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# A study of Various Methods of Waste Disposal and Management in India

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***Abstract: Solid waste management refers to the supervised handling of waste material from generation at the source through the recovery processes to disposal. It encompasses systematic control of generation, collection, storage, transport, source separation, processing, treatment, recovery, and disposal of solid waste. According to Environmental Protection Agency(EPA) solid waste is defined as," any garbage, refuse, sludge from a waste treatment plant, water supply treatment plant, or air pollution control facility and other discarded material, resulting from industrial, commercial, mining, and agricultural operations, and from community activities."Waste marginal quality water is treated and used whenever good quality water is scarce. Although there is no general definition of 'marginal quality' water, but for practical purposes it may be defined as water that has certain characteristics which have the potential to cause problems when it is used for a projected purpose. For example, brackish water is marginal quality water for agricultural use because it has high dissolved salt content and municipal wastewater is marginal quality water because of the health hazards associated with it. Use of marginal quality water for irrigation requires more complex organisation practices and more strict monitoring procedures than when good quality water is used. This publication deals with use of municipal wastewater in agriculture, which is primarily domestic sewage but possibly contains a proportion of industrial effluents discharged to public sewer. Hazardous waste can be defined as any waste that gives a present or future threat to humans or the environment. More precisely, hazardous wastes are unwanted materials that exhibit hazardous characteristics. A useful listing of hazardous characteristics is that provided by the United Nations (1989) as part of recommendations relating to the transport of dangerous goods. Here some methods of waste disposal and management of are discussed.***
***Keywords- Waste, disposal, management, anaerobic bacteria, environment,***

## I. INTRODUCTION

Solid waste treatment is one among the basic essential services provided by municipal authorities in the country to keep urban areas clean. However, it is among the most poorly provided services in the basket—the systems applied are unscientific, outdated and inefficient; population coverage is low; and the poor are side-lined. Waste is littered all over leading to insanitary living conditions. Municipal laws governing the urban local bodies do not have adequate provisions to deal effectively with the ever growing problem of solid waste management. [1] With rapid urbanization, the situation is becoming critical. Per capita waste generation ranges between 0.2 kg and 0.6 kg per day in the Indian cities amounting to about 1.15 lakh MT (million tonnes) of waste per day and 42 million MT annually. With the urban population growing at 2.7 per cent to 3.5 per cent per annum, the yearly increase in the overall quantity of solid waste in the cities will be more than 5 per cent. The Energy and Resources Institute (TERI) has estimated that waste generation will exceed 260 million tonnes per year by2047—more than five times the present level. Hence it is imperative in these times that greater emphasis is laid on solid waste management. [2]

## II. METHODS OF SOLID WASTE DISPOSAL AND MANAGEMENT

### *A. Incineration*

This method, commonly used in developed countries is most suitable for high calorific value waste with a large component of paper, plastic, packaging material, pathological wastes, etc. It can reduce waste volumes by over 90 per cent and convert waste to innocuous material, with energy recovery. The method is relatively hygienic, noiseless, and odourless, and land requirements are minimal. The plant can be located within city limits, reducing the cost of waste transportation.[3] This method, however, is least suitable for disposal of chlorinated waste and aqueous/high moisture content/low calorific value waste as supplementary fuel may be needed to sustain combustion, adversely affecting net energy recovery. The plant requires large capital and entails substantial operation and maintenance costs. Skilled personnel are required for plant operation and maintenance. Emission of particulates, SOx, NOx, chlorinated compounds in air and toxic metals in particulates concentrated in the ash have raised concerns.

