) Finfalt process and viii) Surface regeneration. Brick demolition waste which is in powder form may be mixed with mortar and used.

TABLE III QUANTITIES AND VALUES OF EXPORTED

Category of recyclable materials	Quantity (tonnes)	Value (HK$ thousand)	Value per unit weight (HK$/ tonnes)
Ferrous metals			
Alloy steel scrap	16471	72171	4382
Pig or cast iron	42970	46667	1086
Tinplate	572	1134	1983
Other scraps	743177	6006669	816
Sub-total	803190 (45.5%)	726641 (27.9%)	905
Non-ferrous metals			
Aluminium	17044	69285	4065
Copper and alloys	47580	296645	6235
Lead	2785	4424	1589
Metal ash and residues	226	13144	58159
Nickel	63	1273	20206
Precious metal	117	656386	5610127
Tin	2	39	19500
Zinc	1270	11251	8859
Sub-total	69087 (3.9%)	1052447 (40.4%)	15234
Plastics			
Polyethylene	115653	124594	1077
Polystyrene and copolymers	18445	48076	2606
Polyvinyl chloride	2234	5065	2267
Others	71401	120381	1686
Sub-total	207733 (11.8%)	298116 (11.4%)	1435
Textiles			
Cotton	16539	25746	1557
Man-made fibers	57	295	5175
Old clothing and other textile articles, rags, etc.	3434	11700	3407
Sub-total	20030 (1.1%)	37741 (1.4%)	1884
Wood and paper			
Paper	657336	487785	742
Wood (include sawdust)	8203	4274	521
Sub-total	665539 (37.7%)	492059 (18.9%)	739

Remaining wastes from old building brick materials are mixed with other materials such as timber and concrete to about 10-15%. Sorting and cleaning of brick demolition wastes helps in separating out the required materials. Demolished brick waste, slime burnt ash is replaced in concrete instead of natural aggregate. Wastes from unbound (road, base trench etc.) utilized in concrete gave 90% of fresh concrete strength is achieved. Also 30% replacement of waste concrete aggregate instead of natural aggregate was done in production of new concrete. There is a highly developed market for ferrous metal recycling all over the world. These recycled materials are mostly profitable and is used directly in production of new steel.

In motherland 80% scrap metal is directly recycled and 25% scrap metal is replaced instead of reinforcement in constructions. In Japan and other countries construction waste reinforcement is utilized by cutting it into small size and 100% replacement is done in new construction work especially in small load carrying capacity buildings. Glass industry wastes are recycled to about 60% which accounts for 435 tonnes of waste glass. Recycled glass is used as replacement to cement, fine and coarse aggregate in new concrete production.

Window glasses are directly reused by proper handling, storage & transportation in a very careful manner. Recycled glass wastes are used in manufacture of glass fiber. It is mixed with cement for strengthening. Glass waste isolation materials including glass wood mat, pipe cover and thermal insulation board, facing for plant, ceiling board and acoustical insulation board for automobile is used in cement manufacturing process as a replacement of gypsum or resin. They are used as filling materials and to improve the strength of concrete and tile. 100% replacement of recycled glass is done in United States and other countries.

Paving block recycling technology i) provide an attractive reflective appearance surface after polishing ii) reduce water absorption of concrete block iii) provide good compressive strength quality. To increase the strength of paving block recycled glass aggregate is used. Masonry is normally

crushed and converted to recycled masonry aggregate. It is used as aggregate in traditional clay brick as well as in sodium silicate which 70% recycling is done. Copper is recycled by 119000 tonnes, national market production of waste copper is 262000 tonnes of which 100% recycling is done. Lead is recycled to about 228700 tonnes which accounts for about 85% of total waste generated. Waste zinc production is about 60000 tonnes and is fully recycled.

