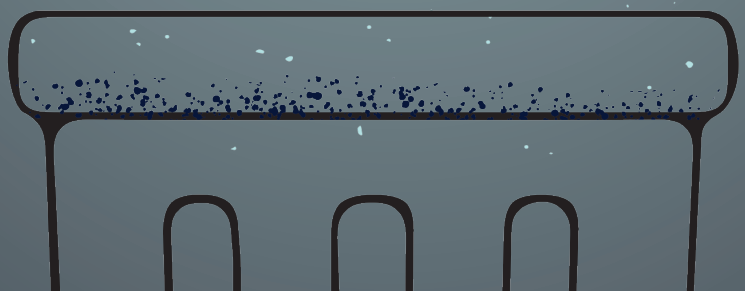
SANITARY WASTE MANAGEMENT IN INDIA

CHALLENGES AND AGENDA



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CHALLENGES AND AGENDA

Research direction: Atin Biswas

Author: Shailshree Tewari

Editor: Archana Shankar

Cover: Ajit Bajaj

Layout: Kirpal Singh

Production: Rakesh Shrivastava and Gundhar Das

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41, Tughlakabad Institutional Area
New Delhi 110 062
Phones: 91-11-40616000
Fax: 91-11-29955879
E-mail: sales@cseinida.org
Website: www.cseindia.org

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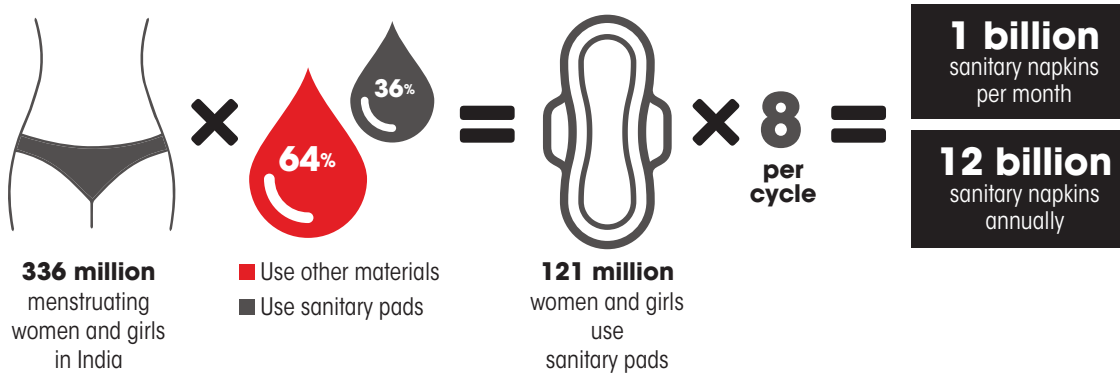
1. Introduction

According to the Solid Waste Management Rules (SWM) Rules, 2016, used sanitary napkins, diapers, condoms, tampons, incontinence sheets and any other similar waste are classified as sanitary waste, and should be disposed of properly with dry waste.[1]

Sanitary waste management has had limited attention due to societal and cultural taboos. Even though it fits squarely within the scope of waste management, it must be treated with adequate importance, with policy and implementation mandates.

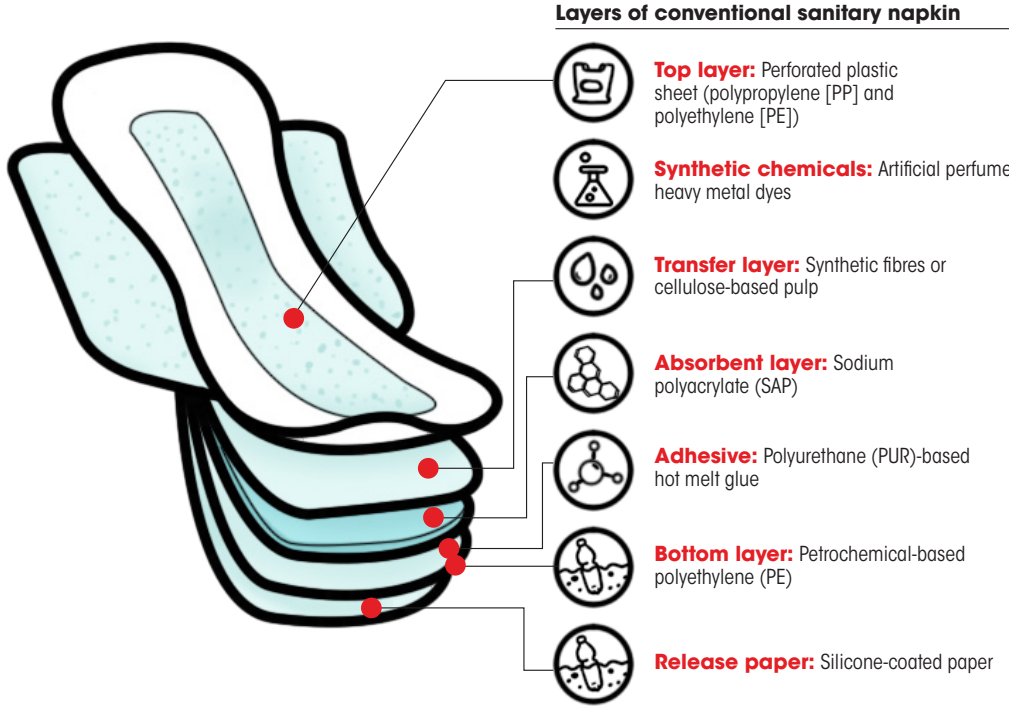
According to advocacy group Menstrual Hygiene Alliance India (MHAI),[2] assuming 36 per cent of women or girls in India use disposable sanitary napkins regularly at an average rate of eight sanitary napkins per month, 336 million menstruating women and girls use about 1 billion sanitary napkins per month, or 12.3 billion sanitary napkins annually. This works out to 33 million disposable sanitary napkins per day. Assuming the average weight of a soiled napkin is 11.3 g, with the average blood and other fluid loss per day during menstruation 8 ml and average weight of a sanitary napkin 10.5 g,[3] India generates approximately 137,483 tonne of used sanitary napkins annually, or 377 tonne daily.

Figure 1: Estimated usage of sanitary napkins in India



Source: MHAI. Graphic prepared by CSE

Figure 2: Components of a sanitary napkin

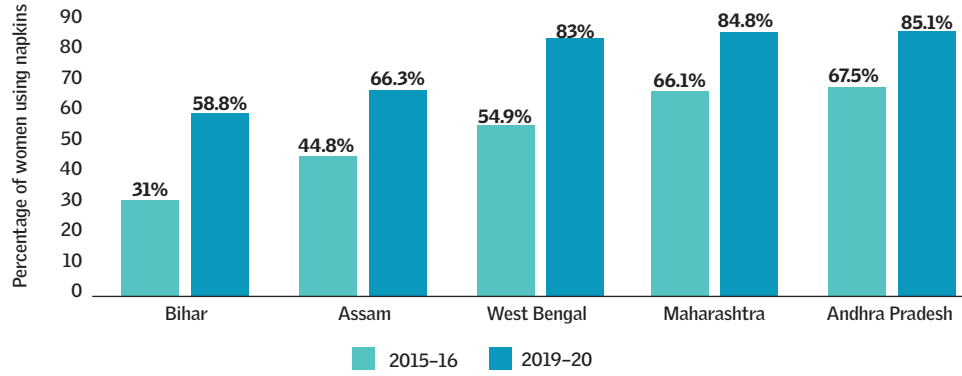


Source: Ingredients Used in Conventional Sanitary Pads, Sparkleuser, 2020; graphic prepared by CSE.