### *B. Landfills*

Sanitary landfills are the ultimate means of disposal of all types of residual, residential, commercial and institutional waste as well as unutilized municipal solid waste from waste processing facilities and other types of inorganic waste and inerts that cannot be reused or recycled in the foreseeable future. Its main advantage is that it is the least cost option for waste disposal and has the potential for the recovery of landfill gas as a source of energy, with net environmental gains if organic wastes are land filled. The gas after necessary cleaning, can be utilized for power generation or as domestic fuel for direct thermal applications. Highly skilled personnel are not required to operate a sanitary landfill. Major limitation of this method is the costly transportation of MSW to far away landfill sites. Down gradient surface water can be polluted by surface run-off in the absence of proper drainage systems and groundwater aquifers may get contaminated by polluted leachate in the absence of a proper leachate collection and treatment system. An inefficient gas recovery process emits two major greenhouse gases, carbon dioxide and methane, into the atmosphere. It requires large land area. There is a risk of spontaneous ignition/explosion due to possible build-up of methane concentrations in air within the landfill or surrounding enclosures if proper gas ventilation is not constructed. Until recently there was not a single sanitary landfill site in India. All cities and towns without exception dispose waste most unscientifically in low lying areas or the lands designated for the purpose within or outside the city. In most of the cities the waste is not even spread or covered to prevent unsightly appearance or foul smell. No pollution prevention measures are taken. Of late four sites have been constructed at Surat (Gujarat), Pune (Maharashtra), Puttur and Karwar(Karnataka). A few more sites are under construction. Under the Municipal Solid (Management and Handling) Rules 2000, it is imperative for all local bodies in the country to have sanitary landfill sites that meet the requirements of law. Nariman Point in Mumbai in an excellent example of land reclamation using sanitary landfill techniques.[4]

### *C. Composting*

Composting is the decomposition of organic matter by microorganisms in warm, moist, aerobic and anaerobic environment. Farmers have been using compost made out of cow dung and other agro-waste. The compost made out of urban heterogeneous waste is found to be of higher nutrient value as compared to the compost made out of cow dung and agro-waste. Composting of MSW is, therefore, the most simple and cost effective technology for treating the organic fraction of MSW. Full-scale commercially viable composting technology is already demonstrated in India and is in use in several cities and towns. Its application to farm land, tea gardens, fruit orchards or its use as soil conditioner in parks, gardens, agricultural lands, etc., is however, limited on account of poor marketing. Main advantages of composting include improvement in soil texture and augmenting of micronutrient deficiencies. It also increases moisture-holding capacity of the soil and helps in maintaining soil health. Moreover, it is an age-old established concept for recycling nutrients to the soil.[5]

It is simple and straightforward to adopt, for source separated MSW. It does not require large capital investment, compared to other waste treatment options. Vermi-compost is the natural organic manure produced from the excreta of earthworms fed on scientifically semi-decomposed organic waste. A few vermin-composting plants generally of small size have been set up in some cities and towns in India, the largest plant being in Bangalore of about 100 MT/day capacity. Normally, vermi-composting is preferred to microbial composting in small towns as it requires less mechanization and it is easy to operate.[6] It is, however, to be ensured that toxic material does not enter the chain which if present could kill the earthworms.

### *D. Biomethanation*

Biomethanation is a comparatively well-established technology for disinfections, deodorizationand stabilization of sewage sludge, farmyard manures, animal slurries, and industrial sludge. Its application to the organic fraction of MSW is more recent and less extensive. It leads to biogas/ power generation in addition to production of compost (residual sludge). This method provides a value addition to the aerobic (composting) process and also offers certain other clear advantages over composting in terms of energy production/consumption, compost quality and net environmental gains.

This method is suitable for kitchen wastes and, other putrescible wastes, which may be too wet and lacking in structure for aerobic composting. It is a net energy producing process (100–150 kWh per tonne of waste input). A totally enclosed system enables all the gas produced to be collected for use. A modular construction of plant and closed treatment needs less land area. This plant is free from bad odour, rodent and fly menace, visible pollution, and social resistance. It has potential for co-disposal with other organic waste streams from agro based industry. Nisarguna biogas plant is an excellent example of use of biomethanation for commercial purposes.[7]

