NATIONAL BUILDING CODE OF INDIA

PART 9 PLUMBING SERVICES
(INCLUDING SOLID WASTE MANAGEMENT)

Section 3 Solid Waste Management

BUREAU OF INDIAN STANDARDS

CONTENTS

FOREWORD

This Code (Part 9/Section 3) covers the solid waste management systems, assessment of per capita solid waste quantities and treatment of solid waste within the building, building complexes and their built environments.

In the first version of the Code formulated in 1970, three separate sections of Part 9 Plumbing Services, were brought out, namely, Section 1 Water Supply, Section 2 Drainage and Sanitation, and Section 3 Gas Supply. These sections were subsequently revised in 1983 and in 2005.

In the second revision in 2005, the Part 9 was renamed as 'Plumbing Services (Including Solid Waste Management)' and provisions on solid waste management were included for the first time under Section 1 which contained in it, Water Supply, Drainage and Sanitation. Gas Supply was covered in Section 2 of Part 9 of the Code.

In this revision, to comprehensively address the various and distinct features related to the plumbing aspects, this Part 9 has been rearranged as follows:

Section 1 Water supply
Section 2 Drainage and sanitation
Section 3 Solid waste management
Section 4 Gas supply

Based on the experience gained in the use of the provisions on solid waste management included in last version, the provisions have been modified under this new Section. The significant changes include the following:

a) Certain new terminologies have been included.
b) References to latest applicable statutory Rules and Regulations have been included.
c) Provisions related to solid waste management systems have been elaborated.
d) Accessibility provisions for persons with disabilities to enable efficient operation of refuse chutes, have been included.
e) Electrically operated dumb-waiters have been recommended for new construction having 5 storeys and above, from the erstwhile 8 storeys.
f) New clause on assessment of per capita waste quantity has been included.
g) Detailed provisions suggesting treatment methods have been included.
h) An informative Annex A relating to municipal solid waste generation has been included, covering quantity, type, description and sources of solid waste generation.
j) An Annex B relating to treatment of food waste has been included.

Reference may also be made to the Manual on Solid Waste Management, 2000, CPHEEO, Ministry of Urban Development, Governement of India.

All Indian Standards, cross-referred to in the main text of this Section, are subject to revision. The parties to agreement based on this Section are encouraged to investigate the possibility of applying the most recent editions of the standards.

For the purpose of deciding whether a particular requirement of this Section is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS 2 : 1960 'Rules for rounding off numerical values (*revised*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this Section.

NATIONAL BUILDING CODE OF INDIA

PART 9 PLUMBING SERVICES (INCLUDING SOLID WASTE MANAGEMENT)

Section 3 Solid Waste Management

1 SCOPE

This Code (Part 9/Section 3) covers the solid waste management systems, assessment of per capita solid waste quantities and treatment of solid waste within the building, building complexes and their built environments.

2 TERMINOLOGY

For the purpose of this Section, the following definitions shall apply, and for other terms those given in the accepted standard [9-3(1)] shall apply.

2.1 Anaerobic Digestion — A controlled process involving microbial decomposition of organic matter in the absence of oxygen.

2.2 Authorization — The consent given by the State Pollution Control Board or Pollution Control Committee, as the case may be, to the operator of a facility.

2.3 Biodegradable Substance — A substance that can be degraded by microorganisms into simpler stable compounds.

2.4 Biomethanation — A process which entails enzymatic decomposition of the organic matter by microbial action to produce methane rich biogas.

2.5 Collection — Lifting and removal of solid wastes from collection points or any other location.

2.6 Composting — A controlled process involving microbial decomposition of organic matter.

2.7 Construction and Demolition Waste — Wastes from building materials debris and rubble resulting from construction, re-modelling, repair and demolition operation.

2.8 Disposal — Final disposal of municipal solid wastes in accordance with the specified measures to prevent contamination of groundwater, surface water and ambient air quality.

2.9 Generator of Wastes — Persons or establishments generating municipal solid wastes.

2.10 Landfilling — Disposal of residual solid wastes on land in a facility designed with protective measures against pollution of groundwater, surface water and air fugitive dust, wind-blown litter, bad odour, fire hazard, bird menace, pests or rodents, greenhouse gas emissions, slope instability and erosion.

2.11 Leachate — Liquid that seeps through solid wastes or other medium and has extracts of dissolved or suspended material from it.

