



भारतीय मानक ब्यूरो BUREAU OF INDIAN STANDARDS

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व्यापक परिचालन मसौदा

हमारा संदर्भ : सीईडी/46 :टी-27

15 नवंबर 2015

तकनीकी समिति : राष्ट्रीय भवन निर्माण संहिता विषय समिति, सीईडी 46

प्राप्तकर्ता :

- 1 सिविल इंजीनियरी विभाग परिषद् के सभी सदस्य
- 2 राष्ट्रीय भवन निर्माण संहिता विषय समिति, सीईडी 46 व
नल-साजी सेवाओं के लिए पैनल, सीईडी 46:P17 के सभी सदस्य
- 3 रुचि रखने वाले अन्य निकाय ।

महोदय/महोदया,

निम्नलिखित मसौदा संलग्न है:

प्रलेख संख्या	शीर्षक
सीईडी 46(8060)WC	राष्ट्रीय भवन निर्माण संहिता का मसौदा : भाग 9 नल-साजी सेवाएं, अनुभाग 3 ठोस अपशिष्ट प्रबंधन [SP7(भाग9/अनुभाग 3)]

कृपया इस मसौदे का अवलोकन करें और अपनी सम्मतियाँ यह बताते हुए भेजें कि यदि यह मसौदा भारत की राष्ट्रीय भवन निर्माण संहिता के भाग के रूप में प्रकाशित हो तो इस पर अमल करने में आपके व्यवसाय अथवा कारोबार में क्या कठिनाइयाँ आ सकती हैं ।

सम्मतियाँ भेजने की अंतिम तिथि : **15 दिसंबर 2015**

यदि कोई सम्मति हो तो कृपया अधोहस्ताक्षरी को उपरिलिखित पते पर संलग्न फॉर्मेट में भेजें । हो सके तो कृपया अपनी सम्मतियाँ ई-मेल द्वारा sanjaypant@bis.org.in पर भेजें ।

यदि कोई सम्मति प्राप्त नहीं होती है अथवा सम्मति में केवल भाषा सम्बन्धी त्रुटि हुई तो उपरोक्त प्रलेखों को यथावत अंतिम रूप दे दिया जाएगा । यदि सम्मति तकनीकी प्रकृति की हुई तो विषय समितिके अध्यक्ष के परामर्श से अथवा उनकी इच्छा पर आगे की कार्यवाही के लिए विषय समिति को भेजे जाने के बाद प्रलेख को अंतिम रूप दे दिया जाएगा ।

यह प्रलेख भारतीय मानक ब्यूरो की वेबसाइट www.bis.org.in पर भी उपलब्ध है ।

धन्यवाद ।

भवदीय,

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(बी.के. सिन्हा)

प्रमुख (सिविल इंजीनियरी)

संलग्न: उपरिलिखित



भारतीय मानक ब्यूरो BUREAU OF INDIAN STANDARDS

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DOCUMENT DESPATCH ADVICE

Reference	Date
CED 46/T-27	15 November 2015

TECHNICAL COMMITTEE:

NATIONAL BUILDING CODE SECTIONAL COMMITTEE, CED 46

ADDRESSED TO:

1. All Members of Civil Engineering Division Council, CEDC
2. All Members of National Building Code Sectional Committee, CED 46 and Panel for Plumbing Services, CED 46:P17
3. All other interests.

Dear Sir/Madam,

Please find enclosed the following draft:

Doc. No.	Title
CED 46 (8060)WC	Draft National Building Code of India: Part 9 Plumbing Services, Section 3 Solid Waste Management [SP 7(Part 9/Section 3)]

Kindly examine the draft and forward your views stating any difficulties which you are likely to experience in your business or profession if this is finally adopted as Part of the National Building Code of India.

Last Date for comments: **15 December 2015.**

Comments if any, may please be made in the format as attached, and mailed to the undersigned at the above address. You are requested to send your comments preferably through e-mail to sanjaypant@bis.org.in.

In case no comments are received or comments received are of editorial nature, you may kindly permit us to presume your approval for the above document as finalized. However, in case of comments of technical nature are received then it may be finalized either in consultation with the Chairman, Sectional Committee or referred to the Sectional Committee for further necessary action if so desired by the Chairman, Sectional Committee.

This document is also hosted on BIS website www.bis.org.in.

Thanking you,

Yours faithfully,

Sd/-

(B. K. Sinha)
Head (Civil Engg)

Encl: as above

FORMAT FOR SENDING COMMENTS ON THE DOCUMENT

[Please use A4 size sheet of paper only and type within fields indicated. Comments on each clause/sub-clause/ table/figure, etc, be stated on a fresh row. Information/comments should include reasons for comments, technical references and suggestions for modified wordings of the clause.

Comments through e-mail in MS WORD format to sanjaypant@bis.org.in shall be appreciated.]