*E. Recycling*

Recycling is a process to change waste materials into new products to prevent waste of potentially useful materials, reduce the consumption of fresh raw materials, reduce energy usage, reduce air pollution (from incineration) and water pollution (from land filling) by reducing the need for "conventional" waste disposal, and lower greenhouse gas emissions as compared to plastic production. Recycling is a key component of modern waste reduction and is the third component of the "Reduce, Reuse and Recycle" waste hierarchy. Industries like glass, lumber, rubber tyres and paper manufacturers benefit greatly from recycled products. Shipbuilding industry also reclaims steel of old ships and vessels. E-waste is a growing problem, accounting for 20-50 million metric tons of global waste per year according to the EPA. TVs, monitors, mobile phones and computers are typically tested for reuse and repaired. If broken, they may be disassembled for parts still having high value. Other e-waste is shredded to ~100 mm pieces and manually checked to separate out toxic batteries and capacitors which contain poisonous metals. The remaining pieces are further shredded to ~10 mm and passed under a magnet to remove ferrous metals. Next an eddy current ejects non-ferrous metals, which are sorted by density either by centrifuge or vibrating plates. Precious metals can be dissolved in acid, sorted, and smelted into ingots. The remaining glass and plastic fractions are separated by density and sold to reprocesses. Plastic recycling is an irreplaceable way of reducing the burden of the ever increasing quantities of plastic waste in today's world.

## III. METHODS OF WASTE WATER DISPOSAL AND MANAGEMENT

Expansion of urban populations and increased coverage of domestic water supply and sewerage give rise to larger amounts of municipal wastewater. With the current stress on environmental health and water pollution concerns, there is an increasing awareness of the need to dispose of these wastewaters securely and beneficially. Use of wastewater in agriculture could be avitalattention when it is disposed of in arid and semi-arid regions. The quantity of wastewater available in most countries will account for only a small fraction of the total irrigation water requirements. But wastewater use will result in the conservation of higher quality water. As the cost of supplies of good quality water will generally be higher in water-short areas. Properly planned use of municipal wastewater improves surface water pollution problems and not only preserves valuable water resources but also takes benefit of the nutrients confined in sewage to grow crops. The nitrogen and phosphorus content of sewage reduces the requirements for commercial fertilizers. It is beneficial to consider effluent reuse at the same time as wastewater collection; treatment and disposal are planned so that sewerage system design can be improved in terms of effluent transport and treatment methods

*A. Anaerobic Bacterial Degradation of Waste Water*

During anaerobic bacterial degradation of organic matter (i.e. in the absence of oxygen), methane gas ($CH_4$), carbon dioxide ($CO_2$) and traces of other elements are formed. $CH_4$ can be used as renewable energy source, in place of fossil fuels. In this type of wastewater treatment, an additional advantage of anaerobic processes is the decrease of total bio-solids volume by 50-80%, which is more than aerobic processes can achieve. Furthermore, the final sludge is biologically stable and can serve as fertilizer or soil conditioner for agriculture. Some conventionally applied anaerobic technologies (e.g. septic tanks) are suitable for domestic wastewater treatment at the single household level or for facilities shared between several households. Other technologies, such as the anaerobic sludge digester, being one common part of the activated sludge process (an aerobic wastewater treatment process) and the up flow anaerobic sludge blanket (UASB) reactors (joint anaerobic treatment of wastewater and sludge) are appropriate for the treatment of municipal wastewater. Anaerobic sludge digesters have a long practice mainly in industrial countries. Since 1980, an increasing number of full-scale UASB anaerobic sewage treatment plants have been set up in larger warm climate countries as well. Municipal wastewater treatment often combines anaerobic and aerobic treatment steps in order to attain the best possible purification and hygienisation results. Often only the main treatment steps (aerobic wastewater treatment without a sludge digestion or anaerobic UASB treatment of sludge and wastewater without a post-treatment of the wastewater) are used in order to reduce the environmental effects. Future considerations have to be based on more strict decomposition values, environmental, hygiene and nutrient standards.[8]

1) *Main requirements of anaerobic municipal wastewater treatment*: The applicability of anaerobic treatment for municipal sewage (mixed sludge and wastewater) depends strongly on the temperature of the sewage. The optimum temperature for the activity of mesophilic anaerobic bacteria is 35°C. At lower temperatures, bacterial activity decreases, which decreases the treatment performances? So in cold climate countries (which are mostly industrialised), only a small separated portion of the sewage, namely the primary (after sedimentation) and secondary sludge (after aeration) are treated an aerobically, which