TABLE IV SUMMARY ON THE EXPERIENCES ON TECHNOLOGY OF MATERIAL RECYCLING PRACTICES

C&D Materials	Recycling Technology	Recycled Product
Asphalt	Cold recycling Heat generation Minnesota process Parallel drum process Elongated drum Microwave asphalt recycling system Finfalt Surface regeneration	Recycled asphalt Asphalt aggregate
Brick	Burn to ash Crush into aggregate	Slime burnt ash Filling material Hardcore
Concrete	Crush into aggregate	Recycled aggregate Cement replacement (replace the cement by fine portion of demolished concrete) Protection of levee Backfilling Filler
Ferrous metal	Melt Reuse directly	Recycled steel scrap
Glass	Reuse directly Grind to powder Polishing Crush into aggregate Burn to ash	Recycled window unit Glass fiber Filling material Tile Paving block Asphalt Recycled aggregate Cement replacement Man-made soil
Masonry	Crush into aggregate Heat to 900 ◦C to ash	Thermal insulating concrete Traditional clay brick Sodium silicate brick
Non-ferrous metal Paper and cardboard	Melt Purification	Recycled metal Recycled paper
Plastic	Convert to powder by cryogenic Clipping Crush into aggregate Burn to ash	milling Panel Recycled plastic Plastic lumber Recycled aggregate Landfill drainage Asphalt Man-made soil
Timber	Reuse directly Cut into aggregate Blast furnace deoxidization Gasification or Pyrolysis Chipping Molding by pressurizing timber chip under steam and water	Whole timber Furniture and kitchen utensils Lightweight recycled aggregate Source of energy Chemical production Wood-based panel Plastic lumber Geofibre Insulation board

Steel strip production is about 40000 tonnes which is used in production of galvanized steel. Small quantity of zinc sheet is generated to about 2000 tonnes per year and is used in rooting, cladding. Zinc waste of 37% is utilized for the production of brass paper and cardboard. Plastic compounds like polyethylene, polypropylene, polystyrene and polyvinylchloride are collected separately, cleaned, materials are recycled as new plastic products i) panel ii)

roof and floor, piling PVC window, noise barrier, cable ducting and pipe, panel, cladding and insulation foam iii) Manmade soil. Timber waste is produced in large quantity in world. More than 2.5 million tonnes of timber waste is generated in United Kingdom alone. Undamaged wood can reused as plank, beam, door, floorboard, rafter, panel, balcony parapet, pile, wood bench, timber stair. Aggregates are made from recycled small wood chunk. Total 400 tonnes monthly waste is generated which is recycled as new construction products of wood based panel for roof, ceiling and floor cladding in agricultural building hoarding, a packaging substitute wall and sand barrier, paper and recycled board adopted by recycling timber.

V. ELECTRONIC WASTE

M.D Jalal uddin Indian author says E waste consists of ferrous and non ferrous metals, plastic, glass ceramic and rubber, Common peripherals, Audio stereo equipment, VCR's, DVD players, Video camera, telephones, fax and copy machines, cellular phones etc., Major sources of e waste are individual and small businesses, institutions and government, original equipment manufacturers, cellular phone, refrigerator, ovens, switch board, air conditioner batteries and TV etc.

Environmentally sound treatment technologies of E waste are used in three way 1st level, 2nd level and 3rd level. 1st level includes treatment of TV, refrigerator and personal computer which involves i) Decontamination: removal of all liquids and gases ii) Dismantling: manual breaking iii) segregation. 2nd level includes treatment of CRT, plastic, circuit board and cables which involves i) Hammering ii) shredding iii) special treatment. For special treatment various methods are available i) CRT treatment ii) Electromagnetic iii) Eddy current separation iv) Density separation using water. 3rd level of E waste treatment includes ferrous and non ferrous metals, plastics and other materials recycling by chemical, mechanical and thermal method. E plastic waste is recycled by chemical process method in India in which the process are adopted i) dismantling ii) pulverization iii) hammering iv) shredding v) density separation using water. E waste treatment process includes i) collection ii) storage iii) dismantling and segregation iv) Recycling v) treatment and disposal. The E waste getting disposed per annum from different industries like mobile store, electric shop, and household scrap shops and computers shops.