2.12 Municipal Authority — Municipal Corporation, Municipality, Nagar Palika, Nagar Nigam, Nagar Panchayat, Municipal Council including notified area committee (NAC) or any other local body constituted under the relevant statutes and, where the management and handling of municipal solid waste is entrusted to such agency.

2.13 Municipal Solid Waste — Commercial and residential wastes generated in municipal or notified areas in either solid or semi-solid form, excluding industrial hazardous wastes and construction and demolition waste but including treated bio-medical wastes.

2.14 Operator of a Facility — A person who owns or operates a facility for collection, segregation, storage, transportation, processing and disposal of municipal solid wastes and also includes any other agency appointed as such by the municipal authority for the management and handling of municipal solid wastes in the respective areas.

2.15 Pelletization — A process whereby pellet are prepared which are small cubes or cylindrical pieces made out of solid wastes and includes fuel pellets which are also referred as refuse derived fuel.

2.16 Processing — The process by which solid wastes are transformed into new or recycled products.

2.17 Recycling — The process of transforming segregated solid wastes into raw materials for producing new products, which may or may not be similar to the original products.

2.18 Segregation — To separate the municipal solid wastes into the groups of organic, inorganic, recyclables and hazardous wastes.

2.19 Storage — The temporary containment of municipal solid wastes in a manner so as to prevent littering, attraction to vectors, stray animals and excessive foul odour.

2.20 Transportation — Conveyance of municipal solid wastes from place to place hygienically through

specially designed transport system so as to prevent foul odour, littering, unsightly conditions and accessibility to vectors.

2.21 Vermi-composting — A process of using earthworms for conversion of biodegradable wastes into compost.

3 GENERAL

3.1 Solid waste is generated from various human activities and which is normally disposed as useless and unwanted. Broadly, depending upon the type of building and built environment, it includes solid or semi-solid domestic waste, such as sanitary waste, commercial waste, office waste, catering and market waste and other non-residential wastes, street sweepings, silt removed or collected from the surface drains, horticulture waste, construction and demolition waste, and treated bio-medical waste. Further, there may be industrial hazardous waste, bio-medical waste and e-waste.

The primary objective of solid waste management is to collect, treat and dispose of solid wastes in an environmentally and socially satisfactory manner using the most economical means available. Ideally, solid waste should not contain faecal matter or urine but despite all precautions, some pathogens and chemical residues inevitably may be present in the waste. Uncontrolled or poorly managed intermediate decomposition of organic components of solid waste can contaminate air, water and soil resources. Implementation of integrated solid waste management practices benefits substantially, both the public health and the quality of the environment.

3.2 Based on source of generation, solid waste can be broadly categorized as follows:

a) *Domestic waste* — It is generated in residential units; and consists of food wastes, paper, cardboard, plastics, textiles, leather, yard wastes, wood, glass, metals, ashes, special wastes (for example, bulky items, consumer electronics, white goods, batteries, oil and tyres), and household hazardous wastes.

b) *Industrial waste* — It is generated in manufacturing units, fabrication plants, construction sites, power and chemical plants; and consists of packaging, hazardous wastes, ashes, special wastes, wood, steel, concrete, dirt, etc.

c) *Institutional and commercial waste* — It is generated in schools, hospitals, prisons, government centres, stores, hotels, restaurants, markets, office buildings, etc; and consists of domestic wastes, paper, cardboard, plastics, wood, glass, metals, special wastes and hazardous wastes.

d) *Horticulture waste* — It is generated in landscaping, parks, orchards, dairies, and consists of street sweepings; landscape and tree trimmings; etc.

3.3 Based on suitability for handling and disposal, solid waste can also be categorized as follows:

a) *Garbage* — Garbage is the term applied to animal and vegetable waste resulting from the handling, storage, sale, cooking and serving food. Such wastes contain putrescible organic matter, which produces strong odours and therefore attracts rats, flies and other vermin. It requires immediate attention in its storage, handling and disposal.

b) *Municipal waste* — Municipal waste includes waste resulting from municipal activities and services such as street wastes, dead animals, market wastes and abandoned vehicles. However, the term is commonly applied in a wider sense to incorporate domestic wastes and commercial wastes.

c) *Hazardous wastes* — Hazardous wastes may be defined as wastes of industrial, institutional or consumer origin which because of their physical, chemical or biological characteristics are potentially dangerous to human and the environment. It includes any waste that exhibits one of the hazardous characteristics, such as ignitability, corrosivity, reactivity, or toxicity, whether alone or when in contact with other wastes or substances. In some cases although the active agents may be liquid or gaseous, they are classified as solid waste because they are confined in solid containers. Typical examples are solvents, paints and pesticides whose spent containers are frequently mixed with municipal wastes. Good waste management should ensure that hazardous wastes are stored, collected, transported and disposed of separately, preferably after suitable treatment to render them innocuous.