require a heavy insulation and heating system, while the bulk of the volume of the wastewater, is treated aerobically commonly with aerators in open or closed ponds. According to the present technology development combined anaerobic sewage treatment is possible without heating sewageabove 15°C. Consequently, anaerobic sewage treatment is primarily of interest for countries with a tropical or sub-tropical climate, which are mostly developing countries.[9] In addition to appropriate sewage temperatures, a further prerequisite for effective anaerobic treatment is the organic loading and nutrient content of the wastewater. The initial organic loading rate should be above 250 mg COD/l (COD = chemical oxygen demand), the optimum loading rate being >400 mg COD / l. The optimum nutrient ratio given as COD:N:P (N = nitrogen, P = phosphorus) is 190-350:5:1, anaerobic treatment however being feasible up to a ratio of 1000:5:1. The usual sewage composition meets these requirements (domestic sewage is very dilute in comparison with most industrial wastewaters). The biogas produced is commonly considered as being of minor importance in the municipal wastewater treatment situation, but collection, treatment and utilisation of the gas is necessary in order to avoid the release of $CH_4$ (which has a high greenhouse gas potential) into the atmosphere and to prevent the emission of bad smell to the neighbourhood. It can be used in electricity production (either for own demand or for feeding to the public power grid) or for heating purposes. From an ecological point of view, the gas should be transformed into $CO_2$ and water, if gas utilisation cannot be executed due to unfavourable infrastructural and economical frame conditions. Anaerobic systems can well be applied on a small scale. This is important for developing countries with a need for decentralised sewage systems, since large-scale centralised treatment is very costly. A comparison of investment and operation costs of different treatment systems shows that, given a high availability of land and thus low land costs, and not considering smell, environmental and climatic effects, pond systems at first appear to be the more economic solution. If however land is scarce and its price is high or other environmental effects are considered, then anaerobic treatment becomes even financially the more attractive and sustainable solution.[10] Compared to the activated sludge system, investment and operation costs are usually about half as high as for the anaerobic UASB process, given sufficient sewage temperatures.

### B. *Features for Joint Anaerobic Municipal Wastewater And Sludge Treatment*

1) *UASB-technology*: The UASB-process (upflow anaerobic sludge blanket) has proven to be the most promising communal or municipal anaerobic low-cost treatment technology. It can now be considered viable for municipal wastewater treatment because of its proven rapid organic removal efficiency, its simplicity and low degree of mechanisation, the low capital and maintenance costs and low land and energy requirements. UASB-reactor for domestic wastewater treatment, Mirzapur, India is built with a definite feeding system comprising of inlet pipes equally delivering influent to the bottom of the unit. The upstream velocity is in equilibrium with the sludge settling speed, so that a suspended sludge (bacterial) blanked is formed. The upstream velocity has to be constant in order to assure a proper sludge-water contact and to prevent a washout of the active bacteria so an external mixing device for this technology is not required. In addition to the distribution system, the most characteristic device is the "gas-liquid-solid-" or "three-phase separator" at the top of the reactor. Its separates the biogas and retains the solids (bacterial sludge) and the treated liquid phase, thus avoiding sludge washout. Due to their anaerobic operation, UASB-reactors are characterised by a considerably lower sludge production (the most relevant cost factor in municipal wastewater treatment) and a low energy demand, thus leaving a net energy surplus. The pathogen removal efficiency of UASB treatment methods is not considered enough if environmental standards from industrial countries are applied, in particular not for the sludge, and must be followed by a post-treatment option to meet the increasingly strict discharge standards. Nevertheless, already now a 90-99% removal of for example helminth eggs in the effluent wastewater is possible with UASB technology alone. [11]
2) *Septic Tank*: The septic tank is asuitable low cost technology and the most common, small scale, decentralised anaerobic treatment plant, however it is built without any gas collection or utilisation system. It is a simple sedimentation tank with a less need for maintenance and a treatment capacity of up to about 50 households. The system consists of a closed tank where sedimentation takes place and settleable solids are retained. Retention time of the liquid is in the order of one day. Sludge is digested anaerobically in the septic tank, which results in a reduced volume of sludge. Based on the low removal efficiencies of 30% COD, 50% BOD and 70% TSS respectively and low nutrient removal, the effluent is destined for use in agricultural irrigation. These anaerobic systems can be built and operated on various scales in size with a high degree of technical sophistication and automation, but sometimes are technically quite simple as well.[10] Anaerobic sewage sludge treatment hasnumerous advantages such as ¾ Reduction of sludge volumes , ¾ Stabilisation of the sludge, ¾ Production of biogas to be used as process energy, ¾ Valuable nutrients are retained, ¾ Anaerobic sludge can be preserved and easier removal of water.