As per the National Family Health Survey (NHFS-4), a country-wide survey conducted by the Ministry of Health and Family Welfare, Government of India, with the International Institute for Population Sciences serving as the nodal agency,[4] around 41.8 per cent of women in the age group 15–24 use disposable sanitary napkins while 16.4 per cent use locally produced napkins. According to recent government statistics, use of disposable sanitary pads is continually increasing among women aged 15–24. In Bihar, for example, 58.8 per cent of girls and women in this age group used such products, an increase of nearly 90 per cent in just four years, i.e. 2016–19. Their use increased to 85.1 per cent in 2019–20 in Andhra Pradesh, up from 67.5 per cent in 2015–16. A similar trend is seen in most Indian states.[5]

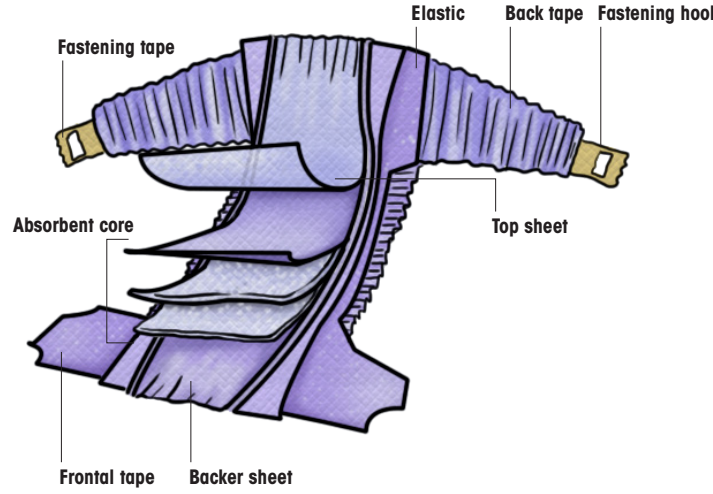
In the context of baby diapers, a one-month-old infant typically has three to four bowel movements a day and wets at least six or more diapers a day, adding up to six to 12 disposable diapers a day.[6, 7] Assuming a one-month-old infant uses 10 diapers a day—or 300 diapers per month—a single one-month-old baby could generate around 3,600 used diapers every year. According to the United Nation Children's Fund (UNICEF), 25 million children are born in India each year[8] and the average weight of the soiled diaper is 800 g.[9] India thus generates approximately 548 tonne of baby diaper waste daily, or 200,000 tonne annually.

Graph 1: Growing usage of sanitary napkins in India



Source: National Family Health Survey, 2020

Figure 3: Components of a diaper

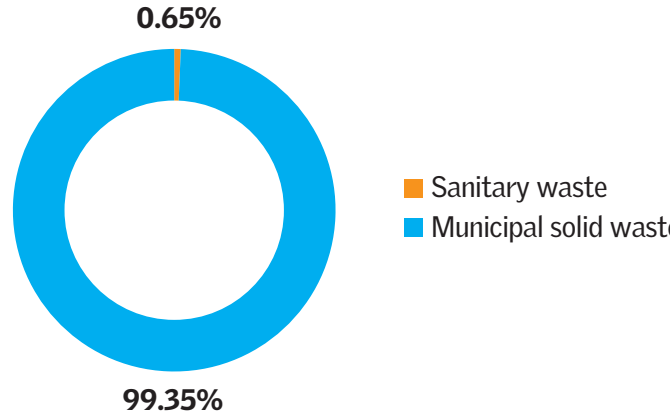


Source: Review on convenience and pollution caused by baby diapers, Aishwariya-Sachidhanandham, Research Gate, 2020. Graphic prepared by CSE.

According to Ministry of Housing and Urban Affairs (MoHUA) data, India generates around 141,000 tonne of solid waste per day. CSE estimates that India's consolidated daily generation of sanitary napkins and baby diaper waste (excluding adult diapers, tampons, condoms, incontinence sheets, and similar waste) is approximately 925 tonne, which accounts for 0.65 per cent of total solid waste.

Given the increasing volume of sanitary waste, including sanitary napkins, diapers, tampons, condoms, incontinence sheets and similar items, the total percentage of sanitary waste in municipal solid waste could reach approximately up to 3–4 per cent. The percentage may not seem much, but sanitary waste is voluminous and

Graph 2: Estimated percentage of sanitary waste in municipal solid waste in India



Source: CSE 2022.

Note: Only disposable sanitary napkins and baby diapers have been considered.

infectious in nature, and plastic is a primary material used in the manufacture of disposable sanitary products, underlining the need for sanitary waste management in India.[10] Due to unorganized sanitary waste management in cities and villages, poor source segregation, and inadequate collection, transportation and disposal networks, most sanitary waste ends up in landfills mixed with solid waste or dumped openly, posing significant health and environmental hazards.

Over the past few years in India, many government bodies such as the Central Pollution Control Board (CPCB), Ministry of Health and Family Welfare (MoHFW) and Ministry of Jal Shakti, Department of Drinking Water and Sanitation (DDWS) have promoted policies on sanitary waste management and menstruation hygiene management (MHM). The government initiatives are primarily aimed at disposing of sanitary napkins. There have been hardly any documented measures for collecting and disposing of other sanitary waste such as tampons, condoms, incontinence sheets, and other similar waste in the country.

There are no comprehensive statistics on sanitary waste management in India. Sanitary waste is likely to have long-term impact on health and adverse environmental consequences unless a science-based solution is found.

This report highlights the key concerns regarding the increasing quantity of sanitary waste. It identifies the critical challenges associated with current sanitary waste disposal practices in India with evidence-based learning and policy measures to be considered going forward.

2. Current legislative framework for sanitary waste management in India

There are two major legal frameworks for sanitary waste management: the Solid Waste Management (SWM) Rules, 2016[11] and the Central Pollution Control Board (CPCB) Guidelines for Management of Sanitary Waste, issued in 2018.[12] The CPCB guidelines cover a wide range of sanitary waste disposal alternatives, including the types of waste that each option can handle, where they can be adopted and implemented, and the technical specifications or pollution control standards that may apply to their manufacturing process and usage. The SWM Rules, 2016 also discuss the role of various stakeholders in the process. Apart from the SWM Rules, 2016, other government initiatives address sanitary waste treatment and disposal methods.

2.1 Solid Waste Management Rules, 2016

According to the Solid Waste Management Rules, 2016:

- Sanitary waste includes used sanitary napkins, diapers, condoms, tampons, incontinence sheets and other similar waste. Sanitary napkins and diapers are also included in the definition of dry waste in the SWM Rules, 2016.
- Every waste generatormust collect and segregate all waste into three categories: biodegradable, non-biodegradable and domestic hazardous waste. In the case of sanitary waste, the waste generator must wrap the used product in the manufacturer's pouches or any other suitable wrapping material as directed by the local authorities and collect it with other non-biodegradable waste.
- Sanitary waste manufacturers must consider using recyclable materials or provide covers, wrappers or bags for disposal after use. They must also raise public awareness on adequately collecting and disposing of sanitary waste.
- Local authorities must use information, education,and communication (IEC) initiatives to raise awareness on the various provisions under the SWM Rules, including the handling and disposal of sanitary waste.

2.2 CPCB Guidelines for Management of Sanitary Waste

According to the CPCB Guidelines for Management of Sanitary Waste:

- A user must dispose of sanitary waste in the wrapper or pouch provided by the

manufacturer. If not provided, the sanitary waste should be wrapped in an old newspaper and disposed of it with other non-biodegradable waste.

- A sanitary waste producer or manufacturer must provide packing material that can be utilized for disposal and help local agencies achieve segregated sanitary waste collection and disposal.
- Authorized waste pickers may undertake incineration as a commercial service. If a nearby centralized biomedical waste treatment facility has sufficient capacity, these waste pickers may also collect sanitary waste and dispose of it in such treatment facilities.
- Where standard incinerators are unavailable, state pollution control boards (SPCBs) may allow the sale of small, decentralized incinerators. Any small incinerator unit manufactured or marketed must meet emission standards prescribed under lawor by the SPCBs. The SPCBs are also responsible for coordinating awareness campaigns with other ministries and government entities, identifying resources for implementation and organizing orientation training for various officers and staff across departments and ministries.
- Urban local bodies (ULBs) shall ensure that all collected waste is disposed of through sanitary waste disposal alternatives—incinerated in treatment, sent to storage or disposal facilities or centralized biomedical waste treatment facilities, or fed into waste-to-energy treatment plants. ULBs may also establish small community-incinerators in their areas.
- ULBs may receive assistance from women in the design and construction of menstrual hygiene management (MHM) infrastructure and private entities and commercial or industrial groups for improved product design and more environmentally friendly usage and disposal methods. They should ensure that the MHM requirements are followed, and they should also conduct training sessions in schools and communities.
- Homemade and biodegradable sanitary products can be disposed of in a burial pit at least 50 cm deep in rural areas and at the panchayat level. Commercially manufactured sanitary products can be burned at low-cost incinerators such as matka incinerators.

