

# Appendix A

## USEPA—RCRA’s Chemical Waste Compatibility List

The mixing of Group A materials with Group B materials may have the following potential consequences.

<b>Group 1A</b>	<b>Group 1B</b>
Acetylene sludge	Acid sludge
Alkaline caustic liquids	Acid and water
Alkaline cleaner	Battery acid
Alkaline corrosive liquids	Chemical cleaners
Alkaline corrosive battery fluids	Electrolyte, acid
Caustic wastewater	Etching acid liquor or solvents
Lime sludge and other corrosive alkalis	Pickling liquor and other corrosive acids
Lime wastewater	Spent acid
Lime and water	Spent mixed acid
Spent caustic	Spent sulphuric acid
<i>Potential consequences:</i> Heat generation; violent reaction	
<b>Group 2A</b>	<b>Group 2B</b>
Aluminum	Any waste in Group 1-A or 1-B
Beryllium	
Calcium	
Lithium	
Magnesium	
Potassium	
Sodium	
Zinc powder	
Other reactive metals and metal hydroxides	
<i>Potential consequences:</i> Fire or explosion; generation of flammable hydrogen gas	

(continued)

<b>Group 3A</b>	<b>Group 3B</b>
Alcohols	Any concentrated waste in Groups 1-A or 1-B
Water	Calcium
	Lithium
	Metal hydrides
	Potassium
	SO <sub>2</sub> Cl <sub>2</sub> , SOCl <sub>2</sub> , PCl <sub>3</sub> , CH <sub>3</sub> SiCl <sub>3</sub>
	Other water-reactive waste
<i>Potential consequences:</i> Fire, explosion, or heat generation; generation of flammable or toxic gases	
<b>Group 4A</b>	<b>Group 4B</b>
Alcohols	Concentrated Group 1-A or 1-B wastes
Aldehydes	Group 2A wastes
Halogenated hydrocarbons	
Nitrated hydrocarbons	
Unsaturated hydrocarbons	
Other reactive organic compounds and solvents	
<i>Potential consequences:</i> Fire, explosion, or violent reaction	
<b>Group 5A</b>	<b>Group 5B</b>
Spent cyanide and sulphide solutions	Group 1-B wastes
<i>Potential consequences:</i> Generation of toxic hydrogen cyanide or hydrogen sulphide gas	
<b>Group 6A</b>	<b>Group 6B</b>
Chlorates	Acetic acid and other organic acids
Chlorine	Concentrated mineral acids
Chlorites	Group 2-A wastes
Chromic acid	Group 5-A wastes
Hypochlorites	Other flammable and combustible wastes
Nitrates	
Nitric acid, fuming	
Perchlorates	
Permanganates	
Peroxides	
Other strong oxidizers	
<i>Potential consequences:</i> Fire, explosion, or violent reaction	

# Appendix B

## Environmental Regulations in India

Two terms are used repeatedly in the following section: Act and Rules. These terms are defined in the following table and salient features of all Acts and Rules pertaining to the environment are described after that. A more complete description of how an Act is passed in Parliament or in State legislative assemblies is available on the Internet.<sup>1</sup> The reader should rely only on the full text of each of the Acts and Rules described in [Appendix A](#). The full text can be obtained from <http://envfor.nic.in/>

Act	Rule
Act means a law	Rules are its procedures
Act means what should be done. It provides the basic framework of the law	Rules are guidelines
The Act contains substantive provisions	Rules specify the procedure for implementing the main provisions of the Act
Act is the statute which prescribes the action by its provisions	Rules flow from the statute to enable its provisions
Act contains main legal provisions on a subject	Rules are mainly procedural matters
Passing an Act is time-consuming	Making Rules takes less time

### *Water (Prevention and Control of Pollution) Act, 1974*

The main objectives of the Water Act are to provide for prevention, control and abatement of water pollution and the maintenance or restoration of the wholesomeness of water by establishing Central and State Pollution Control Boards to monitor and enforce the regulations. It is designed to assess pollution levels and punish

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Compiled by Tandra Mohanta and Deblina Dutta, IIT Kharagpur, Kharagpur.

<sup>1</sup>[https://en.wikipedia.org/wiki/Lawmaking\\_procedure\\_in\\_India](https://en.wikipedia.org/wiki/Lawmaking_procedure_in_India)

polluters. The Act was enacted in 1974 and amended in 1988. The Water (Prevention and Control of Pollution) Cess Act was enacted in 1977 to provide for the levy and collection of a cess on water consumed by persons operating and carrying on certain types of industrial activities. This cess is collected with a view to augment the resources of the Central Board and the State Boards for the prevention and control of water pollution constituted under the Water (Prevention and Control of Pollution) Act, 1974. The Water (Prevention and Control of Pollution) Cess Act was last amended in 2003.<sup>2</sup>

### **Salient Features of the Act**

- The Act deals with water pollution and presents an integrated approach to tackle the problem. It is an important legislative measure which was enacted to implement the decision taken in the United Nations' Conference on Human Environment held in June 1972 at Stockholm.
- The Water (Prevention and Control of Pollution) Act, 1974 has 64 Sections and has been divided into eight chapters relating to (i) Preliminary, (ii) Central and State Boards for the Prevention and Control of Water Pollution, (iii) Joint Boards, (iv) Powers and Functions of the Boards, (v) Prevention and Control of Water Pollution, (vi) Funds, Accounts and Audit, (vii) Penalties and Procedures, and (viii) Miscellaneous.
- The Act provides for the creation of the Central Pollution Control Board and State Pollution Control Boards for preventing water pollution, power to take water samples and their analysis, discharge of sewage or trade effluents, appeals, revision, minimum and maximum penalties, publication of names of offenders, offences by companies and Government departments, water laboratories, analysis, etc. It authorises the establishment of Joint Boards.
- The Act prohibits every person from knowingly doing certain acts which cause water pollution. Violation is punishable under Section 43 of the Act with imprisonment up to 6 years and with fine. Even municipalities, or municipal corporations, companies, government departments can be prosecuted under Water Act.

### ***Air (Prevention and Control of Pollution) Act, 1981***

The Air (Prevention & Control of Pollution) Act was enacted by the Parliament in 1981 and amended in 1987. The objective of this Act is to prevent, control and abate air pollution. It states that sources of air pollution such as industry, vehicles, power plants, etc., are not permitted to release particulate matter, lead, carbon monoxide, sulphur dioxide, nitrogen oxide, volatile organic compounds (VOCs) or other toxic substances beyond a prescribed level. The Act specifically empowers State

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<sup>2</sup><http://envfor.nic.in/division/water-pollution>

Governments to designate air pollution control areas and to prescribe the type of fuel to be used in these designated areas. According to this Act, no person can operate certain types of industries including asbestos, cement, fertilizer and petroleum industries without consent of the State Board.

The main objectives of the Act are:

- (a) To provide for the prevention, control and abatement of air pollution.
- (b) To confer on Central and State Pollution Control Boards the powers to implement the provisions of the Act and assign to the Boards functions relating to pollution.

### ***Environment Protection Act, 1986***

The Environment Protection Act was enacted in 1986 with the objective of providing protection and improvement of the environment. The Act was last amended in 1991. It empowers the Central Government to establish authorities [under section 3(3)] charged with the mandate of preventing environmental pollution in all its forms and to tackle specific environmental problems that are peculiar to different parts of the country.

According to section 2(a) of Environmental Protection Act (1986), 'Environment' includes (i) water, air and land, and (ii) the interrelationship which exists among and between (a) water, air and land and (b) human beings, other living creatures, plants, micro-organisms and property.

### ***Hazardous Waste (Management, Handling and Transboundary Movement) Rules, 2008***

Hazardous Waste Management Rules are notified to ensure safe handling, generation, processing, treatment, packaging, storage, transportation, use, reprocessing, collection, conversion, and offering hazardous waste for sale, destruction and disposal. These Rules came into effect in the year 1989 and have been amended in the years 2000 and 2003. The current notification of the Hazardous Waste (Management, Handling and Transboundary Movement) Rules, 2008 supersedes former notifications. The Rules lay down corresponding duties of various authorities such as MoEF, CPCB, State/UT Govts., SPCBs/PCCs, DGFT, Port Authority and Custom Authority while State Pollution Control Boards/Pollution Control Committees have been designated with wider responsibilities touching almost every aspect of hazardous wastes generation, handling and their disposal.

Hazardous waste means any waste which by reason of any of its physical, chemical, reactive, toxic, flammable, explosive or corrosive characteristics causes danger or is likely to cause danger to health or environment, whether alone or when in contact with other wastes or substances.

These Rules do not apply to the following categories of waste which are also hazardous but are regulated under a different set of rules and regulations:

- (a) Wastewater and exhaust gases as covered under the provisions of the Water (Prevention and Control of Pollution) Act, 1974 (6 of 1974) and the Air (Prevention and Control of Pollution) Act, 1981 (14 of 1981) and rules made thereunder [Regulatory body is the State Pollution Control Board];
- (b) Wastes arising out of the operation from ships beyond five kilometres as covered under the provisions of the Merchant Shipping Act, 1958 (44 of 1958) and the rules made thereunder [Regulatory body is the Director General of Shipping, Government of India];
- (c) Radioactive wastes as covered under the provisions of the Atomic Energy Act, 1962 (33 of 1962) and rules made thereunder [Regulatory body is the Dept. of Atomic Energy, Government of India (under direct charge of Prime Minister)];
- (d) Bio-medical wastes covered under the Bio-Medical Wastes (Management and Handling) Rules, 1998 made under the Act [Regulatory body is the State Pollution Control Board];
- (e) Wastes covered under the Municipal Solid Wastes (Management and Handling) Rules, 2000 made under the Act [Regulatory body is the State Pollution Control Board]; and
- (f) Lead acid batteries covered under the Batteries (Management and Handling) Rules, 2001 made under the Act [Regulatory body is the State Pollution Control Board].