   A sub-category of household hazardous waste, is post-consumer utilization waste which qualifies as hazardous waste when discarded. It includes household chemicals and other consumer products used in home care, personal care, automotive care, pest control, etc. These products exhibit characteristics of reactivity, ignitability, corrosivity, toxicity, or persistence

d) *Bio-medical waste* — Bio-medical waste is

any waste, which is generated during the diagnosis, treatment or immunization of human beings or animals or in research activities pertaining thereto or in the production or testing of biologicals. This waste is highly infectious and can be a serious threat to human health if not managed in a scientific and discriminate manner. It may include wastes like sharps, soiled waste, disposables, anatomical waste, cultures, discarded medicines, chemical wastes, etc. It has been estimated that hospitals generate bio-medical waste at a rate of 1 kg per bed day. Generally these wastes are handed over to common bio-medical treatment and disposal facilities for suitable treatment and final disposal.

Biological means any preparation made from organisms or microorganisms or product of metabolism and biochemical reactions intended for use in the diagnosis, immunization or the treatment of human beings or animals or in research activities pertaining thereto.

Bio-medical waste treatment facility means any facility wherein treatment, disposal of bio-medical waste or processes incidental to such treatment and disposal is carried out, and includes common treatment facilities. The common bio-medical treatment facilities are set up based on the need for ensuring environmentally sound management of bio-medical waste keeping in view the techno-economic feasibility and viable operation of the facility with minimal impacts on human health and environment.

All healthcare establishments including hospitals, research facilities and laboratories generate solid waste in course of performing their intended functions. 75 to 90 percent of such solid waste is non-risk healthcare waste, comparable to domestic waste. It requires minimal treatment and is safely handled by housekeeping staff. The remaining 10 to 25 percent of healthcare waste is designated as bio-hazardous waste and is designated bio-medical waste. It carries a variety of health risks in its handling and disposal. It is handled by trained staff and many safety devices and apparels are deployed. In addition, bio-medical waste includes the waste originating from minor or scattered sources, such as that produced in the course of healthcare undertaken in the home (dialysis, insulin injections, etc).

e) *Plastics* — Plastics, due to their non-biodegradable nature, versatility in use and impact on environment, can be grouped under a different category of solid waste. More than 50 percent of the plastic waste generated in our country is recycled and used in the manufacture of various plastic products. Careless disposal of plastic in various forms chokes drains, blocks the porosity of the soil, causes problems for groundwater recharge, disturbs the soil microbe activity, contaminates foodstuff and when ingested by animals, it can kill them.

3.4 Efficient collection and disposal of domestic garbage from a building or activity area is of significant importance to public health and environmental sanitation and, therefore, an essential part of the built environment. Notwithstanding the provisions given herein, the solid waste management shall have to comply with relevant statutory Rules and Regulations in force from time-to-time. The provisions of the following shall govern the procedures for handling, treatment, etc, of solid wastes as applicable to the concerned building occupancy:

a) *The Environment (Protection) Act*, 1986.
b) *The Solid Waste Management Rules*, 2016.
c) *The Bio-Medical Waste Management Rules*, 2016.
d) *The E-Waste (Management) Rules*, 2016.
e) *The Batteries (Management and Handling) Rules*, 2001.
f) *The Hazardous and Other Wastes (Management and Transboundary Movement) Rules*, 2016.
g) *The Plastics Waste Management Rules*, 2016.

NOTE — Radioactive wastes are covered under the provisions of *The Atomic Energy Act*, 1962 and rules made thereunder and the enforcement agency for these is Atomic Energy Regulatory Commission (AERC).

3.5 The provisions relating to solid waste management given in **4** are applicable to municipal solid waste and specifically exclude the hazardous chemical wastes, bio-medical waste and radioactive waste.

4 SOLID WASTE MANAGEMENT SYSTEMS

4.1 ln designing a system dealing with collection of domestic garbage for a built premises/community/ environment, the aim shall be to provide speedy and efficient conveyance as an essential objective for design of the system. The various available systems may be employed in accordance with **4.2** to **4.4**, which may be adopted individually or in combination as appropriate in specific situations.