2.3 Menstrual Hygiene Management National Guidelines

- The Menstrual Hygiene Management (MHM) Guidelines were published in 2015 by the Ministry of Drinking Water and Sanitation in collaboration with UNICEF India.[13] The Guidelines are an essential aspect of the Swachh Bharat Mission (SBM). As per the Guidelines, all MHM budgetary requirements can be met from the SBM budget. Any Information, Education and Communication (IEC) programmes on MHM can be undertaken from the SBM's IEC campaigns budget. Incinerators can also be purchased for school use.

- The guidelines are divided into three categories. The first category of guidelines focuses on the MHM framework and covers the ways in which adolescent girls and women can be offered MHM options, MHM infrastructure in schools, and safe menstrual waste disposal methods. The second category details the role and responsibility of various government organizations and other relevant stakeholders. The third category addresses the technical details of various disposal methods.
- To collect sanitary waste, separate bins should be used, with a designated schedule for disposing of and properly transporting such waste.
- The available budget, amount and type of material are the significant factors while selecting the appropriate disposal solution for menstrual waste. In addition, sociocultural attitudes may also determine the method's selection and implementation.
- The disposal and treatment solution chosen must ensure minimal human involvement and no adverse environmental impact. If a hospital with a hazardous waste treatment facility is located nearby, the disposal option can be incorporated into the procedure.

2.4 Disposal of menstrual waste under the Guidelines for Swachh Bharat Mission (SBM)-Urban and SBM-Gramin

The Guidelines for Swachh Bharat Mission (SBM) (Urban)[14] and SBM (Gramin)[15] outline the following:

- Disposal of menstrual waste, emphasizing the segregation and collection of sanitary waste. Sanitary napkins and diapers must be separated, specially marked and sent to a biomedical waste for incineration.
- One of the essential specifications for constructing community toilets is installing small-scale incinerators in toilets with more than ten seats. Ladies' toilets shall have a vending machine for sanitary napkins.
- SBM-Gramin guidelines for rural regions outline the deployment of adequate facilities for ensuring MHM and recommend the safe disposal of menstrual waste through incinerators.

The aforementioned legislative is either available as guidelines or advisory issued by various government bodies. However, they are not mandatory, and non-compliance with these guidelines imposes no penalty or legal offence on anyone. Further, each of these policies has a different approach for treating and disposing of sanitary waste, which can cause problems with implementation.

Further, the categorization of sanitary waste, whether biomedical or plastic waste, has been a significant issue. Sanitary napkins, diapers and condoms are classified

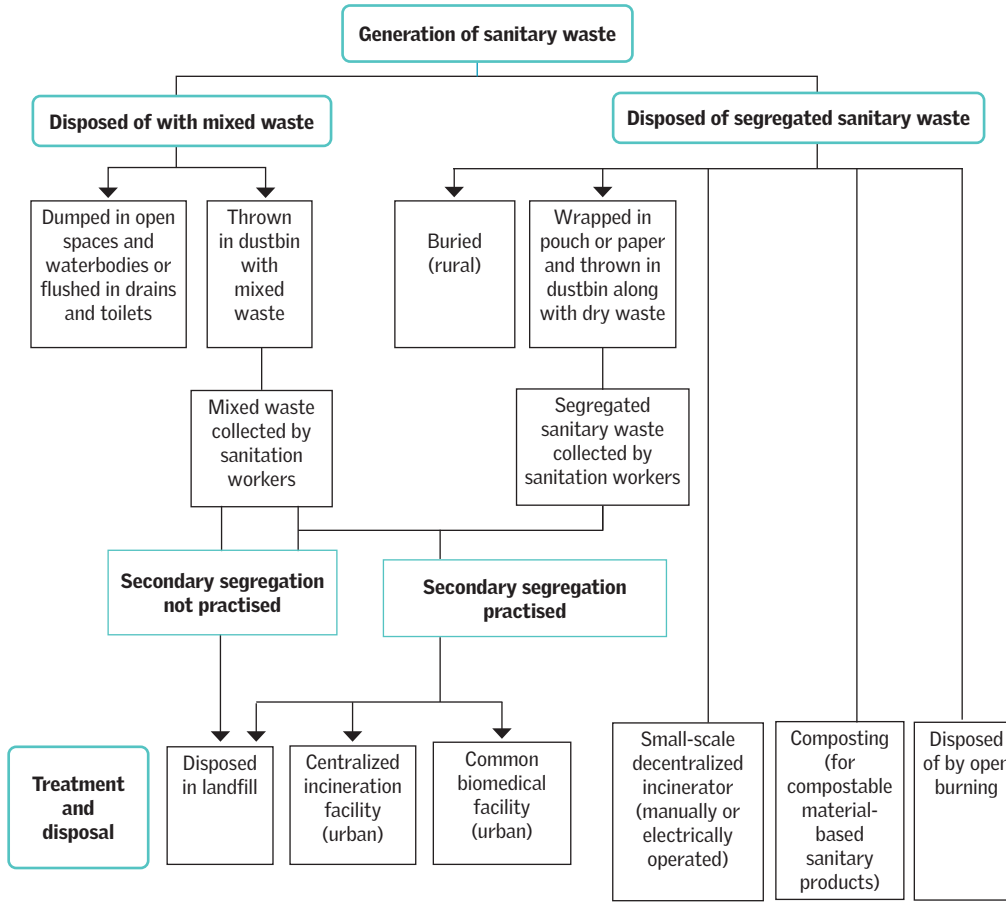
as household wastes and should be disposed of along with dry waste as per CPCB Guidelines and SWM Rules, 2016.[16] However, waste contaminated with blood or other bodily fluids is classified as biomedical waste under Category 6, Schedule I of the Bio-Medical Waste Management Rules 2016.[17] Under the same schedule, Category 2, biomedical waste includes organs, body parts, tissues and bleeding parts of animals. This addresses why sanitary waste, especially menstruation waste, is not classified as biomedical waste. According to the Bio-medical Rules 2016, such biomedical wastes should be microwaved or autoclaved to kill pathogens rather than burying them in landfills as potent viruses like Hepatitis B and C can survive even in a drop of blood or any other fluid, posing a threat to the environment and humankind. Similarly, sanitary items include hazardous germs that can cause diseases in those who work in landfills, and harm the environment by eroding lands, soil, and waterbodies.

The lack of synergy between the government authorities and differences in capacities make it challenging to resolve inconsistencies between the laws with regard to the existing legal framework of sanitary waste management. The multiplicity of laws causes ambiguity in the actual process to be adopted. There are no comprehensive statistics on this subject that reflects our country's concern for sanitary waste management in India. These guidelines and policies are only on paper and have not translated into action on the ground.

3. SANITARY WASTE MANAGEMENT IN INDIA

Waste management is an end-to-end process that includes waste generation, segregation at source, collection, treatment and disposal. Efficient disposal of menstrual waste necessitates source segregation at the level of waste generation (see *Figure 4: Sanitary waste management in India*).

Figure 4: Sanitary waste management in India



Source: CSE

In India, where separate collection of sanitary waste is practised in only a few cities, sanitary waste from residences or other public spaces is typically collected alongside dry waste or mixed waste. As a result, sanitary waste is mixed with other types of waste and disposed of in landfills or dumpsites unscientific and

indiscreet manner. Further, in each city the local authorities manage solid waste management activities; therefore, different methods of sanitary waste disposal have been adopted in different cities.