### ***Fly Ash Rules, 1999***<sup>3</sup>

S.O. 1396(E)—Whereas by notification number S.O. 763(E) dated the 14th September, 1999 (hereinafter referred to as the said notification), notification S.O. 979(5) dated the 27th August, 2003 and S.O. 2804 (E) dated the 3rd November, 2009, the Central Government issued directions for restricting the excavation of top soil for manufacture of bricks and promoting utilisation of fly ash in the manufacture of building materials and in construction activities with a specified radius of 100 kilometres from coal or lignite based thermal power plants;

And whereas, vide the said amendment notification number S.O. 804(E) dated the 3rd November, 2009, timeline to achieve the target of 100% utilisation of fly ash by thermal power plants was specified;

And whereas, it is observed that the thermal power plants are yet to achieve the target of 100% utilization of fly ash and the unutilised fly ash quantum is continuously increasing;

And whereas, it is observed that the construction agencies are not using fly ash and fly ash based-products in their construction projects;

And whereas, it is felt that there is an urgent need to provide additional measures for utilization of fly ash and fly ash based products in the country;

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<sup>3</sup>Emphasis in bold is by the editor

And whereas, the issue has been examined by the Government of India in the Ministry of Environment and Forests and the Central Government is of the opinion that the said notification needs to be amended;

And whereas, clause (a) of sub-rule (3) of rule 5 of the Environment (Protection) Rules, 1986 provides that whenever the Central Government considers it expedient to impose prohibition or restrictions on the locations of any industry or the carrying on of processes or operations in any area, it may give notice of its intention to do so.

### ***Draft Amendments***

(1A) Every construction agency engaged in the construction of buildings within a radius of **500 kms (by road)** from a coal or lignite-based thermal power plant shall use only fly ash based products for construction, such as: cement/concrete, fly ash bricks or blocks or tiles or clay fly ash bricks, blocks or tiles or cement fly ash bricks or bricks or blocks or similar products or a combination or aggregate of them in every construction project.

(1B) The provisions of sub-paragraph (1A) shall be applicable to all construction agencies of Central or State or Local Government and private or public sector. It shall be the responsibility of the agencies either undertaking construction or approving the design or both to ensure compliance of the provisions of sub-paragraph (1A) and to submit annual returns to the concerned State Pollution Control Board or Pollution Control Committee.

(1C) Minimum fly ash content for building materials or products to qualify as “fly ash based products” category shall be as given in the table below:

S. No. (1)	Building materials or products (2)	Minimum % of fly ash by weight (3)
1.	Fly ash bricks, blocks, tiles, etc. made with fly ash, lime, gypsum, sand, stone dust, cement, etc. (without clay).	50% of total raw material.
2.	Paving blocks, paving tiles, checker tiles, mosaic tiles, roofing sheets, pre-cast elements, etc. wherein cement is used as binder.	Usage of PPC (fly ash) or 15% of OPC content.
3.	Cement.	15% of total raw materials.
4.	Clay based building materials such as bricks, blocks, tiles, etc.	25% of total raw materials.
5.	Concrete, mortar and plaster.	Usage of PPC (fly ash) or 15% of total raw material.

(2) The authority for ensuring the use of specified quantity of fly ash as per para (1C) above shall be the concerned Regional Officer of the State Pollution Control Board or the Pollution Control Committee as the case may be. In case of non-compliance, the said authority, in addition to cancellation of consent order issued to establish the brick kiln, shall move the district administration for cancellation of mining lease. The cancellation of mining lease shall be decided after due hearing. To enable the said authority to verify the actual use of fly ash, the thermal power plant shall maintain month-wise records of fly ash made available to each brick kiln.

(2A) The concerned State Government or Union territory Government shall be the enforcing and monitoring authority for ensuring compliance of the provisions of sub-paragraph (1A) and (1B).

(3) In case of non-availability of fly ash from thermal power plants in sufficient quantities as certified by the said power plants, within 500 kms of the site, the stipulation under subparagraph (1A) shall be suitably modified (waived or relaxed) by the concerned State Government or Union territory Government level monitoring committee mentioned elsewhere in this notification.

(3A) A decision on the application for manufacture of fly ash bricks, block and tiles and similar other fly ash based products shall be taken within 30 days from the date of receipt of the application by the concerned State Pollution Control Board or Pollution Control Committee.

(4) Each coal or lignite-based thermal power plant shall constitute a dispute settlement committee which shall include the General Manager of the thermal power plant and a representative of the relevant construction and fly ash brick manufacturing Industry Association/Body, as the case may be. Such a Committee shall ensure unhindered loading and transport of fly ash without any undue loss of time. Any unresolved dispute shall be dealt with by the concerned State or Union territory Government level monitoring committee mentioned elsewhere in this notification.

(5) **No agency, person or organization shall within a distance of 500 kms (by road) of a thermal power plant undertake construction or approve design for construction of roads or flyover embankments with top soil.** The guidelines or specifications issued by the Indian Road Congress (IRC) as contained in IRC specification No. SP: 58 of 2001 regarding use of fly ash shall be followed. Any deviation from this direction can only be agreed to on technical reasons if the same is approved by Chief Engineer (Design) or Engineer-in-Chief of the concerned agency or organisation or on production of a certificate of “fly ash not available” from the thermal power plant(s) (TPPs) located within 100 kms of the site of construction. This certificate shall be provided by the TPP within two working days from the date of receipt of a request for fly ash, if fly ash is not available.

(6) Soil required for top or side covers of embankments of roads or flyovers shall be excavated from the embankment site and if it is not possible to do so, only the minimum quantity of soil required for the purpose shall be excavated from soil borrow area. In either case, the topsoil should be kept or stored separately. **Voids created at soil borrow area shall be filled up with fly ash with proper compaction** and covered with topsoil kept separately as above. This would be done as an integral part of embankment project.

(7) No agency, person or organisation shall within a radius of **500 kms** (by road) of a coal or lignite-based thermal power plant undertake or approve or allow reclamation and compaction of low-lying areas with soil. **Only fly ash shall be used for compaction and reclamation.** They shall also ensure that such reclamation and compaction is done in accordance with the specifications and guidelines laid down by the authorities mentioned in sub-paragraph (1) of paragraph 3.

(8) (i) No person or agency shall within 50 kms (by road) from coal or lignite-based thermal power plants, **undertake or approve stowing of mine without using at least 25% of fly ash on weight to weight basis**, of the total stowing materials used

and this shall be done under the guidance of the Director General of Mines Safety (DGMS) or Central Mine Planning and Design Institute Limited (CMPDIL):

Provided that such thermal power stations shall facilitate the availability of required quality and quantity of fly ash as may be decided by the expert committee referred in subparagraph (10) for this purpose.

(ii) No person or agency shall within 50 kms (by road) from coal or lignite-based thermal power plants, **undertake or approve without using at least 20% of fly ash on volume to volume basis of the total materials used for external dump of overburden and same percentage in upper benches of back filling of opencast mines** and this shall be done under the guidance of the Director General of Mines Safety (DGMS) or Central Mine Planning and Design Institute Limited (CMPDIL):

Provided that such thermal power stations shall facilitate the availability of required quality and quantity of fly ash as may be decided by the expert committee referred in subparagraph (10) for this purpose.

(9) The provisions contained in clauses (i) and (ii) of sub-paragraph (8) shall be applicable to all mine agencies under Government, public and private sector and to mines of all minerals or metals or items. It shall be the responsibility of agencies either undertaking or approving the backfilling or stowing of mine or both to ensure compliance of provisions contained in clauses (i) and (ii) of sub-paragraph (8) and to submit annual returns to the concerned State Pollution Control Board or Pollution Control Committee and Indian Bureau of Mines (IBM) as applicable.

(10) The Ministry of Coal for this purpose shall constitute an expert committee comprising representatives from Fly Ash Unit, Department of Science and Technology, Ministry of Science and Technology, Director General of Mines Safety (DGMS), Central Mine Planning and Design Institute Limited (CMPDIL), Ministry of Environment and Forests, Ministry of Power, Ministry of Mines and the Central Institute of Mining and Fuel Research (CIMFR), Dhanbad. The Committee shall also guide and advice the back-filling or stowing in accordance with the Provisions contained in sub-paragraphs (8) and (9) above, and specifications and guidelines laid down by the concerned authorities as mentioned in subparagraph (1) of paragraph (3).

(11) The concerned State Government or Union territory Government shall be the enforcing and monitoring authority for ensuring compliance of the provisions of sub-paragraphs (8) and (9).

### ***Responsibilities of Thermal Power Plants***

Every coal or lignite based thermal power plant shall take the following steps to ensure the utilisation of fly ash generated by it, namely:

1. All coal or lignite-based thermal power stations would be free to sell fly ash to the user agencies subject to the following conditions, namely:
  - (i) The pond ash and mound ash should be made available free of any charge on “as is where is” basis to manufacturers of bricks, blocks or tiles including clay fly ash product manufacturing unit(s), farmers, the Central and the

State road construction agencies, Public Works Department, and to agencies engaged in backfilling or stowing of mines.

- (ii) At least 20% of dry ESP fly ash shall be made available free of charge to units manufacturing fly ash or clay-fly ash bricks, blocks and tiles on a priority basis over other users. If the demand from such agencies falls short of 20% of quantity, the balance quantity can be sold or disposed of by the power station as may be possible.

Provided that the fly ash obtained from the thermal power station should be utilized only for the purpose for which it was obtained from the thermal power station or plant failing which no fly ash shall be made available to the defaulting users.

2. All coal and, or lignite-based thermal power stations and, or expansion units in operation before the date of this notification are to achieve the target of fly ash utilization as per the table given below:

<b>S. No.</b>	<b>Percentage utilization of fly ash</b>	<b>Target date (Date of notification is 3 Nov 2009)</b>
<b>(1)</b>	<b>(2)</b>	<b>(3)</b>
1.	At least 50% of fly ash generation	One year from the date of issue of this notification.
2.	At least 60% of fly ash generation	Two years from the date of issue of this notification.
3.	At least 75% of fly ash generation	Three years from the date of issue of this notification.
4.	At least 90% fly ash generation	Four years from the date of issue of this notification.
5.	100% fly ash generation	Five years from the date of issue of this notification.

The unutilized fly ash in relation to the target during a year, if any, shall be utilized within next 2 years in addition to the targets stipulated for those years. The balance unutilized fly ash accumulated during first 4 years (the difference between the generation and the utilization target) shall be utilized progressively over next 5 years in addition to 100% utilization of current generation of fly ash.