Doc. No.: CED 46(8060)WC **BIS Letter Ref:** CED 46/T-27 **Dated:** 15 November 2015

Title: NATIONAL BUILDING CODE OF INDIA: Part 9 'Plumbing Services, Section 3 Solid Waste Management' [SP 7 (Part 9/Sec 3)]

Name of the Commentator or Organization: _____

Clause No. with Para No. or Table No. or Figure No. commented (as applicable)	Comments/Modified Wordings	Justification for the Proposed Change

Draft NATIONAL BUILDING CODE OF INDIA

PART 9 PLUMBING SERVICES (INCLUDING SOLID WASTE MANAGEMENT)

Section 3 Solid Waste Management

[SP 7 (Part 9/ Section 3)]

BUREAU OF INDIAN STANDARDS

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IMPORTANT EXPLANTORY NOTE FOR USERS OF THE CODE

In this Part of the Code, where reference is made to 'good practice' in relation to design, constructional procedures or other related information, and where reference is made to 'accepted standard' in relation to material specification, testing, or other related information, the Indian Standards listed at the end of this Part may be used as a guide to the interpretation.

At the time of publication, the editions indicated in the standards were valid. All standards are subject to revision and parties to agreements based on this Part are encouraged to investigate the possibility of applying the most recent editions of the standards.

In the list of standards given at the end of this part, the number appearing in the first column indicates the number of the reference in this Part. For example:

- a) Accepted standard [9-3(1)] refers to the Indian Standard given at serial number (1) of the above list given at the end of this Section 3 of Part 9, that is IS 9569: 1980 'Glossary of terms relating to solid wastes'.
- b) Good practice [9-3(2)] refers to the Indian Standard given at serial number (2) of the above list given at the end of this Section 3 of Part 9, that is IS 6924: 1973 'Code of practice for the construction of refuse chutes in multistoreyed buildings'.

BUREAU OF INDIAN STANDARDS**DRAFT FOR COMMENTS ONLY**

(Not to be reproduced without the permission of BIS or used as a Part of National Building Code of India)

Draft NATIONAL BUILDING CODE OF INDIA:**PART 9 PLUMBING SERVICES (INCLUDING SOLID WASTE MANAGEMENT)****Section 3 Solid Waste Management****[SP 7(Part 9/Section 3)]**

ICS: 01.120; 91.040.01

**National Building Code
Sectional Committee, CED 46**

Last Date for Comments:
15 December 2015

National Building Code Sectional Committee, CED 46

FOREWORD

This Section covers the solid waste management, that is, collection and disposal of domestic garbage from a building and addresses other types of wastes such as municipal waste and electronic waste.

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 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 & Sanitation. Gas Supply was addressed in Section 2 of Part 9.

In this revision, to comprehensively address the various and distinct features related to the plumbing aspects, this Part 9 Plumbing Services 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) Also 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 in clause 4.
- d) Electrically operated dumb-waiters have been recommended for new construction having 5 storeys and above, from the erstwhile 8 storeys.
- e) New clause 5 on assessment of per capita waste quantity has been included.
- f) Detailed provisions suggesting treatment methods have been included in clause 6.
- g) An informative Annex A relating to municipal solid waste generation has been included, covering quantity, type, description and sources of solid waste generation.

Further modifications shall be done based on the comments and suggestions received as a result of this wide-circulation of the document for public comments.

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

BUREAU OF INDIAN STANDARDS**DRAFT FOR COMMENTS ONLY**

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Draft* NATIONAL BUILDING CODE OF INDIA:*PART 9 PLUMBING SERVICES (INCLUDING SOLID WASTE MANAGEMENT)****Section 3 Solid Waste Management**

[SP 7(Part 9/Section 3)]

ICS: 01.120; 91.040.01

**National Building Code
Sectional Committee, CED 46**

**Last Date for Comments:
15 December 2015**

1 SCOPE

1.1 This Section covers the design, layout, construction and maintenance of solid waste management systems within the building and within the plot.

2 TERMINOLOGY

2.1 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.

2.1.1 *Anaerobic Digestion* – A controlled process involving microbial decomposition of organic matter in the absence of oxygen.

2.1.2 *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".

2.1.3 *Biodegradable Substance* – A substance that can be degraded by microorganisms into simpler stable compounds.

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

2.1.5 *Collection* – Lifting and removal of solid wastes from collection points or any other location.

2.1.6 *Composting* – A controlled process involving microbial decomposition of organic matter.

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

2.1.8 Disposal – Final disposal of municipal solid wastes in accordance with the specified measures to prevent contamination of ground-water, surface water and ambient air quality.

2.1.9 Generator of Wastes – Persons or establishments generating municipal solid wastes.

2.1.10 Landfilling – Disposal of residual solid wastes on land in a facility designed with protective measures against pollution of ground water, 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.

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

2.1.12 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.

2.1.13 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.

2.1.14 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.

2.1.15 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.

2.1.16 Processing – The process by which solid wastes are transformed into new or recycled products.

2.1.17 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.

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

2.1.19 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.

2.1.20 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.