At the household level—except in a few cities such as Karad, Jamshedpur, Panaji and Pune, where segregation systems have been implemented for sanitary waste—sanitary waste is primarily collected with dry or mixed waste in most cities. Further, disposal techniques differ between rural and urban areas. In rural areas, where waste collection is less common, sanitary waste is disposed of by burning or shallow burial, which pollutes the waterbodies and air and potentially impacts both the environment and human health. In urban areas, where a waste collection system is in place, sanitary waste is disposed of in a landfill or, if segregated, disposed of by means of a centralized incinerators or decentralized incinerators.

At the community level, menstrual waste may be segregated in the case of community users and public washrooms, depending on management. If the waste is segregated, it is disposed of by means of decentralized incinerators or dumped in a landfill. Due to the emerging focus on sanitary waste management and menstrual hygiene management in India, educational institutes and government departments in a few states such as Goa, Maharashtra and Tamil Nadu have formalized the installation of decentralized incinerators in educational institutes and offices for on-site disposal of menstrual waste.[18, 19] According to the MHM Guidelines, 2015, the following are the most common sanitary waste disposal practices (see *Figure 5: Sanitary disposal practices in India as per MHM Guidelines, 2015*).

Figure 5: Sanitary disposal practices in India as per MHM Guidelines, 2015

It is evident that there is a dearth of awareness and organized sanitary waste disposal infrastructure and disposal practices in rural and urban locations vary greatly (see *Figure 5: Sanitary disposal practices in India as per MHM Guidelines, 2015*). In parts of India, women dispose of the sanitary napkins or cloth in drains and potholes; some who are uncomfortable disposing of sanitary napkins in public flush them in toilets. Many women do not use dustbins because they think it might bring them disgrace as waste collectors might think poorly of them if they notice soiled napkins.

Figure 6: Sanitary waste disposal practices in India

Source: Menstrual Hygiene Management, WaterAid, 2019. Graphic prepared by CSE.

Sociocultural constraints such as myths and taboos play a major limiting factor and aggravate the problem. Community-specific beliefs have a significant impact in determining proper disposal options. In India, some communities believe that burning menstrual waste might harm family members, and any sanitary waste disposal practice that involves burning is unlikely to be accepted.

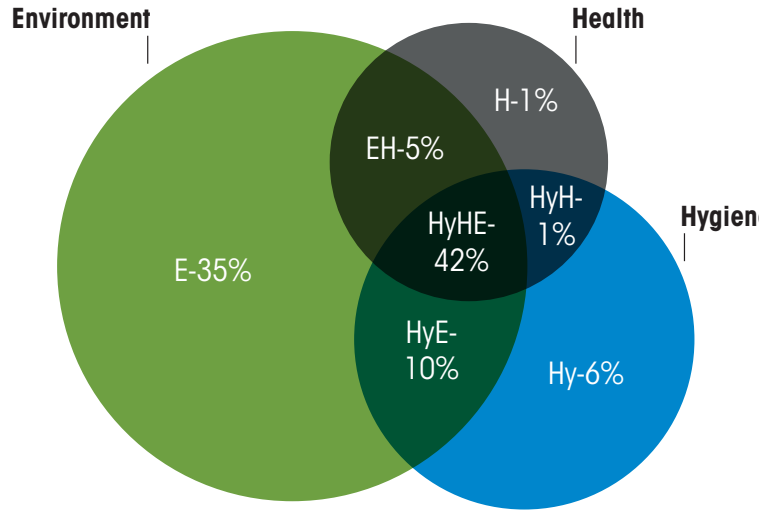
To manage sanitary waste effectively, it is critical to consider other aspects of waste management, starting with continuous Information, Education and Communication (IEC) and followed by source segregation, proper waste collection and transportation, and sanitary waste handling and disposal. The MHM Guidelines and CPCB Guidelines have accelerated incineration utilization to dispose of and treat sanitary waste. Many states have installed decentralized incinerators at the community and institutional levels.

4. Disposal of sanitary waste through incineration

Incineration involves burning waste at a high temperature and converting it to ash. It has gained popularity for disposing of sanitary waste and is a favoured technique of eradicating hazardous microorganisms in sanitary waste.

Sanitary waste takes long to decompose and is thus harmful to the environment. In a survey conducted by New Delhi-based NGO Toxics Link,[20] 487 consumers were asked if they considered sanitary waste to be a problem and if so what difficulties they connected it with. Around 42 per cent of the respondents considered sanitary waste a problem for the environment, health and hygiene. When environment, health and hygiene were considered separately, an overwhelming majority—around 92 per cent—identified sanitary waste as an environmental concern, while 59 per cent identified it as a hygiene issue and 48 per cent of those polled classified it as a health issue. A small percentage of respondents considered it an occupational hazard for waste workers as well.[21]

Graph 3: Major concerns related to menstrual waste



E: Environment; EH: Environment Health; HyHE: Hygiene Health Environment; HyE: Hygiene Environment; H: Health; HyH: Hygiene Health; Hy: Hygiene

Source: Menstrual products and their disposal, Toxics Link, 2021.

Currently, incinerators have been considered the most convenient means of disposal since they allow for on-site treatment and disposal. However, most incinerators are not certified to meet the Central Pollution Control Board (CPCB) regulations. Low-cost incinerators often burn at low temperatures and lack control over harmful pollutants released (i.e. they are carcinogenic). Girls, students, school employees and workers who use or live near these incinerators are at risk of developing health problems. Problems from smoke and smell from incinerators installed in school along with concerns about the emissions released from incinerators have also been reported.[22]

This chapter highlights the various government guidelines about the technical specification and emission standards for incinerators to dispose of sanitary waste. The CPCB Guidelines are intended to outline broad standards with which small-scale incinerators must adhere. The CPCB Guidelines also include the technical aspects of a biomedical waste incinerator, which are covered in detail under Biomedical Waste Management Rules, 2016 (see *Table 1: Technical specifications and standards).*

The Menstrual Hygiene Management (MHM) Guidelines issued by Ministry of Drinking Water and Sanitation in India provides further technical guidance for incinerators. They include a set of technical protocols for incinerators and other disposal methods developed by UNICEF (United Nations Children's Fund) India. The guidelines, however, do not delve into many technical parameters and only give information on available incinerator models. It may be that the technical specifications and standards specified in the guidelines are prescriptive and therefore not enforceable. The classification of incinerators and potential specifications vary between the two sets of guidelines mentioned above.

The manual fire-based incinerator addressed in the MHM Guidelines is similar to the low-cost, locally built incinerator under the Central Pollution Control Board (CPCB) Guidelines on Sanitary Waste. In both the guidelines, however, the prescribed standards for incinerators are different. The MHM Guidelines focuses on electric incinerators. However, instead of offering a set of technical elements for small-scale electric incinerators, it addresses other factors such as a list of products available in the market, cost and potential application (see T*able 1: Technical specifications and standards as per CPCB Guideline, 2018* and *Table 2: Emission standards as per SWM, 2016).*