3. New coal and, or lignite-based thermal power stations and, or expansion units commissioned after this notification to achieve the target of fly ash utilization as per table given below:

<b>S. No.</b>	<b>Percentage utilization of fly ash</b>	<b>Target date</b>
<b>(1)</b>	<b>(2)</b>	<b>(3)</b>
1.	At least 50% of fly ash generation	One year from the date of commissioning.
2.	At least 70% of fly ash generation	Two years from the date of commissioning.
3.	At least 90% of fly ash generation	Three years from the date of commissioning.
4.	100% fly ash generation	Four years from the date of commissioning.

The unutilized fly ash in relation to the target during a year, if any, shall be utilized within next 2 years in addition to the targets stipulated for these years. The unutilized fly ash accumulated during first 3 years (the difference between the generation and utilization target) shall be utilized progressively over next 5 years in addition to 100% utilization of current generation of fly ash.

4. All action plans prepared by coal or lignite-based thermal power plants in accordance with sub-para (2) and (3) of para (2) of this notification shall be

submitted to the Central Pollution Control Board/Committee and concerned, State Pollution Control Board/Committee and concerned regional office of the Ministry of Environment and Forests within a period of 4 months from the date of publication of this notification.

5. The Central and State Government Agencies, the State Electricity Boards, the National Thermal Power Corporation and the management of the thermal power plants shall facilitate in making available land, electricity and water for manufacturing activities and provide access to the fly ash lifting area for promoting and setting up of ash-based production units in the proximity of the area where fly ash is generated by the power plant.
6. The amount collected from sale of fly ash and fly ash based products by coal and/or lignite-based thermal power stations or their subsidiary or sister concern unit, as applicable should be kept in a separate account head and shall be utilized only for development of infrastructure or facilities and promotion/facilitation activities for use of fly ash until 100% fly ash utilization level is achieved. Thereafter as long as 100% fly ash utilization levels are maintained, the thermal power station would be free to utilize the amount collected for other development programmes also. In case, there is a reduction in the fly ash utilization levels in the subsequent year(s), the use of financial return from fly ash shall get restricted to development of infrastructure or facilities and promotion or facilitation activities for fly ash utilization until 100% fly ash utilization level is again achieved and maintained.
7. Annual implementation report (for the period 1st April to 31st March) providing information about the compliance of provisions in this notification shall be submitted by the 30th day of April, every year to the Central Pollution Control Board, concerned State Pollution Control Board or Committee and the concerned Regional Office of the Ministry of Environment and Forests by the coal or lignite-based thermal power plants, and also be made a part of the annual report of the thermal power plant as well as thermal power plant-wise information be provided in the annual report of thermal power producing agency owning more than one thermal power plant.
8. Every coal or lignite based thermal plants shall (a suitable date prospective to final notification is to be specified) upload the stock of each type of fly ash available with them on their website and, thereafter shall update the stock position for each type of fly ash at least once in every fortnight.
9. Within a radius of 100 kms from a coal or lignite-based thermal power plant, the cost of transportation of fly ash for building and road construction projects shall be borne by such coal or lignite-based thermal power plant and the cost of transportation beyond a radius of 100 kms and upto 500 kms shall be shared equally between the user construction agency engaged and the coal or lignite-based thermal power plant.
10. The coal or lignite-based thermal power plants within a radius of 500 kms shall bear the entire cost of transportation of fly ash to the site of road construction projects under Pradhan Mantri Gramin Sadak Yojna and asset creation programmes of the Government involving construction of buildings, roads, dams and embankments.

### ***Specifications for Use of Fly Ash-Based Products***

(1) Manufacture of fly ash-based products such as cement, concrete blocks, bricks, panels or any other material or the use of fly ash in construction activity such as in road laying, embankments or use as landfill to reclaim low lying areas including back filling in abandoned mines or pitheads or for any other use shall be carried out in accordance with specifications and guidelines laid down by the Bureau of Indian Standards, Indian Bureau of Mines, Indian Road Congress, Central Building Research Institute, Roorkee, Central Road Research Institute, New Delhi, Building Materials and Technology Promotion Council, New Delhi, Central Public Works Department, State Public Works Departments and other Central and State Government agencies.

(2) The Central Public Works Department, Public Works Departments in the State/Union Territory Governments, Development Authorities, Housing Boards, National Highway Authority of India and other construction agencies including those in the private sector shall also prescribe the use of fly ash and fly ash-based products in their respective tender documents, schedules of specifications and construction applications including appropriate standards and codes of practice with immediate effect.

(2A) Building construction agencies both in public and private shall prescribe the use of fly ash and fly ash-based products in their respective tender documents, schedules of specifications and construction applications, including appropriate standards and codes of practice and make provisions for the use of fly ash and fly ash based bricks, blocks or tiles or aggregates of them in the schedule of approved materials and rates immediately.

(2B) All agencies undertaking construction of roads or flyover bridges and reclamation and compaction of low lying areas, including Department of Road Transport and Highways (DORTH), National Highways Authority of India (NHAI), Central Public Works Department (CPWD), State Public Works Departments and other State Government Agencies, shall with immediate effect:

- (a) make provisions in their tender documents, schedules of approved materials and rates as well as technical documents for implementation of this notification, including those relating to soil borrow area or pit as per sub-paragraph (7) of paragraph 1; and
- (b) make necessary specifications or guidelines for road or flyover embankments that are not covered by the specifications laid down by the Indian Road Congress (IRC).

(3) All local authorities shall specify in their respective tender documents, building bye-laws and regulations, the use of fly ash and fly ash-based products and construction techniques in building materials, roads embankments or for any usage with immediate effect.

(4) The Central Electricity Authority and other approving agencies may permit the land area for emergency ash pond or fly ash storage area up to 40 h for a

500 MW unit, based on 45% ash content coal, or in the same proportion for units in other capacities taking into account the ash content in coal or lignite to be used.

(5) All financial institutions and agencies which fund construction activities shall include a clause in their loan or grant document for compliance of the provisions of this notification.

(6) A monitoring committee shall be constituted by the Central Government with members from Ministry of Coal, Central Pollution Control Board, Central Electricity Authority, Head Fly Ash Unit of Department of Science and Technology and Building Material Technology Promotion Council to monitor the implementation of the provisions of the notification and submit its recommendations or observations at least once in every 6 months to the Secretary, Ministry of Environment and Forests. Concerned Advisor or Joint Secretary in the Ministry of Environment and Forests will be the convener of this committee.

(7) For the purpose of monitoring the implementation of the provisions of the notification the State Governments or Union territory Government shall constitute a monitoring committee within 3 months from the date of issue of this notification under the chairmanship of Secretary, Department of Environment with representatives from Department of Power, Department of Mining, Road and Building Construction Department and State Pollution Control Board. This committee would deal with any unresolved issue by dispute settlement committee as prescribed in sub-paragraph (4) of paragraph (1), in addition to monitoring and facilitating implementation of this notification at the respective State Government or Union territory level. This committee would also be empowered to suitably modify (waive or relax) the stipulation under sub-paragraph (1) in case of non-availability of fly ash in sufficient quantities from thermal power plant as certified by the said power plant. The Committee will meet at least once in every quarter.

(8) It shall be the responsibility of all State Authorities approving various construction projects to ensure that Memorandum of Understanding or any other arrangement for using fly ash or fly ash based products is made between the thermal power plants and the construction agency or contractors.

### ***Recycled Plastics Manufacture and Usage Rules, 1999***

Recycled Plastics Manufacture and Usage Rules 1999, published and in effect from 2nd September 1999 were amended on 17 June, 2003. These rules were superseded by Plastic Waste (Management & Handling) Rules, 2011.

## ***Plastic Waste (Management & Handling) Rules, 2011***

### **Salient Features**

- Carry bags shall either be in natural shade (colourless), which is without any added pigments or made using only those pigments and colourants which are in conformity with Indian Standard: IS 9833:1981 titled as “List of pigments and colourants for use in plastics in contact with foodstuffs, pharmaceuticals and drinking water”, as amended from time to time.
- Recycled plastic or products made of recycled plastic shall not be used for storing, carrying, dispensing or packaging food stuffs.
- Carry bag made of virgin or recycled plastic, shall not be less than 50 microns in thickness.
- Plastic sheet or like, which is not an integral part of multilayered packaging or cover made of plastic sheet used for packaging or wrapping the commodity shall not be less than 50 microns in thickness.
- The manufacturer shall not sell or provide or arrange plastic to be used as raw material to a producer, not having valid registration from the concerned State Pollution Control Boards or Pollution Control Committee.
- Sachets using plastic material shall not be used for storing, packing or selling gutkha, tobacco and pan masala.
- Recycled carry bags shall conform to the Indian Standard: IS 14534:1998 titled as Guidelines for Recycling of Plastics, as amended from time to time.
- Carry bags made from compostable plastics shall conform to the Indian Standard: IS/ISO 17088:2008 titled as Specifications for Compostable Plastics, as amended from time to time.
- Plastic material, in any form, shall not be used in any package for packaging gutkha, pan masala and tobacco in all forms.

## ***Municipal Solid Wastes (Management and Handling) Rules, 2000 (Revised 2016<sup>4</sup>)***

Application: These rules shall apply to every municipal authority responsible for collection, segregation, storage, transportation, processing and disposal of municipal solid wastes. The revised rules have extended jurisdiction to every urban local body, outgrowths in urban agglomerations, census towns as declared by the Registrar General and Census Commissioner of India, notified areas, notified industrial townships, areas under the control of Indian Railways, airports, airbase, port and harbour, defense establishments, special economic zones, State and Central government organizations, places of pilgrims, religious and historical importance as may be notified by respective state government from time to time and to every

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<sup>4</sup><http://pib.nic.in/newsite/PrintRelease.aspx?relid=138,591>

domestic, institutional, commercial and any other non-residential solid waste generator except industrial waste, hazardous waste, hazardous chemicals, biomedical wastes, e-waste, lead acid batteries and radio-active waste.