4.1.1 The basic stages of the municipal solid waste management system include the following:

a) Waste sorting at source, collection and transportation;
b) Resource recovery through centralized sorting and recycling;
c) Resource recovery through waste processing, that is, recovery of energy; and
d) Waste transformation without recovery.

4.1.2 The functional elements of municipal solid waste management system include the following:

a) *Waste generation* — Activity in which the waste gets generated as material no longer having any value.
b) *Waste handling, sorting, storage and processing at site* — Waste handling and sorting involves the activities associated with management of waste until they are placed in storage container for collection.
c) *Collection* — Gathering of solid wastes including transportation.
d) *Transfer and transport* — Transfer of waste from smaller collection vehicle to larger transport equipment and subsequent transport of wastes over long distances to a processing or disposal site.

4.2 Sorting at Source

Sorting shall be planned based on the existing markets for recyclable materials. It is preferable to have coloured-bin system based on the usage of the facility and the types of the waste likely to be generated in the facility (such as red, green, blue, yellow).

Common sorting methods involve sorting into,

a) dry recyclable materials, for example, glass, paper, plastics, metals, etc;
b) bio-waste and garden waste;
c) bulky waste;
d) hazardous material in household waste;
e) construction and demolition waste; and
f) mingled MSW (mixed waste).

In case of sorting not done at source, it is required to plan centralized sorting. The types of sorting that may be adopted, are:

1) Hand sorting from a raised picking belt.
2) Mechanized sorting facilities using magnetic and electric field separation, density separation, etc.

Sorting at source normally recovers most of the recyclable materials for reuse. However, a small fraction of such materials may escape the sorting process. Sorting may therefore be also undertaken just prior to waste processing, waste transformation or landfilling to recover such recyclable materials.

Wherever manual sorting is adopted, care shall be taken to ensure that sorters are protected from all disease pathways and work in hygienic conditions. The movement of waste shall be planned by suitable mechanism and building shall be planned for easy movement of waste by means of garbage/material lift, ramps, etc, meeting the good engineering practices.

4.3 Refuse Chute System

4.3.1 *General*

Refuse chute system is a convenient and safe mode of transportation and collection of domestic solid wastes from buildings exceeding 5 storeys from floors at different heights. The refuse is received from the successive floor through the inlets located on the vertical system of pipes that convey refuse through it and discharge it into the collecting chamber, located at ground level, from where the refuse is cleared at suitable intervals. This system has got four functionally important components, namely, the chutes, the inlet hopper, the collection chamber and the cleaning and disinfecting arrangements.

The chute may be carried through service shafts meant for carrying drainage pipes. However, the location shall be mostly determined by the position of the inlet hopper and the collecting chamber that is most convenient for the user. It should also be considered to locate the chute away from living rooms in order to avoid noise and smell nuisance. The internal diameter of the chute shall be at least 300 mm.

In individual chute system, the inlet hopper shall be located in the passage near the kitchen and in the common chute system towards the end of the common passage. Natural ventilation should be adequate to prevent any possible odour nuisance. There should be adequate lighting at this location. For ground floor (floor 1), the inlet hoppers may be placed at a higher level, but should be easily accessible. The access to the refuse chute shall be provided from well ventilated and well illuminated common corridor or lobby and preferably it should not be located opposite or adjacent to entry of individual flats or lift.

4.3.2 *Opening for Feeding of Refuse Chute*

Opening, with top or bottom hinged shutters with appropriate lockable latch, shall be provided for convenient accessing of the refuse chute by users. It facilitates total building garbage collection at one single point and provides separate collection for dry and wet garbage. Chute system shall have the following features:

a) Sanitation system for internal cleaning of chutes, with sprinklers at every floor intake level, with disinfectant cleaning, which may preferably be automatic in operation;
b) Exhaust system with 25 to 35 air changes per hour;
c) Discharge end fire resistant door;
d) Chute may be of masonry, R.C.C. pipe, asbestos cement pipe or suitable non-corrosive material, preferably stainless steel. It should be rigid with smooth internal finish, high ductility and alkali/acid resistant properties {*see also* good practice [9-3(2)]};
e) Fire rating shall comply with **3.4.8.3** of Part 4 'Fire and Life Safety' of the Code;
f) Fire sprinklers shall be provided inside chute;
g) Vent shall be installed at roof level to remove foul smell and gases generated;
h) Chute should discharge to trolley directly;
j) Necessary automation of the system may be planned to avoid malfunction by manual operation; and
k) All care shall be taken for ensuring accessibility to the chute for persons with disabilities. The opening of the chute shall not be higher than 700 mm and there shall be a clear space of minimum 1 500 mm × 1 500 mm in front of the chute opening to gain easy access even for persons using wheelchairs. There may be high colour contrast provided around the chute opening to make it easy to identify it. The flooring in front of the chute opening may be texturally highly different from the rest of the floor.