*C.* Perspectives

With increasing skill in combined anaerobic sewage treatment for tropical countries, design, construction and operation of these reactors has been optimised, resulting in an improved system reliability. Due to less investment capital at present and in the very near future, nutrient removal is and will presumably be no focal point of wastewater treatment in the developing countries, yet the priority is to remove pathogens and the organic pollutants. For irrigation purposes in agriculture, a preservation of nutrient resources (N and P) is desired. The improvement of hygiene and sanitation conditions will also gain importance and therefore require further attention. Possibilities of biological nutrient removal with the present anaerobic/ aerobic systems are not yet adequately considered. Usually, the carbon content is too low so that an additional source of carbon is required.

## IV. METHODS OF DISPOSAL OF HAZARDOUS WASTE AND MANAGEMENT

The purpose of treating hazardous waste is to change it into non-hazardous substances or to stabilise or condense the waste so that it will not migrate and cause a hazard when released into the environment. Stabilisation or encapsulating techniques are mainly required for inorganic wastes such as those containing toxic heavy metals. Commercial facilities are available locally to effectively treat all hazardous wastes arising except for organo chlorines such as PCBs, DDT, Aldrin, etc. This type of hazardous waste is denoted as intractable or problem waste. Treatment methods are generally classified as chemical, physical and/or biological.

### *A. Chemical Methods*

1) *Neutralisation:* Waste acid is neutralised with an alkali e.g. sulfuric acid with sodium carbonate.
2) *Oxidation*: Using common oxidising substances such as hydrogen peroxide or calcium hypochlorite poisonous waste can be oxidised to safer substances. e.g. cyanide waste with calcium hypochlorite:
3) *Reduction:* It is used to convert poisonous inorganic substances to a less mobile and safer form e.g. reducing Cr(VI) to Cr(III) with ferrous sulphate.
4) *Hydrolysis*: Hydrolysis of hazardous organic substances in to non- hazardous substances e.g. hydrolysis of certain organ phosphorus pesticides with sodium hydroxide.
5) *Precipitation:* It is useful for converting especially hazardous heavy metals to a less mobile, insoluble form before disposal to a landfill e.g. precipitation of cadmium as its hydroxide by the use of sodium hydroxide.[11]

### *B. Physical Methods*

1) *Encapsulation*: Arresting hazardous materials by stabilisation and incorporation within a solid matrix such as cement concrete or exclusive organic polymers prior to landfilling. e.g. encapsulating beryllium in concrete.
2) *Filtration/Centrifuging/Separation*: It involves physically separation of phases containing hazardous substances from those containing non-hazardous constituents e.g. separation of oils from ship bilge waters. [12]

### *C. Biological Methods*

These involve the use of microorganisms under optimised conditions to mineralise hazardous organic substances e.g. the use of pseudomonas under aerobic conditions to break down phenols.

### *D. Thermal Methods*

These processes involve the application of heat to convert the waste into less hazardous forms. It also decreases the volume and allows opportunities for the recovery of energy from the waste. XIV-Environment-B-Hazardous Waste-8 [13]

1) *High Temperature Incineration*: This treatment method is most commonly used to destroy hazardous organic wastes, including organ chlorines such as polychlorinated biphenyls (PCBs). Currently incineration is only available for hospital, clinical and quarantine wastes. High Temperature Incineration is the controlled combustion process which can be used to degrade organic substances. For a simple hydrocarbon complete combustion takes place. But complete combustion is difficult if not impossible to achieve but for hazardous waste 99.99% or greater destruction or removal is required for the process to be usually suitable. Combustion Parameters of Incinerators for the treatment of hazardous waste must be cautiously designed and operated if they are to achieve the efficiency of destruction essential. Combustion of organic compounds occur in two stages. In the primary stage, volatile matter is driven off leaving the rest to burn to ash. The volatiles are combusted in the secondary stage.[14] Incinerators are designed accordingly. High temperatures are needed, for most wastes 800-900$^\circ$ C is enough but for materials with high thermal stability 1100$^\circ$ C or higher is required. This temperature has to be maintained for sufficient time to let the