## **Salient Features of the Revised Rules**

### *1. Duties of Waste Generators*

- All waste generators shall segregate and store the waste generated by them in three separate streams namely bio-degradable, non-biodegradable and domestic hazardous wastes in suitable bins and handover segregated wastes to authorized rag-pickers or waste collectors.
- Shall wrap securely the used sanitary waste like diapers, sanitary pads etc., in the pouches provided by the manufacturers or brand owners of these products or in a suitable wrapping material and shall place the same in the bin meant for dry waste/non-biodegradable waste.
- Shall store separately construction and demolition waste, as and when generated and dispose off as per the Construction and Demolition Waste Management Rules, 2016.
- Shall store horticulture waste and garden waste generated from his premises separately and dispose off as per the directions of the local authority.
- Shall not throw, burn or bury the solid waste generated by him, on streets, open public spaces outside his premises or in the drain or water bodies.
- Shall pay such user fee for solid waste management, as specified in the bye-laws of the local bodies.
- No person shall organize an event or gathering of more than 100 persons at any unlicensed place without intimating the local authority, at least three working days in advance. Such person or the organizer of such event shall ensure segregation of waste at source and handing over of segregated waste to waste collector or agency as specified by local authority.
- Every street vendor shall keep suitable containers for storage of waste generated during the course of his activity such as food waste, disposable plates, cups, cans, wrappers, coconut shells, leftover food, vegetables, fruits etc. and shall deposit such waste at waste storage depot or container or vehicle as notified by the local authority.
- All Resident Welfare and Market Associations, Gated communities and institution with an area >5000 sq. m and all hotels and restaurants shall, within 1 year from the date of notification of these rules and in partnership with the local authority ensure segregation of waste at source by the generators as prescribed in these rules, facilitate collection of segregated waste in separate streams, handover recyclable material to either the authorized waste pickers or the authorized recyclers. The bio-degradable waste shall be processed, treated and disposed off through composting or bio-methanation

within the premises as far as possible. The residual waste shall be given to the waste collectors or agency as directed by the local authority.

## *2. Duties of Ministry of Urban Development*

MoUD shall formulate National Policy and Strategy on Solid Waste Management including policy on Waste to Energy, promote research and development, undertake training and capacity building of local bodies, provide technical guidelines and project finance and review periodically the measures taken by the States.

## *3. Duties of Department of Fertilisers, Ministry of Chemicals and Fertilizers*

Shall provide market development assistance on city compost and ensure promotion of co-marketing of compost with chemical fertilizers in the ratio of 3–4 bags: 6–7 bags by the fertilizer companies to the extent compost is made available for marketing to the companies.

## *4. Duties of Ministry of Agriculture, Government of India*

MoA shall provide flexibility in Fertiliser Control Order for manufacturing and sale of compost, propagate utilisation of compost on farm land, set up laboratories to test quality of compost produced by local authorities or their authorized agencies.

## *5. Duties of the Ministry of Power*

MoP shall decide tariff or charges for the power generated from the Waste to Energy plants based on solid waste and ensure compulsory purchase power generated from such Waste to Energy plants by DISCOMs.

## *6. Duties of Ministry of New and Renewable Energy Sources*

MNRE shall facilitate infrastructure creation for Waste to Energy plants and provide appropriate subsidy or incentives for such Waste to Energy plants.

## *7. Duties of the Secretary–Incharge, Urban Development in the States and Union Territories and Duties of the Secretary–Incharge of Village Panchayats or Rural Development Department in the State and Union Territory*

- The Secretary, State Urban Development Department in the State or Union Territory through the Commissioner or Director of Municipal Administration or Director of Local Bodies shall prepare a state policy on solid waste management within a year.
- Ensure identification and allocation of suitable land for setting up processing and disposal facilities for solid wastes within 1 year and incorporate them in the master plan.
- Ensure that a separate space for segregation, storage, decentralized processing of solid waste is demarcated in the development plan for group housing or commercial, institutional or any other non-residential complex exceeding 200 dwellings or having a plot area exceeding 5000 square metres.

- Ensure that the developers of Special Economic Zone, Industrial Estate, Industrial Park earmark at least 5% of the total area of the plot or minimum five plots/sheds for recovery and recycling facility.
- Notify buffer zone for the solid waste processing and disposal facilities of more than 5 tons per day in consultation with the State Pollution Control Board.
- Start a scheme on registration of waste pickers and waste dealers.

#### 8. *Duties of Central Pollution Control Board*

- The Central Pollution Control Board shall co-ordinate with the State Pollution Control Boards and the Pollution Control Committees for implementation of these rules and adherence to the prescribed standards by local authorities; formulate/review the standards for ground water, ambient air, noise pollution, leachate in respect of all solid waste processing and disposal facilities.
- Review the proposals of state pollution control boards or pollution control committees on use of any new technologies for processing, recycling and treatment of solid waste and prescribe performance standards, emission norms for the same within 6 months.
- Prepare an Annual Report on implementation of these rules on the basis of reports received from State Pollution Control Boards and Committees and submit to the Ministry of Environment, Forest and Climate Change and the report shall also be put in public domain.
- Publish guidelines for maintaining buffer zone restricting any residential, commercial or any other construction activity from the outer boundary of the waste processing and disposal facilities for different sizes of facilities handling more than 5 tons per day of solid waste.
- Publish guidelines, from time to time, on environmental aspects of processing and disposal of solid waste to enable local bodies to comply with the provisions of the rules.
- Provide guidance to States or Union Territories on inter-state movement of waste.

#### 9. *Duties and Responsibilities of local authorities and village Panchayats of census towns and urban agglomerations*

- The local authorities and Panchayats shall prepare a solid waste management plan as per State Policy within 6 months.
- Arrange for door-to-door collection of segregated solid waste; integrate rag pickers/informal waste collectors in solid waste management.
- Frame bye-laws incorporating the provisions of these rules within 1 year, prescribe user fee.
- Direct waste generators not to litter and to segregate the waste at source and handover the segregated waste to authorized waste pickers or the waste collector authorized by the local authority.

- Setup material recovery facilities or secondary storage facilities and provide easy access to waste pickers and recyclers for collection of segregated recyclable waste.
- Establish waste deposition centre/s for domestic hazardous waste and ensure safe storage and transportation of the domestic hazardous waste to the hazardous waste disposal facility or as may be directed by the state pollution control board/committee.
- Direct street sweepers not to burn tree leaves collected from street sweeping and store them separately and handover to the waste collectors or agency authorised by local authority.
- Provide training on solid waste management to waste-pickers and waste collectors.
- Promote setting up of decentralized compost plant or bio-methanation plant at suitable locations in the markets or in the vicinity of markets ensuring hygienic conditions.
- Collect separately waste from sweeping of streets, lanes and by-lanes daily, or on alternate days or twice a week depending on the density of population, commercial activity and local situation.
- Collect horticulture, parks and garden waste separately and process in the parks and gardens, as far as possible.
- Transport segregated biodegradable waste to the processing facilities like compost plant, bio-methanation plant or any such facility. Preference should be given for on-site processing of such waste.
- Transport non-biodegradable waste to the respective processing facility or material recovery facilities (MRF) or secondary storage facility.
- Transport construction and demolition waste as per the provisions of Construction and Demolition Waste Management Rules, 2016.
- Involve communities in waste management and promotion of home composting, bio-gas generation, decentralized processing of waste at community level subject to control of odour and maintenance of hygienic conditions around the facility.
- Phase out the use of chemical fertilizer in 2 years and use compost in all parks, gardens maintained by local authority and wherever possible in other places under its jurisdiction. Incentives may be provided to recycling initiatives by informal waste recycling sector.
- Facilitate construction, operation and maintenance of solid waste processing facilities such as bio-methanation, microbial composting, vermi-composting, anaerobic digestion or any other appropriate processing for bio-stabilization of biodegradable wastes; waste to energy processes including refused derived fuel for combustible fraction of waste or supply as feedstock to solid waste based power plants or cement kilns.
- Make an application for grant of authorization for setting up waste processing, treatment or disposal facility if the volume of waste is exceeding five metric tons per day.

- Prepare and submit annual report before the 30th April of the succeeding year to the Commissioner or Director, Municipal Administration or designated Officer and be sent to the Secretary-in-Charge of State Urban Development Department or village panchayat or rural development department and to the respective State Pollution Control Board or Pollution Control Committee by the 31st May of every year.
- Educate workers including contract workers and supervisors for door-to-door collection of segregated waste and transporting the unmixed waste during primary and secondary transportation to processing or disposal facility.
- Ensure that the operator of a facility provides personal protection equipment including uniform, fluorescent jacket, hand gloves, raincoats, appropriate foot wear and masks to all workers handling solid waste and the same are used by the workforce.
- Ensure that provisions for setting up of centres for collection, segregation and storage of segregated wastes, are incorporated in building plan while granting approval of building plan of a group housing society or market complex.
- Frame bye-laws and prescribe criteria for levying of spot fine for persons who litters or fails to comply with the provisions of these rules and delegate powers to officers or local bodies to levy spot fines as per the bye laws framed.
- Create public awareness on SWM.
- Stop land filling or dumping of mixed waste soon after the timeline as specified in Rule 23 for setting up and operationalization of sanitary landfill is over.
- Allow only the non-usable, non-recyclable, non-biodegradable, non-combustible and non-reactive inert waste and pre-processing rejects and residues from waste processing facilities to go to sanitary landfill.
- Investigate and analyse all old open dumpsites and existing operational dumpsites for their potential of bio-mining and bio-remediation and where-soever feasible, take necessary actions to bio-mine or bio-remediate the sites.
- In absence of the potential of bio-mining and bio-remediation of dumpsite, it shall be scientifically capped as per landfill capping norms to prevent further damage to the environment.

#### 10. *Duties of District Magistrate or District Collector or Deputy Commissioner*

The District Magistrate or District Collector or Deputy Commissioner shall facilitate identification and allocation of suitable land for setting up solid waste processing and disposal facilities and review the performance of local bodies, at least once in a quarter.

### 11. *Duties of State Pollution Control Board or Pollution Control Committee*

The State Pollution Control Board or Pollution Control Committee shall enforce these rules in their State; monitor environmental standards; examine the proposal for grant of authorization; regulate Inter-State movement of waste.

### 12. *Duty of Manufacturers or Brand Owners of Disposable Products and Sanitary Napkins and Diapers.*

- All manufacturers of disposable products such as tin, glass, plastics packaging etc. or brand owners who introduce such products in the market shall provide necessary financial assistance to local authorities for establishment of waste management system.
- All such brand owners who sale or market their products in such packaging material which are non-biodegradable shall put in place a system to collect back the packaging waste generated due to their production.
- Manufacturers or brand owners or marketing companies of sanitary napkins and diapers shall explore the possibility of using all recyclable materials in their products or they shall provide a pouch or wrapper for disposal of each napkin or diapers along with the packet of their sanitary products.
- All such manufacturers, brand owners or marketing companies shall educate the masses for wrapping and disposal of their products.