4.3.3 *Refuse Collection Chamber*

The collection chamber may be located in ground floor or basement level, provided appropriate arrangement is made for drainage of the collection pit by gravity flow to ensure its dryness, an appropriate ramp access is provided for convenient removal of garbage from the collection pit, and satisfactory ventilation is provided for escape of gas and odour.

The floor of the chamber shall be provided with drainage through a 100 mm diameter trap and screen to prevent any solid matters flowing into the drain and the drain shall be connected to the sewer line. The floor shall be finished with smooth hard surface for convenient cleaning.

The height of the collection chamber and vertical clearance under the bottom level of garbage chute shall be such that the garbage trolley can be conveniently placed.

The collection chamber shall be provided with appropriate shutter to prevent access of scavenging animals like cattle, dogs, cats and rats.

4.3.4 *Refuse Collection Room*

The refuse collection room should be planned in ground or basement level with appropriate ventilation and proper drainage. The room should have access for vehicle or trolley transfer of garbage.

4.3.5 *See also* accepted standards [9-3(3)].

4.4 Dumb-Waiter or Service Lift

In high rise buildings with more than 5 storeys, electrically operated dumb-waiters may be used for carrying domestic garbage in packets or closed containers. For handling of garbage by dumb-waiters in a building, a garbage chamber shall have to be provided either at ground floor or basement level and the provisions of garbage collection chamber for chute as given in **4.3** shall apply.

5 ASSESSMENT OF PER CAPITA WASTE QUANTITY

5.1 For purposes of this Section, the following municipal refuse generation rates are recommended:

a) Residential refuse : 0.3 to 0.6 kg/capita/day
b) Commercial refuse : 0.1 to 0.2 kg/capita/day
c) Street sweepings : 0.05 to 0.2 kg/capita/day
d) Institutional refuse : 0.05 to 0.2 kg/capita/day

Out of the total solid waste generated, 40 percent may be taken as organic waste and 60 percent as inorganic waste. The knowledge of chemical characteristics of waste is important for selecting and designing the waste processing and disposal facilities.

5.2 These generation rates are subject to considerable site-specific factors and are required to be supported by field data. The waste contains a high percentage of ash and fine earth. The calorific value of Indian solid waste varies between 800 and 1 000 kcal/kg and the density varies between 300 and 500 kg/m^3.

5.3 Other than municipal solid waste, the following types of waste may also be generated in urban centers:

a) *Industrial waste* — Hazardous and non-hazardous waste from industrial areas within municipal limits.
b) *Bio-medical waste* — Waste from hospitals, slaughter houses, etc.
c) *Thermal power plant waste* — Fly ash from coal-based electricity generating plant within municipal limits.

d) *Effluent treatment plant waste* — Sludge from sewage treatment plants and industrial effluent treatment plants.

e) *Other wastes* — Special wastes from non-conforming areas or special units.

All waste streams shall be managed by their own waste management system.

6 TREATMENT

6.1 Garbage collected at one location may be treated for organic portion, and inorganic portion shall be handed over to vendors carrying out recycling. Organic waste generated in building/premises/community/ environment may be treated and reused as manure. The norms prescribed by the pollution board authorities shall be followed, keeping hygiene and safe operation for the working/operating people.

Biological or thermal treatment of waste can result in recovery of useful products such as compost or energy.

6.2 Biological Processes

Biological treatment involves using microorganisms to decompose the biodegradable components of waste. The following two types of processes may be typically used, the former being used more commonly:

a) *Aerobic processes* — It may comprise composting, aerated static pile composting and in-vessel composting; vermi-culture, etc. In the aerobic process the utilizable product is compost.

b) *Anaerobic processes* — It may comprise low-solids anaerobic digestion (wet process), high solids anaerobic digestion (dry process) and combined processes. In the anaerobic process the utilizable product is methane gas (for energy recovery).