Table 1: Technical specifications and standards as per CPCB Guidelines, 2018

Options	Type of waste	Where to use	Specifications/pollution control norms
Low cost, locally made incinerator	Napkins and other wastes. Best for pads with high cellulose content, not those that have superabsorbent polymers (SAP)	Rural girls-schools, colleges, institutions, hostels etc.	• Manually operated • Minimum size: 3 foot x 3 foot x 3 foot • Design: As per MHM Guidelines, technical guide • Capacity: 200 napkins per day • Comprises twin chambers • An emission control system with a door for firing. • Made of brick masonry • The opacity of the smoke shall not exceed 20 per cent • All the emissions to air other than water vapour or steam to be odourless and free from mist, fumes, and droplets • Operation temperature reaches up to 300 degrees Celsius • Assures 100 per cent burning effectiveness • The incineration chamber to be designed to use a supplementary gas or oil burner as necessary to maintain the prescribed minimum combustion temperatures. • If diesel is used as fuel in the incinerator, low-sulphur diesel shall be used. • Shall comply with general emission standards for air pollutants notified under E (P) Act, 1986 or as may be prescribed by state pollution control boards (SPCBs) or Pollution Control Committees (PCCs).
Electrically operated incinerators	The bulk amount of napkin wasters	Ladies' toilets, community toilets, shopping malls, society complex etc.	• Ensures complete burning of napkin. • Ensures instant disposal in a scientific, hygienic way. • Burns 150–200 napkins/day, programmed for multiple cycles. • Self-disposal with sanitary waste placed directly into the incinerator. • Ash generation shall not exceed 5 per cent per napkin. • Ash should be collected in a separate tray and stacked on that tray. • Auto power, thermal cut-off and automatic temperature maintenance to be ensured for the safety of the user. • Excellent heat retention ensured inside refractory lining to avoid thermal loss. • The residence time for gaseous products in the combustion chamber will be designed to be at least two seconds to ensure complete combustion. • The emission from incinerators shall adhere to the General Emission Standards mentioned under the section "Standards for incineration" in SWM Rules, 2016.
High-temperature incinerators for biomedical waste	Incinerate all types of pads and all types of biomedical wastes	Waste burned at central/ combined incinerator facility	• Incinerator designed for a capacity of more than 50 kg/hour. • The dual-chamber Incinerator shall preferably be designed on the "controlled-air" incineration principle. Minimum 100 per cent excess air shall be used for the overall design. • Incinerator shall not be allowed to operate unless equipped with Air Pollution Control Device (APCD). • The incineration ash shall be stored in a closely sturdy container in a masonry room to avoid pilferage. Finally, the ash shall be disposed of in a secured landfill. • As per Schedule 11 of the Bio-Medical Waste Management Rules 2016, emission control measures must be followed, notified under the Environment (Protection) Act 1986. • The location, structural design, of the Incinerator shall be as per the guidelines of Bio-Medical Waste Rules, 2016. • A skilled person shall be assigned to operate and maintain the incinerator.

Source: CPCB Guidelines 2018.

Table 2: Emission standards as per SWM Rules, 2016

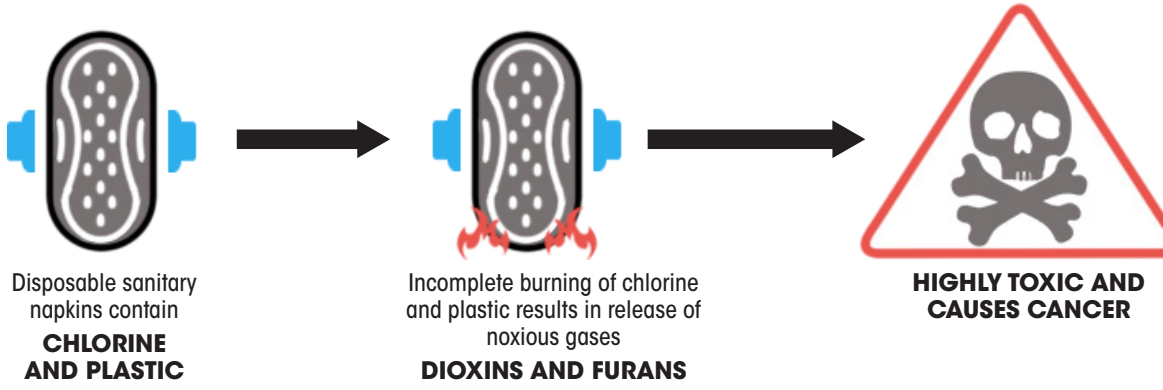
Parameter	Emission standard	
Particulates	50 mg/Nm^3	• Standard refer to half-hourly average
HCl	50 mg/Nm^3	• Standard refer to half-hourly average
SO_2	200 mg/Nm^3	• Standard refer to half-hourly average
CO Total organic carbon HF	100 mg/Nm^3 50 mg/Nm^3 20 mg/Nm^3 4mg/Nm^3	• Standard refer to half-hourly average • Standard refer to half-hourly average • Standard refer to half-hourly average • Standard refer to half-hourly average
NO_X (NO and NO_2 expressed as NO_2)	400 mg/Nm^3	• Standard refer to half-hourly average
Total dioxins and furans	0.1 ng TEQ/Nm^3	• Standard refers to six to eight hours of sampling. Please refer to guidelines for 17 concerning congeners for toxic equivalence values to arrive at total toxic equivalence.
Cd+ Th+ their compounds	0.05 mg/Nm^3	• Standard refers to sampling time anywhere between 30 minutes and 8 hours.
Hg and its compounds	0.05 mg/Nm^3	• Standard refers to sampling time anywhere between 30 minutes and 8 hours.
Antimony (Sb+), arsenic (As+), lead (Pb+), chromium (Cr+), cobalt (Co+), copper (Cu+), manganese (Mn+), nickel (Ni+), vanadium (V+) and their compounds	0.05 mg/Nm^3	• Standard refers to sampling time of 30 minutes to eight hours.
Note: All values corrected to 11 per cent oxygen on a dry basis.		

Source: SWM Rules 2016.

Notes:

1. The appropriate pollution control equipment should be installed or connected with the incinerator to achieve the above emission requirements.
2. Incinerated waste should not be treated chemically with chlorinated disinfectants.
4. The ash should be transported to hazardous waste treatment, storage and disposal facility if the concentration of harmful metals in incineration ash exceeds the limitations provided in the Hazardous Waste Rules, 2016.
5. The incinerator should only burn low-sulphur fuels such as LDO (light diesel oil), LSHS (low-sulphur heavy stock), diesel, biomass, coal, LNG (liquefied natural gas), CNG (compressed natural gas), RDF (refuse-derived fuel), and biogas.
6. The concentration of carbon dioxide in the exhaust gas should be less than 7 per cent.
7. All facilities with a dual-chamber incinerator should be engineered to achieve a minimum temperature of 950°C in the secondary combustion chamber and gas residence time not less than 2 seconds in the secondary combustion chamber.
8. Incineration plants (combustion chambers) should be operated at a temperature, retention time and turbulence so total organic carbon concentration in slag and bottom ash is less than 3 per cent, or a loss on combustion is less than 5 per cent of the dry weight.
9. Site odours should be controlled as per CPCB guidelines.

Figure 7: Impact of incomplete burning of disposable sanitary napkins



Non-compliance with these emission standards can release noxious gases such as dioxins and furans. At present, most small- and medium-scale incinerator options available in the market do not meet the minimum requirements and have limited compliance with existing guidelines. Most incinerators are not certified to meet the Central Pollution Control Board (CPCB) regulations. There are also reports about smoke and smell from incinerators installed in school and concerns about emissions released from incinerators.[23] As is evident, decentralized small-scale incinerators can cause detrimental effects on human health and the environment.

Table 3: Compliance of small-scale incinerator options as per SWM Rules, 2016

S. no.	Type of incinerator	>800 degrees Celsius	Ash disposal guideline provided?	Emission control standards
1.	Earthen pot (matka) incinerator	No	No, usually mixed with soil	Non-compliant
2.	Low-cost locally made incinerator	No	No, usually mixed with soil	Non-compliant
3.	Electrically operated incinerator	Yes	No, usually mixed with soil	Most of the available incinerators do not comply with these standards

Source: Compiled by CSE, 2022.

The incinerators available in the market adhere to only a few components of the standards. Further, unlike other consumer electronic items, incinerators made in India are not subject to any testing to confirm standard certification.

The authorities must therefore ensure the following critical requirements before adopting any incinerator for disposing of sanitary waste. First, the incinerator must burn waste at a temperature of at least 800 degrees Celsius to minimize

smoke and odour in accordance with WHO's 2014 publication *Safe Management of Wastes from Health-care Activities*.[24] The CPCB Guidelines, however, prescribe a burning temperature of only 300 degrees Celsius, which causes incomplete burning of sanitary waste and releases highly toxic gases such as dioxins and furans. Second, emission control standards stipulated by the Solid Waste Management (SWM) Rules, 2016 must be followed. Third, after testing, ash generated from the incineration process must be disposed of in a secure or sanitary landfill to have limited contact with the environment.