### 13. *Duties of the Industrial Units Located within 100 km from the RDF and Waste to Energy Plants based on Solid Waste*

All industrial units using fuel and located within 100 km from a solid waste based RDF plant shall make arrangements within 6 months from the date of notification of these rules to replace at least 5% of their fuel requirement by RDF so produced.

### 14. *Criteria for Setting up Solid Waste Processing and Treatment Facility*

- The department dealing with the allocation of land will be responsible for providing suitable land for setting up of the solid waste processing and treatment facilities.
- The operator of the facility shall obtain necessary approvals from the State Pollution Control Board or Pollution Control Committee and responsible for safe and environmentally sound operations of the solid waste processing and/or treatment facilities.
- The operator of the solid waste processing and treatment facility shall submit annual report by 30th April to the State Pollution Control Board/ Pollution Committee and local authority.

### 15. *Criteria and Actions to be Taken for Solid Waste Management in Hilly Areas*

- Construction of landfill on the hill shall be avoided. A transfer station at a suitable enclosed location shall be setup to collect residual waste from the processing facility and inert waste. A suitable land shall be identified in the plain areas down the hill within 25 km for setting up sanitary landfill. The residual waste from the transfer station shall be disposed off at this sanitary landfill.

- In case of non-availability of such land, efforts shall be made to set up regional sanitary landfill for the inert and residual waste.

#### 16. *Criteria for Waste to Energy Process*

- Non-recyclable waste having calorific value of 1500 kcal/kg or more shall not be disposed of on landfills and shall only be utilized for generating energy either or through refuse-derived fuel or by giving away as feed stock for preparing refuse-derived fuel.
- High calorific wastes shall be used for co-processing in cement or thermal power plants.

#### 17. *State Level Advisory Body*

Every department in-charge of local bodies of the concerned State Government or Union Territory administration shall constitute a State Level Advisory Body within 6 months from the date of notification of these rules.

#### 18. *Time Frame for Implementation*

- Necessary infrastructure for implementation of these rules shall be created by the local bodies and other concerned authorities, as the case may be, on their own directly or by engaging agencies within the time frame specified in the rules, and
- Setting up solid waste processing facilities by all local bodies having 100,000 or more population within 2 years, local bodies and census towns below 100,000 population, setting up common or stand-alone sanitary landfills by or for all local bodies having 0.5 million or more population and setting up common or regional sanitary landfills by all local bodies and census towns under 0.5 million population within 3 years, bio-remediation or capping of old and abandoned dumpsites for 5 years.

#### 19. *Specifications for Sanitary Landfills*

- The rules specifies criteria for site selection, development of facilities at the sanitary landfills, specifications for land filling operations and closure on completion of landfilling, pollution prevention, closure and rehabilitation of old dumps, and specify Criteria for special provisions for hilly areas.
- The rules specify standards of processing and treatment of solid waste, composting, treated leachates and incineration.

### **Monitoring**

- The Ministry of Environment, Forest and Climate Change shall be responsible for overall monitoring the implementation of these rules in the country. It shall constitute a Central Monitoring Committee under the chairmanship of Secretary, Ministry of Environment, Forest and Climate Change comprising the Ministry of Urban Development, Ministry of Rural Development, Ministry of Chemicals

and Fertilizers, Ministry of Agriculture, Central Pollution Control Board, Three State Pollution Control Boards/Pollution Control Committees, Urban Development Departments of three State Governments, Rural Development Departments from two State Governments, three Urban Local Bodies, two census towns, FICCI, CII and two subject experts.

- This committee shall meet at least once a year to monitor and review the implementation of the rules. The Ministry may co-opt other experts, if needed. The Committee shall be renewed every 3 years.

### ***Battery (Management and Handling) Rules, 2001***

**Application** These rules shall apply to every manufacturer, importer, re-conditioner, assembler, dealer, recycler, auctioneer, consumer and bulk consumer involved in manufacture, processing, sale, purchase and use of batteries or components thereof.

#### **Responsibilities of Manufacturer, Importer, Assembler and Re-Conditioner**

1. Ensure that the used batteries are collected back as per the Schedule against new batteries sold excluding those sold to original equipment manufacturer and bulk consumer(s).
2. Ensure that used batteries collected back are of similar type and specifications as that of the new batteries sold.
3. File a half-yearly return of their sales and buy-back to the State Board in Form I latest by 30 June and 30 December of every year.
4. Set up collection centres either individually or jointly at various places for collection of used batteries from consumers or dealers.
5. Ensure that used batteries collected are sent only to the registered recyclers.
6. Ensure that necessary arrangements are made with dealers for safe transportation from collection centres to the premises of registered recyclers.
7. Ensure that no damage to the environment occurs during transportation.
8. Create public awareness through advertisements, publications, posters or by other means with regard to the following
  - (a) hazards of lead;
  - (b) responsibility of consumers to return their used batteries only to the dealers or deliver at designated collection centres; and
  - (c) addresses of dealers and designated collection centres.
9. Use the international recycling sign on the batteries.
10. Buy recycled lead only from registered recyclers.

11. Bring to the notice of the State Board or the Ministry of Environment and Forests any violation by the dealers.

### ***Batteries (Management and Handling) Rules, 2001 Also Mentioned***

1. Registration of Importers.
2. Customs clearance of imports of new lead acid batteries.
3. Responsibilities of dealer.
4. Responsibilities of recycler.
5. Procedure for registration/renewal of registration of recyclers.
6. Responsibilities of consumer or bulk consumer.
7. Responsibilities of auctioneer.
8. Prescribed Authority.
9. Duties of Central Pollution Control Board.
10. Computerization of Records and Returns.

### ***E-Waste (Management and Handling) Rules, 2011***

**Application** These rules effective from 01-05-2012 shall apply to every producer, consumer or bulk consumer involved in the manufacture, sale, and purchase and processing of electrical and electronic equipment or components as specified in Schedule-1, collection centre, dismantler and recycler of e-waste.

Two categories of end of the life electrical and electronic equipment namely (i) IT and Telecommunication Equipment and (ii) Consumer Electricals and Electronics such as TVs, Washing Machines, Refrigerators and Air Conditioners are covered under these Rules.

The rule will not apply to lead acid batteries as covered under the Batteries (Management and Handling) Rules, 2001. The rules shall not apply to Micro and Small enterprises as defined in the Micro, Small and Medium Enterprises Development Act, 2006 (27 of 2006) and radio-active wastes as covered under the provisions of the Atomic Energy Act, 1962 (33 of 1962) and rules made thereunder.

### **Salient Features of the E Waste Rules**

- The E-waste Rules place main responsibility of e-waste management on the producers of the electrical and electronic equipment by introducing the concept of “Extended Producer Responsibility (EPR)”.

- EPR means responsibility of any producer of electrical and electronic equipment, for their product beyond manufacturing until environmentally sound management of their end-of-life products.
- Under this EPR, producer is also entrusted with the responsibility to finance and organize a system to meet the costs involved in complying with EPR.

### ***E-Waste (Management and Handling) Rules, 2015***

**Application** These rules shall apply to every manufacturer, producer, consumer, bulk consumer, collection centres, dealers, refurbishers, dismantler and recycler involved in manufacture, sale, transfer, purchase, collection, storage and processing of e-waste or electrical and electronic equipment (EEE) listed in Schedule-1, including their components, consumables and spare parts which make the product operational.

In the E-waste rules of 2011 the role of producers in EPR to be fulfilled was not clarified.

The draft rules have laid down the details of how producers would go about implementing EPR. The producer of e-waste will now have to seek authorization for carrying out EPR and seek authorization from SPCB or CPCB and submit state specific plans. The state specific EPR plans by the producers will be screened by CPCB.

Producer Responsibility Organizations (PROs) are included in the new rules of 2015 in addition to the Extended Producer Responsibility (EPR).

PROs are professional organizations authorized collectively by producers, but sometimes they also act independently or on a public-private partnership basis. PROs can take the responsibility of a group of producers for collection and channelization of e-waste generated from the 'end of life' of their products.

Another new feature that has been incorporated in the new rules is the Deposit Refund Scheme. Under this, a portion of the sale price shall be retained by the producers and be refundable to consumers once the end-of-life products are channelized according to the prescribed methods.

### **Penalty**

Penalty remains the same under these rules. Penalty and punishment for noncompliance are in accordance with section 15 and 16 of the Environment (Protection) Act, 1986 which says that whoever fails to comply with the rules will be punishable with imprisonment for a term which may extend to 5 years or with fine which may extend to Rs. 1 lakh.

The penal provisions are the same as the existing rules of 2011. Stringent penal provisions are a must which can deter erring parties from violating rules.

## ***Construction and Demolition Waste Management Rules, 2016<sup>5</sup>***

**Application** The rules, effective from 29 March, 2016, shall apply to every waste resulting from construction, re-modelling, repair and demolition of any civil structure of individual or organisation or authority who generates construction and demolition waste such as building materials, debris, rubble.

### **Duties of the Waste Generator**

1. Every waste generator shall prima-facie be responsible for collection, segregation of concrete, soil and others and storage of construction and demolition waste generated, as directed or notified by the concerned local authority in consonance with these rules.
2. The generator shall ensure that other waste (such as solid waste) does not get mixed with this waste and is stored and disposed separately.
3. Waste generators who generate more than 20 tons or more in 1 day or 300 tons per project in a month shall segregate the waste into four streams such as concrete, soil, steel, wood and plastics, bricks and mortar and shall submit waste management plan and get appropriate approvals from the local authority before starting construction or demolition or remodelling work and keep the concerned authorities informed regarding the relevant activities from the planning stage to the implementation stage and this should be on project to project basis.
4. Every waste generator shall keep the construction and demolition waste within the premise or get the waste deposited at collection centre so made by the local body or handover it to the authorised processing facilities of construction and demolition waste; and ensure that there is no littering or deposition of construction and demolition waste so as to prevent obstruction to the traffic or the public or drains.
5. Every waste generator shall pay relevant charges for collection, transportation, processing and disposal as notified by the concerned authorities; Waste generators who generate more than 20 tons or more in 1 day or 300 tons per project in a month shall have to pay for the processing and disposal of construction and demolition waste generated by them, apart from the payment for storage, collection and transportation. The rate shall be fixed by the concerned local authority or any other authority designated by the State Government.