complete combustion take place. For example, two seconds at 1200° C would be appropriate for most organic waste. In addition to temperature and time, sufficient air must be provided to supply the oxygen needed for combustion. Public concern relating to the use of incineration for the disposal of hazardous waste relates particularly to emissions of potentially toxic combustion products from the process. Such as Carbon monoxide and hydrocarbons resulting from incomplete combustion of organic waste, Sulphur dioxide resulting from the combustion of wastes containing sulphur,Hydrogen chloride from the combustion of wastes containing chlorinated compunds,[15] Heavy metal fumes and particulates resulting from the incineration of organic wastes which also contain heavy metals such as lead, cadmium or chromium. Polychlorinated dibenzodioxins - Dioxins Polychlorinated dibenzodioxins (PCDDs) are often associated with emissions from waste incinerators which are carcinogens or cancer promoters. Gas scrubbers using alkaline liquors are used to control acid gases such as sulphur dioxide and hydrochloric acid. Particulate emissions, including heavy metals in the form of particles, are controlled by the use of bag filters (both wet and dry), high energy scrubbers or, less frequently, electrostatic precipitators. [16]

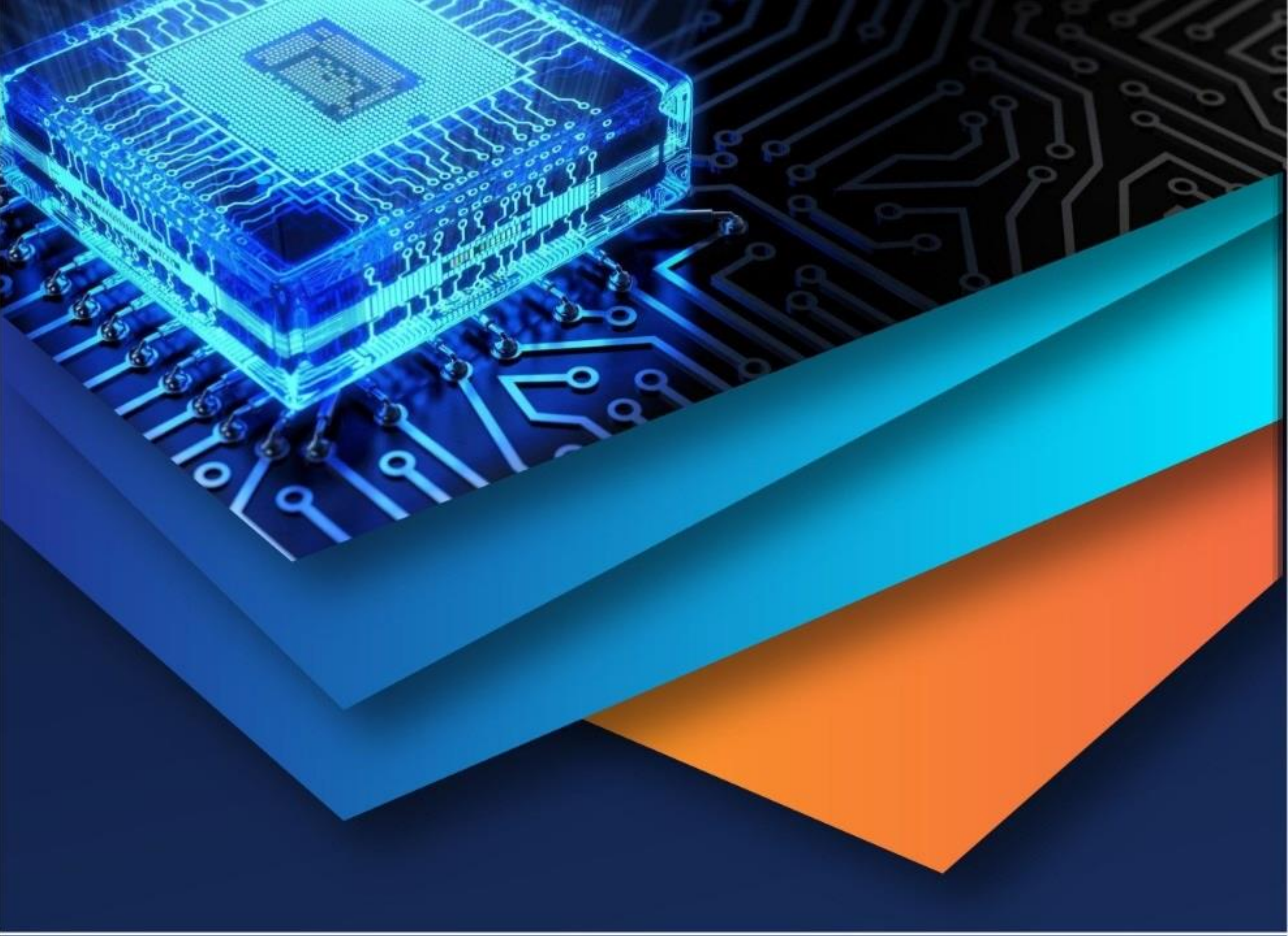
2) *Potential Environmental Impacts*: The ash resulting from incineration of hazardous waste may itself possess hazardous properties. This is expected when toxic heavy metals are involved. So the ash must be constantly monitored and may require stabilisation and encapsulation before disposal to landfills. Liquid effluent results where water is used for temperature reduction of gases. Some recycling may be combined after cooling and chemical treatment, but a quantity of liquid effluent has to be discharged after appropriate treatment. Cement Kilns used for the production of cement clinker in the production of Portland cements are designed and operated in a manner that achieves the required parameters for the destruction of hazardous waste. An additional advantage from the use of cement clinker kilns is that the alkaline particulates involved act to neutralise acidic combustion products. [17, 18]
3) *Landfills as Disposal Method:* Some of the treatment processes discussed above result in residues that themselves require disposal. This disposal is best carried out in properly designed and operated landfills. Controlled quantities of definite hazardous wastes may be broken down to non-hazardous substances, immobilised or suitably diluted by the physical, chemical and biochemical processes which occur in landfills accepting mainly normal municipal refuse. Such an exercise is called co-disposal and involves a degree of management and monitoring generally limited to the modern larger provincial landfills. [19]