4.1 Centralized incinerators for disposing of sanitary waste

In India, large-scale or centralized incinerators are present largely in urban and semi-urban areas and used to treat biomedical waste or a combination of biomedical waste and sanitary waste. Standards have been prescribed under the Bio-Medical Waste Management Rules, 2016, and regulations and guidelines framed under it. Incinerators at biomedical waste treatment facilities that can incinerate more than 1,400 sanitary napkins a day come under the category of large-scale or centralized incinerators.[25]

Centralized incinerator at a common biomedical waste treatment facility (CBWTF) in Agra

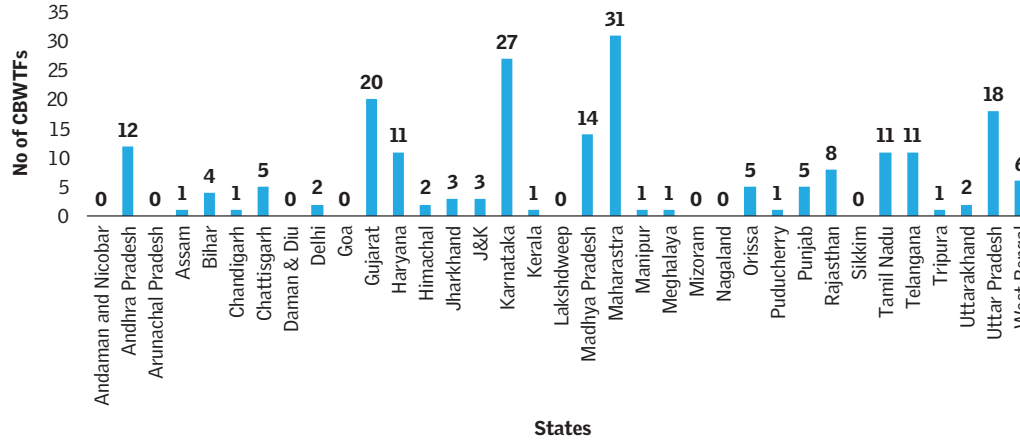
Source: CSE, 2022

One of the critical factors affecting the operation of any centralized incinerator is source segregation. According to the Guidelines for Swachh Bharat Mission (SBM) 2.0, waste generators must segregate all waste into four categories, namely, biodegradable, non-biodegradable, sanitary waste, and domestic hazardous waste. Source segregation in four fractions is still a significant challenge in many cities in India. Most authorities collect waste only into two fractions—dry and wet. Sanitary waste is collected along with dry fraction, which eventually ends up in landfills, leading to air, soil and water pollution.

Several cities such as Karad, Jamshedpur and Pune, however, have made concerted efforts over the last decade to address the issue of segregation at the ULB level through the combined efforts of the municipal local body and citizens.

There are 207 operational common biomedical waste treatment facilities (CBWTFs) in India, with a total incineration capacity of 621 tonne per day.[26] Assuming the per day generation of sanitary napkins and baby diapers (excluding adult diapers, tampons, condoms, incontinence sheets and other similar waste) is 925 tonne, with the per day total incineration capacity of common biomedical treatment units 621 tonne, there is a capacity constraint to treat sanitary waste alongside biomedical waste. Failing this centralized arrangement, the majority of sanitary waste ends up in landfills or dumpsites. CBWTFs need to stretch beyond their capacity to run this ecosystem successfully as the volume of sanitary waste continues to increase.

Graph 4: State-wise status of common biomedical waste treatment facilities



Source: Annual Bio-Medical Report CPCB, 2019–20 and SOE (State of Environment), CSE 2022.

4.1.1 Key challenges of centralized management of sanitary waste

Given the increasing quantum of sanitary waste and challenges associated with their management, the following set of critical challenges must be addressed to ensure the long-term viability of centralized incinerators.

- **Lack of source segregation:** One of the most significant challenges faced by centralized incinerators is inadequate source segregation. The overall waste management system is weakened due to a lack of source segregation. Except for a few cities such as Karad and Pune, most cities segregate waste at source only into two streams—biodegradable and non-biodegradable waste. Waste should be separated at source into a minimum into four fractions—wet, dry,

domestic hazardous waste and sanitary waste—to avoid adverse health and environmental impact due to improperly handled sanitary waste. In 2002, the Panaji Municipal Corporation launched an initiative to segregate sanitary waste at the household level and dispose of it at the Goa Medical College's biomedical incinerator. While this example was frequently recognized as a best practice in the Indian context, Panaji eventually encountered difficulties maintaining this sanitary waste disposal strategy since many houses discontinued source segregation due to a lack of regular inspections and enforcement.[27]

- **Inadequate infrastructure and services:** Appropriate infrastructure and services play a significant role in sustaining the overall waste management system. A separate container or bag for storage of segregated sanitary waste at source, collection vehicles with a minimum of four compartments, and appropriate treatment and disposal facilities that use the right technology for sanitary waste are required to make sanitary waste management efficient.

Collection vehicles in South Delhi Municipal Corporation (SDMC). The vehicles do not have a separate container or compartment for sanitary waste

Source: CSE, 2022.

In India, sanitary waste is either disposed of with mixed or dry waste due to which centralized facilities are sometimes hesitant to receive sanitary waste from households. Waste management with insufficient infrastructure and services affects systematic collection, transportation, treatment and disposal of sanitary waste.

- **Handling issues:** In India, manual sorting is the most widely used and accepted method of waste segregation. Most waste management steps such as waste collection at source, waste transportation and even secondary segregation require human contact. Sanitation workers at each step (door-to-

door collection to treatment facilities) must be informed about proper handling of sanitary waste to ensure that sanitary waste does not come in direct contact with sanitation workers, is not mixed with the other waste and is disposed of scientifically.

- **Capacity constraint:** The capacity of an in incinerator at a centralized biomedical waste treatment facility can dispose of only a limited amount of sanitary waste at a time, posing a capacity constraint for sanitary waste disposal and resulting in a large amount of sanitary waste left untreated or unprocessed This can fail the city's integrated sanitary waste disposal. In 2002, Panaji Municipal Corporation launched an initiative to segregate sanitary waste at the household level and dispose of it at Goa Medical College's biomedical incinerator. While this example is frequently recognized as a best practice in the Indian context, Panaji eventually encountered difficulties in maintaining this sanitary waste disposal due to the capacity constraint of the facility.

  Goa Medical College's common biomedical waste incinerator can only burn 40 kg of sanitary waste at a time. A huge quantum of sanitary waste is left untreated and stored in a material recovery facility. The limited capacity of the common biomedical incinerator has resulted in failure of Panaji's sanitary waste disposal ecosystem as their facilities have been stretched beyond capacity while the volume of waste continues to increase.[28]

- **Financial constraint:** To dispose of sanitary waste, a few cities utilize existing centralized biomedical facilities. However, there are no incentives for these biomedical treatment facilities to collaborate with urban local bodies (ULBs) in sanitary waste disposal, frequently managed by private entities. Lack of financial support is a significant factor in forcing local authorities to pay commercial rates for sanitary waste treatment. In addition, distance to the nearest common biomedical waste treatment facility (CBWTF) increases transportation cost, which imposes a financial burden on municipalities that may already be struggling to develop sanitary systems due to lack of resources.

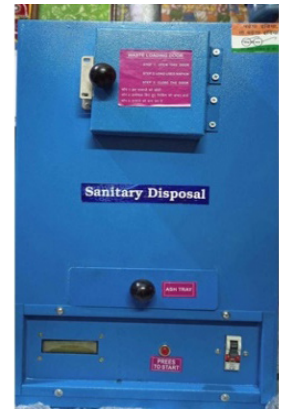
4.2 Decentralized incinerators for disposing of sanitary waste

Decentralized incineration for sanitary waste disposal has emerged in India for promoting and improving menstrual hygiene management. Waste disposal systems should to be installed near the source, need little human invention, and should be used directly by the waste generator. Decentralized incinerators

are commonly installed at educational institutions, public spaces and offices. Centralized incinerators on the other hand are large-scale biomedical waste or sanitary waste treatment facilities that require a significant amount of land to put up and are installed by local authorities. Small- and medium-scale incinerators are two types of decentralized incinerators.