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<sup>5</sup><http://www.moef.gov.in/sites/default/files/C%20&D%20rules%202016.pdf>

### **Duties of Service Provider and Their Contractors**

1. The service providers shall prepare within 6 months from the date of notification of these rules, a comprehensive waste management plan covering segregation, storage, collection, reuse, recycling, transportation and disposal of construction and demolition waste generated within their jurisdiction.
2. The service providers shall remove all construction and demolition waste and clean the area every day, if possible, or depending upon the duration of the work, the quantity and type of waste generated, appropriate storage and collection, a reasonable timeframe shall be worked out in consultation with the concerned local authority.
3. In case the service providers have no logistics support to carry out the work specified in subrules (1) and (2), they shall tie up with the authorised agencies for removal of construction and demolition waste and pay the relevant charges as notified by the local authority.

### **Duties of Local Authority**

1. The local authority shall issue detailed directions with regard to proper management of construction and demolition waste within its jurisdiction in accordance with the provisions of these rules and the local authority shall seek detailed plan or undertaking as applicable, from generator of construction and demolition waste.
2. Chalk out stages, methodology and equipment, material involved in the overall activity and final clean up after completion of the construction and demolition.
3. Seek assistance from concerned authorities for safe disposal of construction and demolition waste contaminated with industrial hazardous or toxic material or nuclear waste if any.
4. Shall make arrangements and place appropriate containers for collection of waste and shall remove at regular intervals or when they are filled, either through own resources or by appointing private operators.
5. Shall get the collected waste transported to appropriate sites for processing and disposal either through own resources or by appointing private operators.
6. Shall give appropriate incentives to generator for salvaging, processing and or recycling preferably in-situ.
7. Shall examine and sanction the waste management plan of the generators within a period of 1 month or from the date of approval of building plan, whichever is earlier from the date of its submission.
8. Shall keep track of the generation of construction and demolition waste within its jurisdiction and establish a data base and update once in a year.
9. Shall device appropriate measures in consultation with expert institutions for management of construction and demolition waste generated including

processing facility and for using the recycled products in the best possible manner.

10. Shall create a sustained system of information, education and communication for construction and demolition waste through collaboration with expert institutions and civil societies and also disseminate through their own website.
11. Shall make provision for giving incentives for use of material made out of construction and demolition waste in the construction activity including in non-structural concrete, paving blocks, lower layers of road pavements, colony and rural roads.

### **Criteria for Storage, Processing or Recycling Facilities for Construction and Demolition Waste and Application of Construction and Demolition Waste and Its Products**

1. The site for storage and processing or recycling facilities for construction and demolition waste shall be selected as per the criteria given in Schedule I;
2. The operator of the facility as specified in sub-rules (1) shall apply in Form I for authorization from State Pollution Control Board or Pollution Control Committee.
3. The operator of the facility shall submit the annual report to the State Pollution Control Board in Form II.
4. Application of materials made from construction and demolition waste in operation of sanitary landfill shall be as per the criteria given in Schedule II.

### **Duties of State Pollution Control Board or Pollution Control Committee**

1. State Pollution Control Board or Pollution Control Committee shall monitor the implementation of these rules by the concerned local bodies and the competent authorities and the annual report shall be sent to the Central Pollution Control Board and the State Government or Union Territory or any other State level nodal agency identified by the State Government or Union Territory administration for generating State level comprehensive data. Such reports shall also contain the comments and suggestions of the State Pollution Control Board or Pollution Control Committee with respect to any comments or changes required.
2. State Pollution Control Board or Pollution Control Committee shall grant authorization to construction and demolition waste processing facility in Form III as specified under these rules after examining the application received in Form I.
3. State Pollution Control Board or Pollution Control Committee shall prepare annual report in Form IV with special emphasis on the implementation status of compliance of these rules and forward report to Central Pollution Control Board before the 31st July for each financial year.

### **Duties of State Government or Union Territory Administration**

1. The Secretary in-charge of development in the State Government or Union territory administration shall prepare their policy document with respect to management of construction and demolition of waste in accordance with the provisions of these rules within 1 year from date of final notification of these rules.
2. The concerned department in the State Government dealing with land shall be responsible for providing suitable sites for setting up of the storage, processing and recycling facilities for construction and demolition waste.
3. The Town and Country Planning Department shall incorporate the site in the approved land use plan so that there is no disturbance to the processing facility on a long term basis.
4. Procurement of materials made from construction and demolition waste shall be made mandatory to a certain percentage (say 10–20%) in municipal and Government contracts subject to strict quality control.

### **Duties of the Central Pollution Control Board**

The Board shall: (1) prepare operational guidelines related to environmental management of construction and demolition waste management.

(2) Analyze and collate the data received from the State Pollution Control Boards or Pollution Control Committee to review these rules from time to time.

(3) Coordinate with all the State Pollution Control Board and Pollution Control Committees for any matter related to development of environmental standards.

(4) Forward annual compliance report to Central Government before the 30th August for each financial year based on reports given by State Pollution Control Boards or Pollution Control Committees.

### **Duties of Bureau of Indian Standards and Indian Roads Congress**

The Bureau of Indian Standards and Indian Roads Congress shall be responsible for preparation of code of practices and standards for use of recycled materials and products of construction and demolition waste in respect of construction activities and the role of Indian Roads Congress shall be specific to the standards and practices pertaining to construction of roads.

### **Duties of the Central Government**

1. The Ministry of Urban Development, and the Ministry of Rural Development, Ministry of Panchayat Raj, shall be responsible for facilitating local bodies in compliance of these rules.
2. The Ministry of Environment, Forest and Climate Change shall be responsible for reviewing implementation of these rules as and when required.

### **Timeframe for Implementation of the Provisions of These Rules**

The timeline for implementation of these rules shall be as specified in Schedule III.

### **Accident Reporting by the Construction and Demolition Waste Processing Facilities**

In case of any accident during construction and demolition waste processing or treatment or disposal facility, the officer in charge of the facility in the local authority or the operator of the facility shall report of the accident in Form V to the local authority. Local body shall review and issue instruction, if any, to the in-charge of the facility.

### ***Biomedical Waste Handling (BWM), 2016***

Biomedical Waste (Management & Handling) Rules, 1998 were notified by the Ministry of Environment & Forests (MoEF) under the Environment (Protection) Act, 1986. These Rules apply to all persons who generate, collect, receive, store, transport, treat, dispose or handle biomedical waste in any form. The 'prescribed authority' for enforcement of the provisions of these rules in respect of all the health care facilities located in any State/Union Territory is the respective State Pollution Control Board (SPCB)/Pollution Control Committee (PCC) and in case of healthcare establishments of the Armed Forces under the Ministry of Defence shall be the Director General, Armed Forces Medical Services (DGAFMS). These Rules consist of six schedules and five forms.

The rules were recently revised, effective from their date of publication, March 28, 2016.

## Treatment and Disposal

1. Bio-medical waste shall be treated and disposed off in accordance with Schedule I, and in compliance with the standards provided in Schedule-II by the health care facilities and common bio-medical waste treatment facility.
2. Occupier shall hand over segregated waste as per the Schedule-I to common bio-medical waste treatment facility for treatment, processing and final disposal, provided that, the lab and highly infectious bio-medical waste generated shall be pre-treated by equipment like autoclave or microwave.
3. No occupier shall establish on-site treatment and disposal facility, if a service of common bio-medical waste treatment facility is available at a distance of 75 kms.
4. In cases where service of the common bio-medical waste treatment facility is not available, the Occupiers shall set up requisite biomedical waste treatment equipment like incinerator, autoclave or microwave, shredder prior to commencement of its operation, as per the authorisation given by the prescribed authority.
5. Any person including an occupier or operator of a common bio medical waste treatment facility, intending to use new technologies for treatment of bio medical waste other than those listed in Schedule I shall request the Central Government for laying down the standards or operating parameters.
6. On receipt of a request referred to in sub-rule (5), the Central Government may determine the standards and operating parameters for new technology which may be published in Gazette by the Central Government.
7. Every operator of common bio-medical waste treatment facility shall set up requisite biomedical waste treatment equipment like incinerator, autoclave or microwave, shredder and effluent treatment plant as a part of treatment, prior to commencement of its operation.
8. Every occupier shall phase out use of non-chlorinated plastic bags within 2 years from the date of publication of these rules and after 2 years from such publication of these rules, the chlorinated plastic bags shall not be used for storing and transporting of bio-medical waste and the occupier or operator of a common bio-medical waste treatment facility shall not dispose of such plastics by incineration and the bags used for storing and transporting biomedical waste shall be in compliance with the Bureau of Indian Standards. Till the Standards are published, the carry bags shall be as per the Plastic Waste Management Rules, 2011.
9. After ensuring treatment by autoclaving or microwaving followed by mutilation or shredding, whichever is applicable, the recyclables from the treated bio-medical wastes such as plastics and glass shall be given to such recyclers having valid authorisation or registration from the respective prescribed authority.
10. The Occupier or Operator of a common bio-medical waste treatment facility shall maintain a record of recyclable wastes referred to in sub-rule (9) which are

auctioned or sold and the same shall be submitted to the prescribed authority as part of its annual report. The record shall be open for inspection by the prescribed authorities.

11. The handling and disposal of all the mercury waste and lead waste shall be in accordance with the respective rules and regulations.

### **Segregation, Packaging, Transportation and Storage**

1. No untreated bio-medical waste shall be mixed with other wastes.
2. The bio-medical waste shall be segregated into containers or bags at the point of generation in accordance with Schedule I prior to its storage, transportation, treatment and disposal.
3. The containers or bags referred to in sub-rule (2) shall be labelled as specified in Schedule IV.
4. Bar code and global positioning system shall be added by the Occupier and common bio-medical waste treatment facility in 1 year time.
5. The operator of common bio-medical waste treatment facility shall transport the bio-medical waste from the premises of an occupier to any off-site bio-medical waste treatment facility only in the vehicles having label as provided in part 'A' of the Schedule IV along with necessary information as specified in part 'B' of the Schedule IV.
6. The vehicles used for transportation of bio-medical waste shall comply with the conditions if any stipulated by the State Pollution Control Board or Pollution Control Committee in addition to the requirement contained in the Motor Vehicles Act, 1988 (59 of 1988), if any or the rules made thereunder for transportation of such infectious waste.
7. Untreated human anatomical waste, animal anatomical waste, soiled waste and, biotechnology waste shall not be stored beyond a period of 48 h:
  - Provided that in case for any reason it becomes necessary to store such waste beyond such a period, the occupier shall take appropriate measures to ensure that the waste does not adversely affect human health and the environment and inform the prescribed authority along with the reasons for doing so.
8. Microbiology waste and all other clinical laboratory waste shall be pre-treated by sterilisation to Log 6 or disinfection to Log 4, as per the World Health Organisation guidelines before packing and sending to the common bio-medical waste treatment facility.

