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In today's world, one of the most concerning issues is protection of human civilization from the threatening effect of man-made wastes. Indeed, wastes are the residue part of raw materials, which are generally unwanted after primary use. Among different waste materials, solid wastes are generated in our society through various humans' activities. In its consequence, population and their education level, monthly income is also a contributing factor in waste generation. The waste management is easy for limited population; however, in India due to rapid increase in population together with modern urbanization the lifestyle has also been simultaneously changed. In turn, this leads to amplification of solid wastes. In its connection, the improper solid waste management improvises the rigorous outcome on public health and environment. Consequently, solid waste management becomes a major concern in the twenty-first century. Several hazardous solid wastes from various sources are further characterized as organic, reusable and recyclable waste.

Solid wastes mainly includes village, agriculture, municipal and hospital solid wastes. Village wastes (VWs) contains a major part of decomposable and recyclable materials. On the other hand, agriculture solid wastes (ASWs) may exert groundwater contamination and soil infertility. Toxic organic materials and metals are the main sources of this contagious effect. The majority of solid wastes are originated from the municipalities where the amount is thousands of tons per day; municipal solid waste (MSW) contains all types of hazardous, non-hazardous and organic waste, and a few extents of MSW is compostable. The increasing rate of MSW generation annually is around 1–1.33% per capita. In India, the MSW generation rate

per capita is around 0.2–0.5 kg per day in small towns. MSW causes release of many toxic gases and substances which further can contaminate the soil, groundwater and the environment. Contamination of these toxic elements to the food chain results in harmful effect on the ecosystem. In case of hospital solid wastes (HSWs), the scenario is more alarming HSWs are generated during observation, diagnosing, treatment and curative process of a patient in any field of humans or veterinary.

Production and testing of biological product also generate harmful waste. In general, HSW is hazardous, of which only 5% is non-infectious and remaining considered as infectious waste. Infectious wastes are expected that it is abounding of pathogens which are spreading or capable to cause disease to humans and animals. HSW may cause flare of dangerous disease like AIDS, hepatitis A, B, C, tuberculosis, pneumonia, diarrhoeal diseases, tetanus and whooping cough. Some toxic chemicals such as dioxins and furans are generating from HSW which have significant harmful effect on health of animals and birds.

In the era of globalization and fast life, electronic waste (e-waste) is one of the solid wastes generated every day in a mammoth rate. A survey reveals that approximately 4 out of 7 people in only 4 billion people of constitutional regions were generating e-waste around 41.8 million tonnes (MT) through all over the world in 2014. It is expected that sitting on growth rate 4–5% annually, the quantity of e-waste will reach around 49.8 MT by 2018. That huge quantity of e-waste is generating from the discarded electrical and electronic equipment. Rapid obsolescence of technology reduces the lifetime of electrical and electronic product which in turn results in a rapid enhancement in amount of e-waste. E-waste contains toxic elements such as acids, polychlorinated biphenyls, hexavalent chromium (PVV). These may cause bronchial maladies, lung cancer, damage in liver and kidneys. Some heavy metals like lead, mercury, cadmium, arsenic are present in e-waste possessing serious effect on central nervous system, immunology system of our human body. On contamination to groundwater, these wastes may cause detrimental effect to children and cause several diseases (i.e. Minamata, Itaiitai).

Solid waste management (SWM) process includes various actions related to generation, storage, collection, transfer & transport, processing and disposal of solid wastes. Solid waste generation and its management depend on national income and legal policies of the nation. Application and maintenance of these facilities like collection, recycling, treatment and disposal of solid wastes needs a large amount of finance. Moreover, for waste treatment there needs a suitable locations which is gradually more difficult to find due to the most popular

attitude Not In My Backyard (NIMBY) throughout all the communities. Reduce, Reuse, Recycle (3Rs) and integrated solid waste management, these pursue greater interested on waste prevention, reduction and waste recycling rather than waste treatment and disposal. Disposal of solid waste is very important and this disposal technique comprises landfilling, Incineration, pyrolysis, composting etc.

Solid Waste Management (SWM) Process

Globally, solid waste generation is growing day by day with the increasing population. Only in India, it is ranging around 0.2–0.6 kg/capita in cities which is generating 42 million tonnes of total solid every year, and these figures will cross 260 million tonnes in 2047. Therefore, for healthy environment proper integrated solid waste management (ISWM) is essential rather than conventional SWM which only involves waste collection, treatment and disposal. But ISWM focused on the reduction of waste at source, reuse of recovered resource and recycle of residue. Solid are waste are collected from various source and characterized upon there category like recyclability, combustibility, reusability, disposability and accordingly accumulate in corresponding places. As an example, hospital wastes are collected in different bins according to their colour code. Stored solid wastes are transported to various treatment facilities like thermal, mechanical-biological, mechanical biological, material reclamation facility and some waste along with residual part of treatment facilities transported to final disposal.

Lack of awareness and modern facilities of proper waste management can cause serious health issues and environmental impact. With limitation and advantage the main technologies in solid waste disposal and treatments are landfilling, composting, vermi-composting, biomethanation are the Mechanical Biological Treatment (MBT) methods and some thermal treatments like incineration, gasification and pyrolysis, plasma pyrolysis, production of Refuse-Derived Fuel (RDF) are the main technologies in solid waste disposal and treatment.