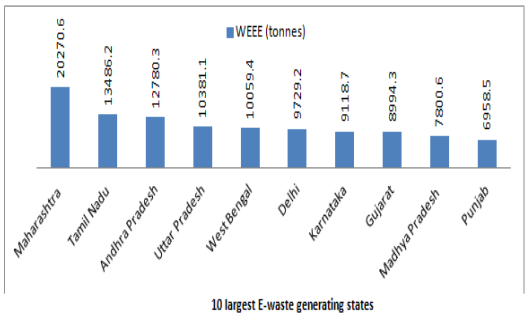

Fig. 2 E-Waste Generation Large 10 States

TABLE IV 3RD LEVEL TREATMENTS

Input/ WEEE Residues	Unit Operation/ Disposal/ Recycling Technique	Output
Sorted Plastic	Recycling	Plastic Product
Plastic Mixture	Energy Recovery/ Incineration	Energy Recovery
Plastic Mixture with BFR	Incineration	Energy Recovery
CRT	Breaking/ Recycling	Glass Cullet
Lead bearing residue	Secondary Lead Smelter	Lead
Ferrous metal scrap	Secondary steel/ iron recycling	Iron
Non Ferrous metal Scrap	Secondary copper and aluminium smelting	Copper/ Aluminium
Precious Metals	Au/ Ag separation	Gold/ Silver
Batteries (Lead, Acid/ Nickel metal Hydride (Ni-MH) and Li – ion	Lead recovery and smelting remelting and separation	Lead
CFC	Recovery/ Reuse / Incineration	CFC/ Energy recovery

Sivakumaran in Sri Lanka in his research paper wrote about current disposal methods i)land filling, ii)acid baths iii) incineration of which the mostly used method is land filling which pollutes the air, land and human beings. Ankit arora and Dr.vrimil v.dave in Ahmadabad in his paper wrote the methods of e waste disposal includes incineration and replacing by E waste ash in cement and fine aggregate in new concrete preparation. The strength is equal to or nearer to the compressive strength, split tensile strength, flexural strength and in the basic tests of fine aggregate and cement.

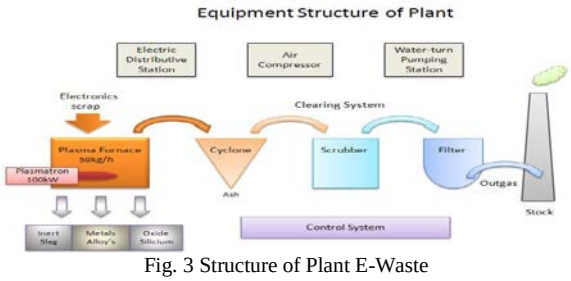

Fig. 3 Structure of Plant E-Waste

VI. PLASTIC WASTES

Rafat siddiyul, jamal khatib inderpreet kaur in India wrote in his paper about plastic wastes. They are of very low density, good strength, user friendly designs, better fabrication capabilities, long life and light weight plastic are used in different industry like automotive, medical delivery systems, healthcare, in different and artificial implants. Types of plastic: polyethylene terphthalate, high density polyethylene, low density polyethylene, polypropylene and polystyrene and other plastic. Different plastic recycled products obtained include i) virgin polypropylene ii) recycled plastic (metal) iii) recycled plastic (automobile) iv) recycled plastic (shredded). Management of plastic recycling method is by i) collection ii) land filling plastic iii) incineration of plastic iv) plastic recycling. Plastic recycling methods are 1) Mechanical recycling 2) Chemical or feedstock recycling a) chemical modification b) thermal reprocessing c) fillers d) other recycling techniques. The basic tests were conducted in fresh concrete containing the plastic wastes for bulk density, air content, slump test, and harden concrete compressive strength, split tensile strength, modulus of elasticity and time and temperature dependent an properties, impact resistance, permeability and abrasion resistance.

VII. CONCLUSION

The waste recycling, reuse and reduce is most important for every people in the industry. Industrial waste like metals, slag, fly ash, sludge is mostly replaced and utilized in concrete and is reused in energy generating process. Biomedical waste are human tissues, hospital waste and medical waste etc. It is mostly disposed of by incineration, land filling and chemical treatment. Incineration of biomedical wastes results in ash which is used as fine aggregate and cement in concrete. Construction and demolition waste of glass, wood, paper and other waste is recycled and utilized in concrete or reused in other works of construction. Construction and demolition waste recycling techniques are i) cold recycling ii) heat recycling etc. E waste includes DVD players, Video camera, telephones, etc. E waste ash is used as replacement material in concrete making operations. The recycling process has still other methods in which the chemical method is mostly preferred.

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