6.2.1 *Composting*

Decomposition and stabilization of organic waste matter is a natural phenomenon. Composting is an organized method of producing compost manure by adopting this natural phenomenon.

a) *Manual composting* — It is an anaerobic method conventionally carried out in pits. Initially the waste is anaerobically stabilized in pits where alternate layers of solid waste and night soil are laid. The pit is completely filled and a final soil layer is laid to prevent fly breeding, entry of rain water into the pit and for conservation of the released energy. The material is allowed to decompose for 4 to 6 months after which the stabilized material is taken out and used as compost.

b) *Mechanical composting* — Mechanical processes are preferred where higher labour costs and limitations of space exist. It is the process using a combination of aerobic and anaerobic decomposition in enclosed containers. Organic wet waste composter is used where raw refuse is composted in large vessel, which are turned at intervals by mobile pedals or plates. Several other processes have now been developed, using different methods of processing of solid waste, using different designs of digester.

Latest technology uses electrically operated rapid processing organic waste convertor with different capacities as mechanical composters. The organic wet and dry waste is separated and shredder is used to homogenize the materials and blenders are used under controlled temperature and bio-enzyme addition in closed containers. These output manure may be used for horticultural/ agriculture works.

c) *Vermi-composting* — Vermi-compost treatment shall be provided to the organic wastes in composting pits located in shade. The pits shall be used to receive the garbage in a predetermined (periodic) cyclic order (for example, 5 pits to receive garbage in 5 days and these 5 pits together accepting daily load of garbage). The gross area of the composting pits may be about 0.1 m^2 per person.

The site for vermi-composting shall be enclosed from all sides with appropriate fencing (for keeping scavenging animals away) and provided with a small door for accessing the enclosed premises.

Composting pits shall be constructed either under the shade of trees (except Neem tree) or created under sheeting or shade-net, so as to keep the pits under shade. The pits shall be easily accessible for convenience of receiving of garbage through trolleys.

The composting pits shall be made in a manner that the pits do not have the risk of inundation by water. This may be achieved by appropriately raising the base level of the pit and providing weep holes from sides. Height of side walls of compost pits shall be 0.6 m to 0.75 m high. It is preferable to have the bottom of the pit without any lining.

Initiation of composting pits shall be done by providing a 75 mm thick layer of cow dung (fresh or partially decomposed), spreading 1 kg of vermi-compost and covering it with 75 mm to 100 mm thick layer of dry leaves/grass, etc, and sprinkling of water and allowing to decompose naturally for about 10 to 15 days.

Sorted garbage free from inert and toxic matters shall be applied in the composting pit in layers of 75 mm and spread, and covered with a layer of 75 mm thick dry leaves, followed by sprinkling of water.

The compost may be removed from the bottom of the compost pit after intervals of 3 to 6 months. The compost so made may be used in appropriate horticultural and related applications.

See also accepted standard [9-3(4)] for manure grade municipal solid waste compost.

6.3 Thermal Processes

Thermal treatment involves conversion of waste into gaseous, liquid and solid conversion products with concurrent or subsequent release of heat energy.

Three types of systems can be adopted, namely:

a) *Combustion systems (Incinerators)* — Thermal processing with excess amounts of air.
b) *Pyrolysis systems* — Thermal processing in complete absence of oxygen (low temperature).
c) *Gasification systems* — Thermal processing with less amount of air (high temperature).

6.4 Land Filling

6.4.1 Disposal of waste on lands identified for the purpose is typical of this method of waste disposal. The depth of filling depends upon the site topography and location and varies from deep to shallow filling. A municipal solid waste landfill plant is an engineered facility used for disposal of solid waste. Landfills in which municipal waste is placed are designated as 'MSW landfills'. The main considerations in respect of landfill sites are:

a) Specifications for landfill sites,
b) Site selection,
c) Facilities at site, and
d) Specification of land filling.

6.4.2 Improper landfill generally impacts the environment in the following ways:

a) Groundwater contamination by the leachate generated by the waste dump;
b) Surface water contamination by the run-off from the waste dump;
c) Bad odour, pests, rodents and wind-blown litter in and around the waste dump;
d) Generation of inflammable gas (for example, methane) within the waste dump;
e) Bird menace above the waste dump which affects flight of aircraft;
f) Fires within the waste dump;
g) Erosion and stability problems relating to slopes of the waste dump;
h) Epidemics through stray animals;
j) Acidity to surrounding soil; and
k) Release of greenhouse gas.

6.5 Some recycling/treatment methods for food waste are given in Annex B for guidance.

6.6 *See also* accepted standards [9-3(5)] for solid waste management, and for analysis and testing of solid wastes.