## Schedule I

### Part 1

Biomedical wastes categories and their segregation, collection, treatment, processing and disposal options.

Category (1)	Type of waste (2)	Type of bag or container to be used (3)	Treatment and disposal options (4)
Yellow	<p><b>(a) Human Anatomical Waste:</b> Human tissues, organs, body parts and fetus below the viability period (as per the Medical Termination of Pregnancy Act 1971, amended from time to time).</p> <p><b>(b) Animal Anatomical Waste:</b> Experimental animal carcasses, body parts, organs, tissues, including the waste generated from animals used in experiments or testing in veterinary hospitals or colleges or animal houses</p> <p><b>(c) Soiled Waste:</b> Items contaminated with blood, body fluids like dressings, plaster casts, cotton swabs and bags containing residual or discarded blood and blood components.</p>	Yellow coloured non-chlorinated plastic bags	Incineration or Plasma Pyrolysis or deep burial <sup>a</sup>
	<p><b>(d) Expired or Discarded Medicines:</b> Pharmaceutical waste like antibiotics, cytotoxic drugs including all items contaminated with cytotoxic drugs along with glass or plastic ampoules, vials etc.</p>	Yellow coloured non-chlorinated plastic bags or containers	<p>Incineration or Plasma Pyrolysis or deep burial<sup>a</sup>. In absence of above facilities, autoclaving or microwaving/hydroclaving followed by shredding or mutilation or combination of sterilization and shredding. Treated waste to be sent for energy recovery.</p> <p>Expired cytotoxic drugs and items contaminated with cytotoxic drugs to be returned back to the manufacturer or supplier for incineration at temperature &gt;1200 °C or to common bio-medical waste treatment facility or hazardous waste treatment, storage and disposal facility for incineration at &gt;1200 °C Or Encapsulation or Plasma Pyrolysis at &gt;1200 °C. All other discarded medicines shall be either sent back to</p>

(continued)

Category (1)	Type of waste (2)	Type of bag or container to be used (3)	Treatment and disposal options (4)
	<b>(e) Chemical Waste:</b> Chemicals used in production of biological and used or discarded disinfectants.	Yellow coloured containers or non-chlorinated plastic bags	manufacturer or disposed by incineration. Disposed of by incineration or Plasma Pyrolysis or Encapsulation in hazardous waste treatment, storage and disposal facility.
	<b>(f) Chemical Liquid Waste:</b> Liquid waste generated due to use of chemicals in production of biological and used or discarded disinfectants, Silver X-ray film developing liquid, discarded Formalin, infected secretions, aspirated body fluids, liquid from laboratories and floor washings, cleaning, house-keeping and disinfecting activities etc.	Separate collection system leading to effluent treatment system	After resource recovery, the chemical liquid waste shall be pre-treated before mixing with other wastewater. The combined discharge shall conform to the discharge norms given in Schedule III.
	<b>(g) Discarded linen, mattresses, beddings contaminated with blood or body fluid.</b>	Non-chlorinated yellow plastic bags or suitable packing material	Non-chlorinated chemical disinfection followed by incineration or Plasma Pyrolysis or for energy recovery. In absence of above facilities, shredding or mutilation or combination of sterilization and shredding. Treated waste to be sent for energy recovery or incineration or Plasma Pyrolysis. Pre-treat to sterilize with non-chlorinated chemicals on-site as per National AIDS Control Organisation or World Health Organisation guidelines thereafter for Incineration.
	<b>(h) Microbiology, Biotechnology and other clinical laboratory waste:</b> Blood bags, Laboratory cultures, stocks or specimens of micro-organisms, live or attenuated vaccines, human and animal cell cultures used in research, industrial laboratories, production of biological, residual toxins, dishes and devices used for cultures.	Autoclave safe plastic bags or containers	

(continued)

Category (1)	Type of waste (2)	Type of bag or container to be used (3)	Treatment and disposal options (4)
Red	<b>Contaminated Waste (Recyclable):</b> Wastes generated from disposable items such as tubing, bottles, intravenous tubes and sets, catheters, urine bags, syringes (without needles and fixed needle syringes) and vacutainers with their needles cut and gloves.	Red coloured non-chlorinated plastic bags or containers	Autoclaving or micro-waving/hydroclaving followed by shredding or mutilation or combination of sterilization and shredding. Treated waste to be sent to registered or authorized recyclers or for energy recovery or plastics to diesel or fuel oil or for road making, whichever is possible. Plastic waste should not be sent to landfill sites.
White (Translucent)	<b>Waste sharps including Metals:</b> Needles, syringes with fixed needles, needles from needle tip cutter or burner, scalpels, blades, or any other contaminated sharp object that may cause puncture and cuts. This includes both used, discarded and contaminated metal sharps.	Puncture proof, Leak proof, tamper proof containers	Autoclaving or Dry Heat Sterilization followed by shredding or mutilation or encapsulation in metal container or cement concrete; combination of shredding cum autoclaving; and sent for final disposal to iron foundries (having consent to operate from the State Pollution Control Boards or Pollution Control Committees) or sanitary landfill or designated concrete waste sharp pit.
Blue	<b>(a) Glassware:</b> Broken or discarded and contaminated glass including medicine vials and ampoules except those contaminated with cytotoxic wastes.	Cardboard boxes with blue coloured marking	Disinfection (by soaking the washed glass waste after cleaning with detergent and Sodium Hypochlorite treatment) or through autoclaving or microwaving or hydroclaving and then sent for recycling.
	<b>(b) Metallic Body Implants</b>	Cardboard boxes with blue coloured marking	

<sup>a</sup>Disposal by deep burial is permitted only in rural or remote areas where there is no access to common biomedical waste treatment facility. This will be carried out with prior approval from the prescribed authority and as per the Standards specified in Schedule-III. The deep burial facility shall be located as per the provisions and guidelines issued by Central Pollution Control Board from time to time.

**Part 2**

1. All plastic bags shall be as per BIS standards as and when published, till then the prevailing Plastic Waste Management Rules shall be applicable.
2. Chemical treatment using at least 10% Sodium Hypochlorite having 30% residual chlorine for 20 min or any other equivalent chemical reagent that should demonstrate  $\text{Log}_{10}4$  reduction efficiency for microorganisms as given in Schedule III.
3. Mutilation or shredding must be to an extent to prevent unauthorized reuse.
4. There will be no chemical pre-treatment before incineration, except for microbiological, lab and highly infectious waste.
5. Incineration ash (ash from incineration of any bio-medical waste) shall be disposed through hazardous waste treatment, storage and disposal facility, if toxic or hazardous constituents are present beyond the prescribed limits as given in the Hazardous Waste (Management, Handling and Transboundary Movement) Rules, 2008 or as revised from time to time.
6. Dead fetus below the viability period (as per the Medical Termination of Pregnancy Act 1971, amended from time to time) can be considered as human anatomical waste. Such waste should be handed over to the operator of common bio-medical waste treatment and disposal facility in yellow bag with a copy of the official Medical Termination of Pregnancy certificate from the Obstetrician or the Medical Superintendent of hospital or healthcare establishment.
7. Cytotoxic drug vials shall not be handed over to unauthorised person under any circumstances. These shall be sent back to the manufactures for necessary disposal at a single point. As a second option, these may be sent for incineration at common bio-medical waste treatment and disposal facility or TSDFs or plasma pyrolysis at temperature  $>1200\text{ }^{\circ}\text{C}$ .
8. Residual or discarded chemical wastes, used or discarded disinfectants and chemical sludge can be disposed at hazardous waste treatment, storage and disposal facility. In such case, the waste should be sent to hazardous waste treatment, storage and disposal facility through operator of common bio-medical waste treatment and disposal facility only.
9. On-site pre-treatment of laboratory waste, microbiological waste, blood samples, blood bags should be disinfected or sterilized as per the Guidelines of World Health Organisation or National AIDS Control Organisation and then given to the common bio-medical waste treatment and disposal facility.
10. Installation of in-house incinerator is not allowed. However in case there is no common biomedical facility nearby, the same may be installed by the occupier after taking authorisation from the State Pollution Control Board.
11. Syringes should be either mutilated or needles should be cut and or stored in tamper proof, leak proof and puncture proof containers for sharps storage. Wherever the occupier is not linked to a disposal facility it shall be the responsibility of the occupier to sterilize and dispose in the manner prescribed.

12. Bio-medical waste generated in households during healthcare activities shall be segregated as per these rules and handed over in separate bags or containers to municipal waste collectors. Urban Local Bodies shall have tie up with the common bio-medical waste treatment and disposal facility to pickup this waste from the Material Recovery Facility (MRF) or from the house hold directly, for final disposal in the manner prescribed in this schedule.