Types of decentralized electric incinerators

Size: Small-scale incinerator
Capacity: Approx. 100–300 pads a day
Cost: Rs 10,000–25,000



Size: Medium-scale incinerator
Capacity: Approx. 400–900 pads a day
Cost: Rs 30,000–70,000

Source: GeM Portal, Government of India
Note: Image for representational purposes only

Many states have issued tenders for decentralized incinerators to be installed in various locations such as educational institutions, government offices and hostels. Such incinerators are purchased either through a tendering process or directly from an e-marketplace. Several states, such as Goa and Maharashtra, have installed incinerators in educational institutions through financial assistance from Rotaract Clubs or the corporate sector.

As per a 2019 study by the US-based initiative Sanitation Technology Platform (STeP) and the Bill and Melinda Gates Foundation (BMGF), *Menstrual Hygiene Market (MHM) Landscape*, the market opportunity for decentralized incinerators in India has grown significantly.[29] The statistics show that the market opportunity for MHM incinerators in India is expected to grow at 3.84 per cent compounded annual growth rate (CAGR), and the government is now the largest consumer of decentralized incinerators (see *Table 4: The decentralized incinerator market landscape in India*). That market is, however, expected to shift to the private sector as more private organizations and educational institutes have begun procuring decentralized incinerators to create awareness on menstrual hygiene management.

Table 4: Decentralized incinerator market landscape in India

Market size for decentralized incinerators	• The market opportunity of decentralized incinerators in India is 1,371,890 units (in 2020) and is expected to grow at a 3.84 per cent compounded annual growth rate (CAGR). • The government is projected as the leading buyer (54 per cent) in 2020, but this is projected to flip to the private sector (54 per cent) by 2030 as the private sector is growing faster than the government sector (in aggregate across segments analysed).
Key market segments for decentralized incinerators	• Combining quantitative and qualitative factors, private sector-controlled schools and higher educational institutions (HEIs) (2.59 per cent CAGR) and offices (5.64 per cent CAGR) are the most promising market segments for decentralized incinerators. • Incumbents primarily focused on schools and HEIs, making private offices an interesting target market segment for new decentralized incinerator developers.

Source: Compiled from Sanitation Technology Platform (STeP) and Bill and Melinda Gates Foundation (BMGF), Menstrual Hygiene Market (MHM) Landscape, 2019.

4.2.1 Key challenges of decentralized management of sanitary waste

Given the growing demand and market for decentralized incinerators for sanitary waste disposal, the following set of significant challenges must be addressed before their use is expanded.

- **Standards for decentralized incinerators:** Items such as APCD (Air Pollution Control Device), combustion chambers, emission outlet pipe stack, detachable ashtray used to manufacture the decentralized incinerators available on the Government e-Marketplace (GeM) portal—or any other e-marketplace—are inconsistent. Some of the incinerators do not meet CPCB's emission standards.[30] While CPCB's guidelines are legally enforceable, a lack of standards for small-scale incinerators attracts no penalty. Tenders for the purpose of procurement of decentralized incinerators that are publicly available also reflect the same concern.[31]

- **Self-certification:** As a result of self-certification of compliance, several decentralized incinerators are available in the market that claims to be environmentally sustainable. In the absence of regular monitoring and inspection from the State Pollution Control Board, many state governments are procuring decentralized incinerators that do not meet technical specifications prescribed under CPCB Guidelines 2018. The possible consequences of insufficient emission control or poor thermal treatment are hazardous to the environment and human health.

- **Lack of technical guidance:** Many decentralized incinerators have fallen into disuse due to users' limited technical understanding of the machines and their hesitation to use the machines. According to a 2012 comparative study in a school in Nepal, 46 per cent of girls thought using the incinerator was simple,

5 per cent were hesitant, and 49 per cent had never used an incinerator due to lack of technical guidance.[32] Users should receive sufficient technical assistance from the authorities before decentralized incineration units are installed.

- **Taboo and myths associated with sanitary disposal:** Women in Tamil Nadu who used a community toilet were hesitant to put sanitary waste in common bins and instead used latrine pits as a disposal technique because they did not want to burn their sanitary waste. Burning sanitary waste is forbidden in some cultures on the basis of the belief that doing so will jeopardize a woman's reproductive ability, making it more challenging to utilize decentralized electric or clay pot incinerators.[33]

- **Inappropriate placement of incinerator:** Occupational hazards might arise from improper installation of the decentralized incinerator. While incinerators are convenient and allow for on-site disposal, there have been reports of broken school incinerators not being utilized, issues with smoke and odour from decentralizedincinerators in schools, and concerns raised regarding emissions.[34]

  There is a high risk of emissions entering the room if decentralized incinerators are installed in confined rooms or toilet blocks and the vent stack/outlet pipe is not long enough to reach a suitable height outside the room. In some instances, privacy has often been overlooked for the design and placement of incinerators.[35] A straight duct should run from the toilet room to the incinerator to ensure privacy; this design has been implemented in Tamil Nadu.[36] According to the Central Pollution Control Board (CPCB) guidelines, the stack height must be at least 2 metre above the roof or the nearest building or as determined by the State Pollution Control Board (SPCB). As can be seen in the following image, the incinerator machine installed in a public toilet in a park in Gurugram does not comply with this, which can have deleterious effects on human health and the environment.

Decentralized incinerator installed in a public toilet in a park in Gurugram

Source: CSE,, 2022

- **Disposal of ash:** Most decentralized incinerators have a cut-off temperature below 800 degrees Celsius. If sanitary waste is not burnt at the correct temperature, the ash will likely contain residues of heavy metals and chlorinated organic chemicals, such as dioxins, arsenic, lead and nickel, which could affect human health and the environment. There is currently no standardized protocol for ash disposal for decentralized incinerators, because of which ash is disposed of indiscriminately.

- **Functioning of incinerators:** Every decentralized incinerator has an overall capacity and run time for each incineration cycle. Further, specific models with a higher capacity have a feed-in rate, which is the number of sanitary napkins that may be placed in the burning chamber at a given frequency during the run-time. Overloading might affect the quality of the burning process, causing incomplete incineration and irregularities in the burning cycle in the long term, putting the machine's overall functioning at risk if the feed rate is not rigorously monitored.

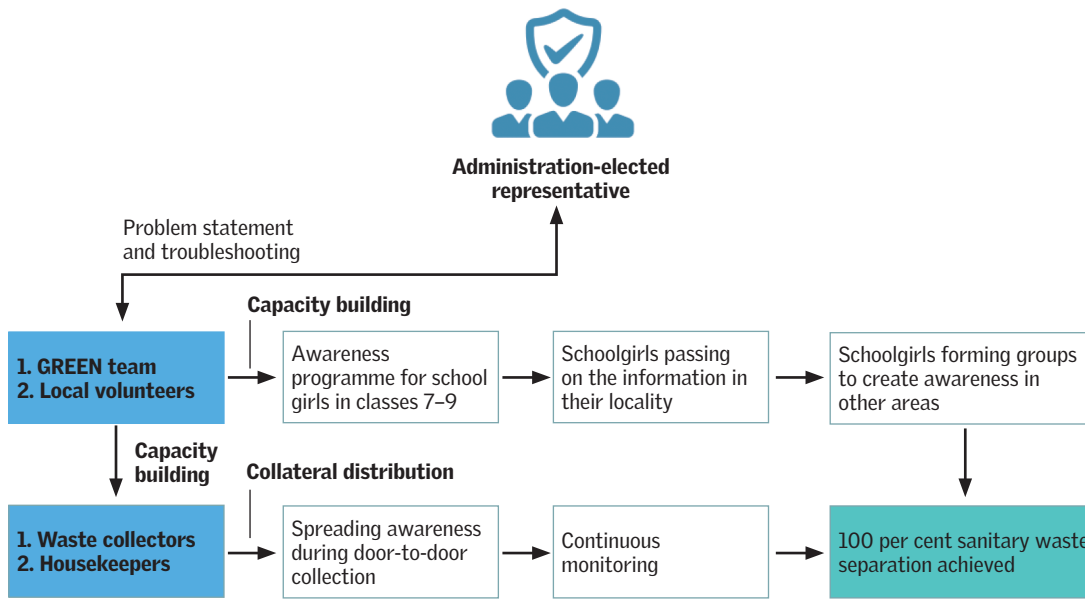
5. Centralized incinerators

Case study—Karad city

Karad city, in the state of Maharashtra, spreads over 10.51 sq. km and is divided into two zones, North and South, with 14 wards and an estimated population of 86,000 in 2021. In 2001, the Karad Hospital Association was given a one-acre stretch of land to build and commission a 600 kg/day biomedical treatment facility. As a result, the Karad Municipal Corporation signed an agreement with Karad Hospital Association to allow sanitary waste collected by urban local bodies (ULBs) to be processed at the existing biomedical facility at no expense to the ULB. However, the corporation had difficulties managing sanitary waste due to a lack of awareness and source segregation.