## V. CONCLUSION

The national and state solid waste management missions need to be created to ensure that municipal authorities perform their obligatory duties regularly in compliance with MSW Rules 2000 within a predetermined time frame. The financial allocation of the government of India as per the 12th Finance Commission recommendations, the urban renewal fund, and state level allocations for SWM need to be pooled judiciously and used in a planned manner through the national and state missions. ULBs need to be strengthened with handholding wherever necessary to meet the challenge. The national mission should include a nation-wide awareness campaign through media using expert communication agencies seeking community participation in solid waste management. State missions should give wide publicity to conducive solid waste management practices to attract community, NGO and private sector participation. To market compost produced through SWM activities,[4] the mission should include a programme to promoteits use as compost amongst farmers raising awareness about its advantages over chemical fertilizers in preserving the fertility of the soil while leading to productivity increases. All states should appoint an Empowered Committee for the allotment of government land for treatment and disposal of waste free of cost. Local bodies as well as regional planning authorities like the District Planning Committee and Metropolitan Planning Committees, Improvement Trusts, and Urban Development Authorities should make adequate provisions of appropriate land for setting up temporary waste store depots in each city and for setting up treatment plants and sanitary landfill sites. Though levels of SWM services in the country have started improving on account of active monitoring by the Supreme Court of India, the central and state pollution control boards and finance and technical support from proactive state governments there still is a long way to go. A firm commitment from central and the state governments towards a time bound mission to turn the provisions into action is urgent. A comprehensive nationwide programme needs to be actively implemented for the proper management of the ever increasing solid waste to ensure that the dream of "Swachha Bharat" materialises into reality. Established chemical, physical, and or biological methods are available to stabilise or break down most hazardous waste to a form which will have minimal adverse effect on health, safety and or the environment. Methods available are appropriate for all but a few problem wastes which are mainly the organochlorine based. Technologies for these are, however, becoming more readily available. Modern refuse landfills have a role in the disposal of residuals from treatment processes and possibly for limited co-disposal of hazardous waste with normal refuse. This requires a level of management of these landfills considerably in excess of that practised at refuse dumps in the past.