2.1.21 Vermi-composting – A process of using earthworms for conversion of biodegradable wastes into compost.

3 GENERAL

3.1 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 construction 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. In this regard, the provisions of the following shall govern the procedures for handling, treatment, etc of solid wastes as applicable to the concerned building occupancy:

- a) *Manufacture, Storage and Import of Hazardous Chemical Rules*, 1989;
- b) *The Bio-Medical Waste (Management and Handling) Rules*, 1998;
- c) *The Municipal solid wastes (Management and Handling) Rules*, 2000;
- d) *The Hazardous Wastes (Management, Handling and Transboundary Movement) Rules*, 2008;
- e) *The Plastic waste (Management and Handling) Rules*, 2011; and
- f) *The E waste (Management and Handling) Rules*, 2011.

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

4 SOLID WASTE MANAGEMENT SYSTEMS

4.1 In 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 planned to be generated in the facility (such as red, green, blue, yellow).

Common sorting methods are:

- a) Dry recyclable materials, for example, glass, paper, plastics, cans, 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. Further 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

Refuse chute system is a convenient and safe mode of collection of domestic solid wastes from buildings exceeding 5 storeys. The internal diameter of the chute shall be at least 300 mm.

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.

4.3.1 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 (see Fig. 1) 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 25-35 air changes/hr,
- c) Discharge end fire resistant door,
- d) The 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',
- f) Fire sprinklers shall be provided in side chute,
- g) Vent shall be installed at roof level to remove foul smell and gases generated,
- h) Chute should discharge to trolley directly, and
- j) Necessary automation of the system may be planned to avoid malfunction by manual operation.



FIG. 1 TYPICAL CHUTE WITH OPENABLE DOOR DETAIL

4.3.2 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.

4.3.3 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.

4.3.4 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.

4.5 The electronic waste may be dealt with in accordance with the *E-waste (Management and Handling) Rules, 2011*.

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 |

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 to 1 000 Kcal/kg and the density varies between 300 to 500 kg/m³.

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) *Biomedical 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 micro-organisms 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* – Vermicompost 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 m² 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) Ground water 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 See also accepted standards [9-3(5)] for analysis and testing of solid wastes.

Annex A (*Informative*)
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	<p><u><i>Combustible (primary organic)</i></u> Paper, cardboard, cartons wood, boxes, plastics, rags, cloth, bedding, leather, rubber, grass, leaves, yard trimmings</p> <p><u><i>Non-combustible (primary inorganic)</i></u> Metals, tin cans, metal foils dirt, stones, bricks, ceramics, crockery, glass bottles, other mineral refuse</p>	-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	Small animals: cats, dogs, poultry etc. 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, 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	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:

<i>Population range (in Millions)</i>	<i>Average per capita value (kg/capita/day)</i>
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.

<i>Name of Industry</i>	<i>Quantity, (in Million tonnes per annum)</i>
Steel and Blast	35.0
Brine mud	0.02
Copper slag	0.0164
Fly ash	30.0
Kiln dust	1.6
Lime sludge	3.0
Mica scraper waste	0.005
Phosphogypsum	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 dispose of by methods like rendering/controlled incineration/burial/composting/anaerobic digestion, etc. The estimated waste generation may be as per the following:

Sl.No	Type of slaughter house	Annual capacity	Dry waste generated
1.	Large	Large animals more than 40000 Small animals more than 6,00,000	6 to 7 tonnes/day
2.	Medium	Large animals more than 40000 Small animals more than 6,00,000	2 to 6 tonnes per day

3.	Small	Large animals more than 40000 Small animals more than 6,00,000	0.5 to 1.0 tonne/day
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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, micro-organisms, 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.

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 as a guide in conformance with the requirements of the referred clauses in the code.

(1)	IS 9569: 1980	Glossary of terms relating to solid wastes
(2)	IS 6924: 1973	Code of practice for the construction of refuse chutes in multistoreyed buildings
(3)	IS 12402 (Part 1): 1988	Mobile containers for solid waste, Part 1 General characteristics
	IS 12402 (Part 2): 1988	Mobile containers for solid waste, Part 2 Methods of test
	IS 12647: 1989	Solid Waste Management System - Collection Equipment - Guidelines
	IS 12662 (Part 1): 1989	Guidelines for Use of Vehicles for Collection of Municipal Solid Wastes : Part 1 Selection Of Vehicles
	IS 12662 (Part 2): 2002	Vehicles for Collection of Municipal Solid Wastes: Part 2 : Guidelines for Maintenance
(4)	FAD 7(2189)C	Draft Indian Standard specification for municipal solid waste compost, manure grade
(5)	IS 9234: 1979	Methods for preparation of solid waste sample for chemical and microbiological analysis
	IS 9235: 1979	Physical Analysis and Determination of Moisture in Solid Wastes (Excluding Industrial Solid wastes)
	IS 10158: 1982	Methods of Analysis of Solid Wastes (Excluding Industrial Solid Wastes)