## Appendix C

### Country-Wise E-Waste Generation Rates (Ordered from Highest to Lowest by kg/Person-year) (Balde et al. 2015)

Rank	Continent	Country	kg/ person- year	Kilo tons/ year	Regulations <sup>a</sup>	Population (in 1000s)
1	Europe	Norway	28.3	146	Yes	5150
2	Europe	Switzerland	26.3	213	Yes	8098
3	Europe	Iceland	26	9	Yes	331
4	Europe	Denmark	24	135	Yes	5610
5	Europe	UK and N Ireland	23.5	1511	Yes	64,271
6	Europe	Netherlands	23.3	394	Yes	16,861
7	Europe	Sweden	22.2	215	Yes	9655
8	Europe	France	22.1	1419	Yes	63,996
9	Americas	USA	22.1	7072	No	3,19,701
10	Europe	Austria	22	188	Yes	8520
11	Europe	Germany	21.6	1769	Yes	81,589
12	Asia	Hong Kong, China	21.5	157	Yes	7296
13	Europe	Finland	21.4	118	Yes	5476
14	Europe	Belgium	21.4	242	Yes	11,260
15	Europe	Luxembourg	21	12	Yes	550
16	Americas	Canada	20.4	725	No	35,538
17	Oceania	Australia	20	468	Yes	23,339
18	Europe	Ireland	19.8	92	Yes	4641
19	Asia	Singapore	19.6	110	No	5595
20	Americas	Bahamas	19.1	7	No	360
21	Oceania	New Zealand	19	86	No	4510
22	Asia	Taiwan	18.6	438	–	23,499
23	Asia	Brunei	18.1	7	No	411
24	Europe	Spain	17.7	817	Yes	45,995
25	Europe	Italy	17.6	1077	Yes	61,156
26	Asia	Japan	17.3	2200	Yes	1,27,061

(continued)

Rank	Continent	Country	kg/ person- year	Kilo tons/ year	Regulations <sup>a</sup>	Population (in 1000s)
27	Asia	UAE	17.2	101	No	5873
28	Asia	Israel	17.2	138	No	8040
29	Asia	Kuwait	17.2	69	No	3999
30	Asia	UAE	17.2	101	No	5873
31	Asia	Qatar	16.3	33	No	1989
32	Asia	Cyprus	16.3	14	Yes	876
33	Europe	Portugal	16.1	171	Yes	10,569
34	Asia	Republic Korea	15.9	804	Yes	50,475
35	Europe	Greece	15.1	171	Yes	11,242
36	Europe	Slovenia	15	31	Yes	2066
37	Europe	Czech	14.8	157	Yes	10,594
38	Europe	Malta	14.6	6	Yes	418
39	Europe	Estonia	14	19	Yes	1340
40	Asia	Oman	14	46	No	3288
41	Americas	Barbados	13.2	4	No	279
42	Asia	Bahrain	12.9	16	No	1198
43	Europe	Hungary	12.6	125	Yes	9922
44	Asia	Saudi Arabia	12.5	379	No	30,254
45	Americas	Antigua & Barbuda	11.6	1	No	88
46	Europe	Slovakia	11.4	62	Yes	5447
47	Europe	Lithuania	11.4	34	Yes	2970
48	Africa	Seychelles	10.9	1	No	94
49	Africa	Equatorial Guinea	10.8	8	No	785
50	Europe	Croatia	10.8	48	Yes	4402
51	Europe	Bulgaria	10.7	77	Yes	7146
52	Europe	Latvia	10.7	22	Yes	2030
53	Americas	Saint Kitts and Nevis	10.1	1	No	60
54	Europe	Poland	10	397	Yes	39,638
55	Americas	Grenada	10	1	No	106
56	Americas	Saint Lucia	9.9	2	No	170
57	Americas	Chile	9.9	176	No	17,711
58	Americas	Dominica	9.7	1	No	71
59	Americas	Saint Vincent & Grenadines	9.7	1	No	110
60	Americas	Uruguay	9.5	32	No	3404
61	Asia	Lebanon	9.4	39	No	4115
62	Africa	Mauritius	9.3	12	No	1309
63	Europe	Romania	9.2	197	Yes	21,266
64	Americas	Trinidad & Tobago	9	12	No	1341
65	Europe	Russia	8.7	1231	No	1,40,955
66	Americas	Suriname	8.5	5	No	560
67	Africa	Libya	8.3	55	No	6649
68	Africa	Botswana	8.3	16	No	1920
69	Americas	Mexico	8.2	958	No	1,17,181
70	Americas	Panama	8.2	31	No	3788
71	Europe	Belarus	7.7	72	No	9293
72	Asia	Kazakhstan	7.7	131	No	17,019

(continued)

<b>Rank</b>	<b>Continent</b>	<b>Country</b>	<b>kg/ person- year</b>	<b>Kilo tons/ year</b>	<b>Regulations<sup>a</sup></b>	<b>Population (in 1000s)</b>
73	Africa	Gabon	7.6	12	No	1586
74	Americas	Venezuela	7.6	233	No	30,457
75	Asia	Malaysia	7.6	232	No	30,467
76	Americas	Costa Rica	7.5	36	Yes	4770
77	Asia	Iran	7.4	581	No	78,089
78	Europe	Serbia	7.3	56	Yes	7566
79	Europe	Montenegro	7.1	4	Yes	626
80	Americas	Argentina	7	292	No	41,961
81	Americas	Brazil	7	1412	No	2,01,413
82	Africa	South Africa	6.6	346	No	52,433
83	Asia	Turkey	6.5	503	Yes	76,707
84	Americas	Belize	6.5	2	No	355
85	Asia	Thailand	6.4	419	No	64,945
86	Europe	Albania	6.1	20	No	3275
87	Europe	Yugoslav	6.1	13	Yes	2076
88	Americas	Guyana	6.1	5	No	780
89	Asia	Maldives	6.1	2	No	342
90	Europe	Albania	6.1	20	No	3275
91	Americas	Jamaica	5.8	16	No	2774
92	Europe	Ukraine	5.7	258	No	45,000
93	Americas	Dominican Republic	5.4	58	No	10,610
94	Europe	Bosnia & Herzegovina	5.3	21	Yes	3871
95	Americas	Colombia	5.3	252	Yes	47,711
96	Asia	Azerbaijan	5.1	48	No	9383
97	Africa	Tunisia	5	56	No	11,060
98	Africa	Namibia	5	11	No	2192
99	Africa	Algeria	4.9	183	No	37,597
100	Americas	Paraguay	4.9	34	No	6930
101	Americas	El Salvador	4.8	30	No	6282
102	Americas	Peru	4.7	148	Yes	31,424
103	Americas	Ecuador	4.6	73	Yes	15,699
104	Asia	Armenia	4.6	16	No	3433
105	Asia	Georgia	4.6	21	No	4531
106	Asia	Jordan	4.5	30	No	6694
107	Asia	China	4.4	6033	Yes	13,67,520
108	Africa	Egypt	4.3	373	No	85,833
109	Asia	Sri Lanka	4.2	87	No	20,964
110	Asia	Timor-Leste	4.1	5	No	1172
111	Americas	Bolivia	4	45	Yes	11,246
112	Africa	Swaziland	4	4	No	1106
113	Asia	Turkmenistan	3.9	22	No	5796
114	Africa	Morocco	3.7	121	No	33,179
115	Asia	Bhutan	3.7	3	Yes	746
116	Americas	Guatemala	3.5	55	No	15,870
117	Asia	Iraq	3.1	112	Yes	35,871
118	Africa	Angola	3	65	No	21,444
119	Asia	Indonesia	3	745	No	2,51,490

(continued)

Rank	Continent	Country	kg/ person- year	Kilo tons/ year	Regulations <sup>a</sup>	Population (in 1000s)
120	Africa	Congo	2.5	11	No	4274
121	Africa	Cape Verde	2	1	No	542
122	Europe	Moldova	1.8	6	No	3553
123	Asia	Mongolia	1.8	5	No	2914
124	Americas	Honduras	1.8	16	No	8546
125	Americas	Nicaragua	1.7	11	No	6165
126	Asia	Uzbekistan	1.5	45	No	30,160
127	Asia	Pakistan	1.4	266	No	1,86,279
128	Africa	Ghana	1.4	38	No	26,216
129	Asia	Philippines	1.3	127	No	99,434
130	Asia	Vietnam	1.3	116	Yes	92,571
131	Asia	India	1.3	1641	No	12,55,565
132	Africa	Nigeria	1.3	219	Yes	1,73,938
133	Africa	Djibouti	1.2	1	No	939
134	Africa	Sao Tome and Principe	1.2	0	No	179
135	Africa	Sudan	1.2	43	No	35,276
136	Asia	Kyrgyzstan	1.2	7	No	5700
137	Asia	Yemen	1.2	34	No	27,460
138	Asia	Lao PDR	1.2	8	No	6557
139	Asia	Yemen	1.2	34	No	27,460
140	Africa	Gambia	1.2	2	No	1927
141	Africa	Kenya	1	44	No	44,572
142	Asia	Cambodia	1	16	No	15,561
143	Africa	Uganda	0.9	33	Yes	38,040
144	Africa	Zambia	0.9	13	No	14,617
145	Africa	Cameroon	0.9	21	Yes	22,544
146	Africa	Lesotho	0.9	2	No	1911
147	Africa	Benin	0.9	8	No	9858
148	Africa	Mauritania	0.9	4	No	3804
149	Africa	Senegal	0.9	12	No	13,830
150	Africa	Chad	0.8	9	No	11,284
151	Asia	Tajikistan	0.8	7	No	8302
152	Asia	Bangladesh	0.8	126	No	1,53,257
153	Africa	Côte d'Ivory	0.8	20	No	24,791
154	Africa	Guinea	0.8	9	No	11,403
155	Africa	Togo	0.8	5	No	6587
156	Africa	Comoros	0.7	1	No	724
157	Africa	Mozambique	0.7	16	No	23,365
158	Africa	Rwanda	0.6	6	No	10,865
159	Americas	Haiti	0.6	6	No	10,470
160	Africa	Burkina Faso	0.6	11	No	18,166
161	Africa	Mali	0.6	10	No	17,379
162	Africa	Ethiopia	0.5	43	No	90,982
163	Africa	Tanzania	0.5	26	No	49,047
164	Asia	Nepal	0.5	15	No	32,010
165	Africa	Guinea-Bissau	0.5	1	No	1646
166	Asia	Myanmar	0.4	29	No	66,257
167	Africa	Sierra Leone	0.4	2	No	6481

(continued)

<b>Rank</b>	<b>Continent</b>	<b>Country</b>	<b>kg/ person- year</b>	<b>Kilo tons/ year</b>	<b>Regulations<sup>a</sup></b>	<b>Population (in 1000s)</b>
168	Africa	Eritrea	0.3	2	No	6000
169	Africa	Madagascar	0.3	6	No	23,537
170	Africa	Zimbabwe	0.3	4	No	13,260
171	Africa	CAR	0.3	1	No	5109
172	Asia	Afghanistan	0.3	9	No	33,967
173	Africa	Burundi	0.2	2	No	9201
174	Africa	Malawi	0.2	4	No	17,604
175	Africa	Dem Congo	0.2	17	No	79,301
176	Africa	Liberia	0.2	1	No	4187
177	Africa	Niger	0.2	4	No	17,116
178	Asia	Syria			No	

<sup>a</sup>Were any national regulations in effect in 2013?

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