## REFERENCES

[1] MOUD Report (2005). Management of Solid Waste in Indian Cities, Ministry of Urban Development, Government of India, New Delh
[2] NEERI (1995). 'Strategy Paper on SWM in India', National Environmental Engineering Research Institute, Nagpur
[3] GOI (2003). Report of the Technology Advisory Group on Solid Waste Management, Government of India Publications, New Delhi.
[4] Asnani, P.U. (2004). United States Asia Environmental Partnership Report, United States Agency for International Development, Centre for Environmental Planning and Technology, Ahmedabad. (2005). Technical Committee Report, West Bengal SWM Mission 2005, Government of West Bengal, Kolkata.
[5] Akolkar, A.B. (2005). Status of Solid Waste Management in India, Implementation Status of Municipal Solid Wastes, Management and Handling Rules 2000, Central PollutionControl Board, New Delhi.
[6] Bhide, A.D., Shekdar, A.V.,1998. Solid waste management in Indian urban centers. International Solid Waste Association Times (ISWA) 1, 26-28
[7] Ambulkar, A.R., Shekdar, A.V.,2004. Prospects of biomethanation technology in Indian context: a pragmatic approach. Journoul of Resources. Conservation and recycling 40 (20), 111-128.
[8] Alaerts, G.J., Veenstra, S., Bentvelsen, M., van Duijl, L.A. et al.: Feasibility of Anaerobic Sewage Treatment in Sanitation Strategies in Developing Countries. IHE Delft, The Netherlands, 1990
[9] Collazos C.J., Hoyos L.F., Schellinkhout, A.: Manual de DiseñoConstrucción, Operación y Mantenimiento de la PTAR "Rio Frío" Bucaramanga. DICOM-DHV. Bucaramanga, Colombia, 1991
[10] Haandel, A.C. van; Lettinga, G.: Anaerobic sewage treatment. A practical guide for regions with a hot climate. John Wiley & Sons Ltd, Chichester, England, 1994.
[11] Haskoning Consulting Engineers and Architects: Evaluation report on process performance. 14 MLD UASB treatment plant, Mirzapur, India. Internal Report. Nijmegen, The Netherlands, 1996. [
[12] Kellner C.: Biogas Technology - Global Overview on the State of the Art, Environmental, Technical and Economical Aspects. CAMARTEC-GTZ-TBW. Arusha, Tansania, 1992.
[13] Koné S.: ZusätzlicheEinsatzmöglichkeiten der Biogastechnologie in der AbfallundAbwasserbehandlung, Ergebnisse Phase I: notwendigestrategischeMaßnahmen und VorschlägezuderenDurchführung. GTZ-TBW. Frankfurt, Germany, 1992.
[14] Mang, H.-P., Navía G., Jiménez F., Guardia F.: Planta de Tratamiento de AguasResiduales "CAPINOTA". FIDESCEINCA-GTZ-BMZ-TBW, Bonn, Germany, 1997
[15] Peña Romay L.: Empleo de DigestoresAnaerobios de FlujoAscendente "DAFA", en el Tratamiento de EfluentesDomesticos del Area de Santa Cruz. UAGRM. Santa Cruz de la Sierra, Bolivia, 1998.
[16] Sasse, L.: DEWATS. Decentralised Wastewater Treatment in Developing Countries. Bremen Overseas Research and Development Association (BORDA), Bremen, Germany, 1998.
[17] Ministry for the Environment, Wellington; Hazardous Waste Management Handbook; 199
[18] Ministry for the Environment, Wellington; Landfill Guidelines; 1992
[19] New Zealand Chemical Industry Council, Wellington; Guidelines for Waste Management Practice in New Zealand; 1991



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