6.7 Other/special wastes shall be dealt with in accordance with the statutory provisions in respect of the same (*see* **3.4**).

ANNEX A

(*Foreword*)

MUNICIPAL SOLID WASTE GENERATION

A-1 WASTE GENERATION

A-1.1 The typical type of wastes generated may be as follows:

Types of Solid Waste	Description	Sources
Food waste (garbage)	Wastes from the preparation, cooking, and serving of food. Market refuse, waste from the handling, storage, and sale of produce and meats and vegetable	Households, institutions and commercial such as hotels, stores, restaurants, markets, etc
Rubbish	a) *Combustible* (*primary organic*) — Paper, cardboard, cartons wood, boxes, plastics, rags, cloth, bedding, leather, rubber, grass, leaves, yard trimmings b) *Non-combustible* (*primary inorganic*) — Metals, tin cans, metal foils dirt, stones, bricks, ceramics, crockery, glass bottles, other mineral refuse	-do-
Ashes and residues	Residue from fires used for cooking and for heating buildings, cinders, clinkers, thermal power plants	-do-
Bulky waste	Large auto parts, tyres, stoves refrigerators, others large, appliances, furniture, large crates, trees, branches, palm fronts, stumps	-do-
Street waste	Street sweepings, dirt, leaves, catch basin dirt, animal droppings, contents of litter receptacles, dead animals	Streets, sidewalks, alleys, vacant lots, etc
Dead animals	a) *Small animals* — Cats, dogs, poultry, etc b) *Large animals* — Horses, cows, etc	-do-
Construction and demolition waste	Lumber, roofing and sheathing scraps, crop residues, rubble, broken concrete, plaster, conduit pipe, wire, insulation, etc	Construction and demolition sites, remodelling, repairing sites
Industrial waste and sludge	Solid wastes resulting from industry processes and manufacturing operations, such as food processing wastes and boiler House cinders, wood, plastic and metal scraps and shaving, etc. Effluent treatment plant sludge of industries and sewage treatment plant sledges, coarse screening, grit and septic tank	Factories, power plants, treatment plants, etc
Hazardous wastes	Pathological waste, explosives, radioactive material, toxic waste, etc	Households, hospitals, institution, stores, industry, etc
Horticulture wastes	Tree-trimmings, leaves, waste from parks and gardens, etc	Parks, gardens, roadside trees, etc

A-1.2 The typical quantity of waste generated measured per capita in urban areas may be as follows:

Population Range (Million)	*Average Per Capita Value (kg/capita/day)*
0.1-0.5	0.21
0.5-1.0	0.25
1.0-2.0	0.27
2.0-5.0	0.35
More than 5.0	0.50

A-2 INDUSTRIAL WASTE

The major generators are thermal power plants, integrated iron and steel mills, non-ferrous industries, pulp and paper industries and fertilizer and allied industries. Following are the source and quantum of generation of some major industrial wastes.

Name of Industry	*Quantity (Million tonne per annum)*
Steel and blast	35.0
Brine mud	0.02
Copper slag	0.016 4
Fly ash	30.0
Kiln dust	1.6
Lime sludge	3.0
Mica scraper waste	0.005
Phospho-gypsum	4.5
Red mud/Bauxite	3.0

A-3 SLAUGHTER HOUSE WASTE

Slaughtering of animals generates consisting of non-edible offal (lungs, large intestines, etc), stomach/ intestinal contents, dung, sludge from waste water and bones, etc. These have to be disposed of by methods like rendering/controlled incineration/burial/composting/anaerobic digestion, etc. The estimated waste generation may be as per the following:

Type of Slaughter House	*Annual Capacity*	*Dry Waste Generated (tonne per day)*
Large	Large animals more than 40 000 Small animals more than 600 000	6 to 7
Medium	Large animals – 10 001 to 40 000 Small animals – 100 001 to 600 000	2 to 6
Small	Large animals up to 10 000 Small animals up to 100 000	0.5 to 1.0

A-4 BIO-MEDICAL WASTE

The waste generated from medical activities can be hazardous, toxic and even lethal because of their high potential for disease transmission.

The components of bio-medical waste include,

a) human anatomical waste (tissues, organs, body parts, etc);
b) animal waste (as above, generated during research/experimentation, from veterinary hospitals, etc);
c) microbiology and biotechnology waste, such as, laboratory cultures, microorganisms, human and animal cell cultures, toxins, etc;
d) waste sharps, such as hypodermic needles, syringes, scalpels, broken glass, etc;
e) discarded medicines and cyto-toxic drugs;
f) soiled waste, such as dressing, bandages, plaster casts, material contaminated with blood, etc;
g) solid waste (disposable items like tubes, catheters, etc, excluding sharps);
h) liquid waste generated from any of the infected areas;
j) incineration ash; and
k) chemical waste.