Mechanical Biological Treatment

Landfilling

Landfilling is the most general and ultimate way of waste disposal though it ranked lowest in quality of waste management. All types of inert, remaining and residual part of waste treatment, organic waste, and mixed waste are dumped in lands which are the major source of greenhouse gases (CO_2, CH_4). Some heavy metals and organic material are responsible for

groundwater contamination which results in lead, mercury, cadmium toxicity and other diseases. Landfilling sites are breading house of insects, vermin which can spread malaria, cholera, etc., and rag pickers are searching this sites for their daily income, as a result but they are most exposed to, tetanus, respiratory problem, neural disorder. People live around or downwind; these sites are also suffering from respiratory problem, headache and irritation due its odour.

Advantage of landfilling

- No need of highly skilled employees. (ii) Low cost for waste treatment. (iii) Highly potential for gas recovery which can use as source of energy. (iv) Through burying organic waste leads net gain for environment.

Limitation of landfilling

- Costly transportation to dumping land sites. Choke the drainage system and can contaminate both the groundwater and surface water. • Major source of greenhouse gases. • Need a large area of land for dumping. • Birthplace for vermin, insect and may be origin of various diseases.

Composting

Farmers have been composting compostable organic material (cow dung, agro-waste) from the immoral time. Micro-organism plays the main role in this technology for decomposition in various environments like warm, moist, aerobic and anaerobic. This technology is simple and commercially viable, and it is effectively applied in agricultural lands, fruit orchards, farmland, tea gardens, also in parks, gardens, etc. Some plants are established in Baroda, Mumbai, Solid Waste Management in India: A Brief Review 1043 Calcutta, Delhi, Jaipur and Kanpur with capacities ranging from 150 to 300 tons per day during 1975–1980.

Advantage of composting

• Augmentation in micronutrient deficiencies and improvement in soil texture. • It maintains the soil health through increasing moisture-holding capacity and recycling nutrients into soil. • It is very much straight forward and simple as well as cost-effective. • Reduce the dependency on chemical fertilizer in agriculture field.

Limitation of composting

• Not suitable for all types of waste. • Large open land required. • Composting plants emits methane, odour and flies. • Soil can contaminate with entering toxic materials. • Lack of awareness and proper marketing of compost material

Vermi-Composting

Vermi-composting is a process where biodegradable part of solid waste which is composted with the assistance of earthworms. Resultant part of vermi-composting is very much nutrient-rich, and further it can use for fertilization of agriculture field. *Pheretima* sp., *Eisenia* sp., *Perionyx excavates* sp., these worm species only survive in 20–40 °C and moisture ranges from 20 to 80% and responsible for generation of 50 MT of solid waste per day in town and cities. These worms consume waste five times more than their body weight. Largest vermi-composting plant with capacity of 100 MT/day is situated in Bangalore, India. Some plants in Hyderabad, Bangalore, Mumbai and Faridabad are established for vermi-composting. Introduction of toxic materials in waste can kill these earthworms and the process requires a large area of land composting.

Anaerobic Digestion and Biomethanation

In recent time, this technology is less expensive for disinfection and stabilization of waste like farmland residue, industrial sludge and animal slurries. The main objective of this process is generation of biogas which contains 50–60% of methane through composting of organic waste. Production of bio-gas can source of power generation. The value-added part of this process is that the residual part is enriched with nutrients and could be as composting fertilizer which results in environmental a net gain. Efficiency and energy recovery of biomethanation are better than composting.

Thermal Treatment

The main aim of this technology is to minimize the release of toxic waste and treatment residual part, and principle technologies are incineration, gasification and pyrolysis.

Incineration

Incineration is subjected to disposal of solid waste through high-temperature combustion in control with proper way. The incineration temperature belongs within the range 980 to 2000 °C. At this high temperature, wastes are converted into ash as a residual part with emission of gaseous product gas. This process leads to destructions of toxic material as well as

recovery of energy. Incineration reduces volume upto 80–90% of the total volume of combustible waste. This feature can be developed with enough high temperature, and it reduces up to 5% of its original volume. Additionally, this process is noise free, odorless and hygienic. These thermal plants can be constructed nearer to the source of the waste which will minimize the transportation cost. In developed countries like japan having insufficient place for landfilling, therefore such incineration methodologies are most commonly used in this country keeping in mind lack of large area for landfill.

Pyrolysis

A substance when thermally degraded without oxygen that process is called pyrolysis. In pyrolysis, required temperature ranges is in between 300 and 850°C and for thus a continuous external heat source is continuously required. Synthetic gas and char are the products of pyrolysis of waste material. Carbon and non-combustible materials are the main constitution of char, wherein syngas like methane, carbon mono oxide, hydrogen are major content. These gases further can be used for fuel oil generation and condensed for wax and tar preparation.

Gasification

Gasification is a partial oxidation process of substance with insufficient oxygen and resulted in a process between the combustion and pyrolysis. The operating temperatures are typically above 650°C of this exothermic reaction. Before application wastes are required to be dried and then segregated. During the operation the syngas so generated comprises of hydrogen, carbon monoxide and methane. This syngas can be used instead of natural gas as fuel gas and energy recovery could be possible with this method. In compared to incineration, gasification does not emit any toxic gas like SOx, NOx because of insufficient oxygen. This process needs high amount of financial support and power source, and the efficiency can be affected by the presence of high moisture and inert content in waste. Production of high viscosity may cause in operation and its 1046P. After gasification, the solid non-combustible residual part needs proper handling and disposal. In plasma gasification technology high temperature (electric arc) is applied to the waste material thereby converting it to an inert residue (ash).

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