The estimated generation of total waste is 1.5 kg/bed and the estimated generation of bio-medical waste at 25 percent of total waste generation.

ANNEX B

(*Foreword and Clause* 6.5)

TREATMENT OF FOOD WASTE

B-1 FOOD WASTE

Food waste represents a large percentage of the solid waste. For establishments that serve food, there is an average of 400 g of food waste generated per meal served; when both pre-service and post-service waste is considered. The organic nature of food waste makes it unsuitable for disposal by landfills, though it is bio-degradable.

In order to use the nutrient and calorific value of the food waste, it is collected, stored and then recycled. When collecting, it should be ensured that food waste does not enter the drainage system. When providing temporary storage, the risk of physical contamination of kitchen working areas should be avoided. It should be a separate ventilated room with 6 total air changes per hour. In hot climates, it shall be cooled to a temperature of 24°C to minimize odour generation. The storage area should be cleaned at least once everyday.

A brief overview of some of the ways of food waste recycling/treatment is given in **B-2** to **B-4**. Before recycling/treatment, it requires non-organic materials to be removed from food waste.

B-2 FEEDING ANIMALS

Food discards can be made available for feeding animals. This may involve provisions for farmers, zoos and many other applications. Converting food discards to animal feed and pet food is common and a suitable option for recycling food scraps.

B-3 INDUSTRIAL USES

Food waste can be used in the rendering industry for converting these materials to soaps, cosmetics and biodiesel fuel.

B-4 ANAEROBIC DIGESTION

This process involves breaking down organic matter in an oxygen-free environment in order to generate biogas, which is a combination of methane and carbon dioxide. The methane is burned for energy. The material that remains after digestion (digestate) should then be composted aerobically to complete the process and produce a valuable soil amendment.

Food waste drying system can provide a fast, simple and user friendly onsite process for decomposing and dehydrating food scraps into rich soil sediments. These systems do not require microorganisms, enzymes, fresh water or other additives.

Food cycler sterilizes, deodorizes and turns potentially harmful food scraps into safe, sterilized compost that can be reused as a soil amendment. It is a multi-phase, onsite organic food waste recycling machine that dehydrates and converts daily food waste into a sterile biomass. The sterilization process takes place at 82°C and reduces the waste volume by 85 to 93 percent. After sterilization, the food waste is converted into compostable humus-rich, high-carbon organic particles. The by-products of the process can be reused as soil amendment, compost accelerant, biofuels, animal feed, pet food, etc. Further benefits can be obtained by mixing the water produced from the food cycler units with potable or non-potable supplies to reduce the amount of water used from mains for use in gardens, landscaping and cooling towers.

LIST OF STANDARDS

The following list records those standards which are acceptable as 'good practice' and 'accepted standards' in the fulfillment of the requirements of the Code. The latest version of a standard shall be adopted at the time of enforcement of the Code. The standards listed may be used by the Authority for conformance with the requirements of the referred clauses in the code.

In the following list, the number appearing in the first column within parantheses indicates the number of the reference in this Section.

	IS No.	*Title*
(1)	9569 : 1980	Glossary of terms relating to solid wastes
(2)	6924 : 1973	Code of practice for the construction of refuse chutes in multi-storeyed buildings
(3)	12402	Mobile containers for solid waste:
	(Part 1) : 1988	General characteristics
	(Part 2) : 1988	Methods of test

	IS No.	*Title*
	12647 : 1989	Guidelines for solid waste management system — Collection equipment
	12662	Guidelines for use of vehicles for collection of municipal solid wastes:
	(Part 1) : 1989	Selection of vehicles
	(Part 2) : 2002	Guidelines for maintenance
(4)	16556 : 2016	Specification for municipal solid waste compost, manure grade
(5)	9234 : 1979	Methods for preparation of solid waste sample for chemical and microbiological analysis
	9235 : 1979	Physical analysis and determination of moisture in solid wastes (Excluding industrial solid wastes)
	10158 : 1982	Methods of analysis of solid wastes (Excluding industrial solid wastes)
	16557 : 2016	Guidelines for solid waste management — Segregation, collection and utilization at household/community level