In August 2021, the Municipal Council adopted a communication strategy and began a comprehensive campaign to raise awareness among the citizens. IEC activities and capacity-building programmes educated people about the health and environmental consequences of improper sanitary waste management and mixing it with the rest of municipal solid waste.

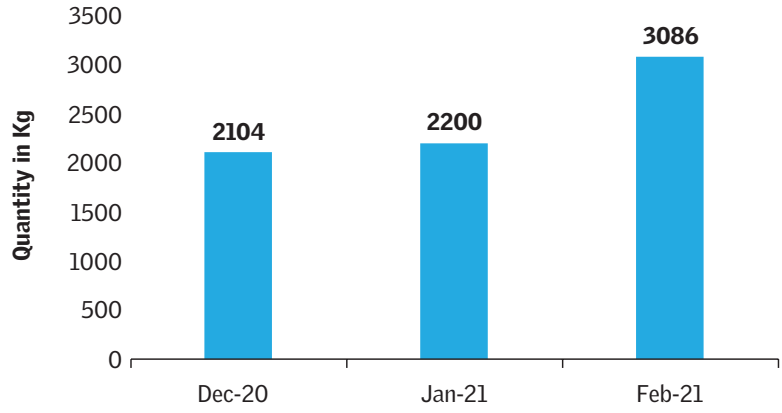
Figure 8: Strategy for the IEC campaign



Source: Karad Municipal Council

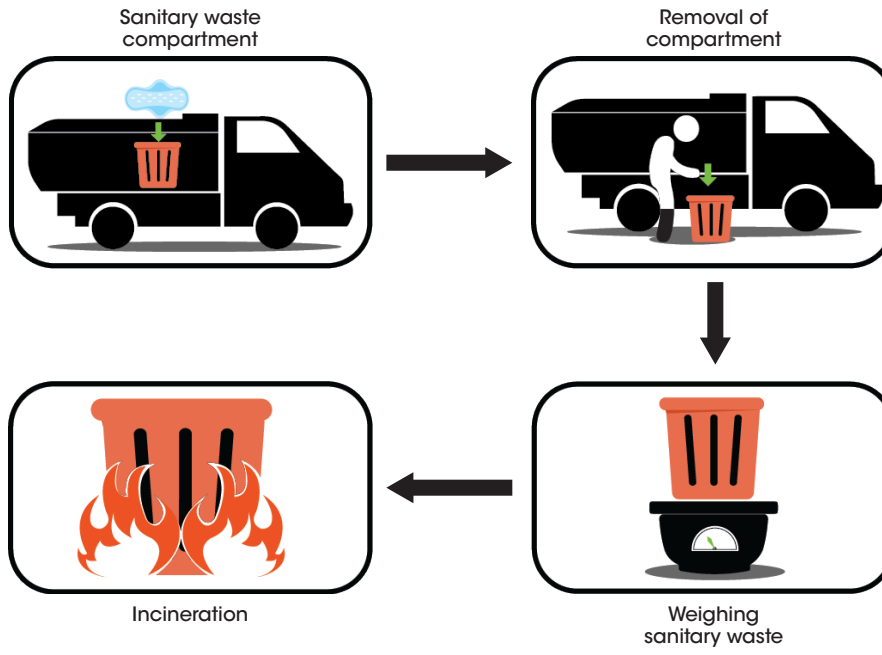
In June 2021, the council introduced waste segregation into four fractions—biodegradable, non-biodegradable, domestic hazardous and sanitary. Adequate infrastructure and services to improve sanitary waste management was set up. The facility was located on the same plot where biodegradable waste was brought in for windrow composting and non-biodegradable waste for recycling at the material recovery facility. The plot also houses a material recovery facility, so integration of the whole system came at no extra transport cost.

Graph 5: Sanitary waste generation in Karad



Source: Karad Municipal Council

Figure 9: Sanitary waste management in Karad



Source: Karad Municipal Council

By spending a small amount of money on IEC and modification of waste collection vehicles, the city administration has been able to achieve the feat of separate collection and scientific processing of sanitary waste. According to Karad Municipal Council, a total of 11.919 tonne of sanitary waste was treated in October 2020–March 2021.[37]

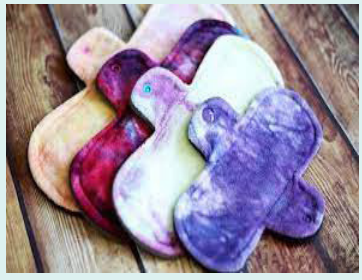
The Karad Hospital Association handles the operation and maintenance of an integrated centralized biomedical and sanitary waste facility. It is a one-of-a-kind project in which a hospital organization has stepped up, partnered with an urban local body (ULB), and demonstrated how to properly handle sanitary waste.

6. Alternative sanitary products and methods of disposal

Regulations, guidelines, waste management practices and sanitary products are continually updated. In India, 50 per cent of females use cloth sanitary napkins; 45 per cent use commercial napkins; 13 per cent use both cloth remaining 6 per cent "don't use anything" during menstruation.[38]

Sanitary waste is largely disposable commercial products like pads and tampons. Polythene, cotton, rayon, polyester, cellulose and superabsorbent polymers (SAPs) are used in commercial disposable sanitary napkins. It takes at least six months for compostable materials to decay; plastics take hundreds of years. Most commercial sanitary products are bleached and scented, and contain chlorine and other chemicals that if not disposed of properly can have a negative impact on the environment. Many women also opt for menstruation cups and reusable cotton pads, which have little or no environmental impact. Many others choose "biodegradable" sanitary napkins to switch to sustainable periods. There has, however, been some debate regarding how sustainable these biodegradable napkins are.[39]

Examples of eco-friendly sanitary products used by Indian women



Reusable cloth napkins

Layers of natural absorbent materials, such as fabric and hemp plant fibre, are used to make reusable cloth napkins. Some reusable cotton pads contain a leak-proof lining made of synthetic materials like polyester. They can be used for three to four hours after which they must be washed and dried. They can last for a year or two. They have a longer lifespan than commercial sanitary pads and produce less waste.

Menstrual cup

Menstrual cups are made of silicone or rubber of medical quality. They must be cleaned and sterilized after each cycle and stored in a dry place. They can last for up to five to ten years. They have a longer lifespan and produce less waste than commercial disposable napkins.

Compostable napkins

Bamboo, banana tree fibre and water hyacinth are used to create layers of natural absorbent materials that are compostable. They are single-use and can be used for three to four hours.

Personal preference, culture, economic status, and availability in the local market influence selection of sanitary product (see *Table 5: Advantages and disadvantages of various sanitary products*). The pros and cons are dependent on social and economic factors and vary with the local context. For example, in rural areas, reusable cloth napkins are the most common sanitary product. However, urban women prefer commercial napkins, and women and girls in a few metropolitan cities have shifted to tampons or menstrual cups.

Table 5: Advantages and disadvantages of various sanitary products

Sanitary product	Affordability	Accessibility	Amount of waste generated	Cultural acceptance
Cloth-based napkins	Disadvantage	Disadvantage	Disadvantage	Disadvantage
Commercial disposable napkins	Advantage	Disadvantage	Advantage	Disadvantage
Tampons	Advantage	Disadvantage	Advantage	Advantage
Commercial reusable napkins	Disadvantage	Advantage	Disadvantage	Advantage
Biodegradable disposable napkins	Advantage	Advantage	Disadvantage	Advantage
Menstrual cups	Advantage	Advantage	Disadvantage	Advantage

Advantage Disadvantage

Source: Compiled from WaterAid 2012, Menstrual Hygiene Management.

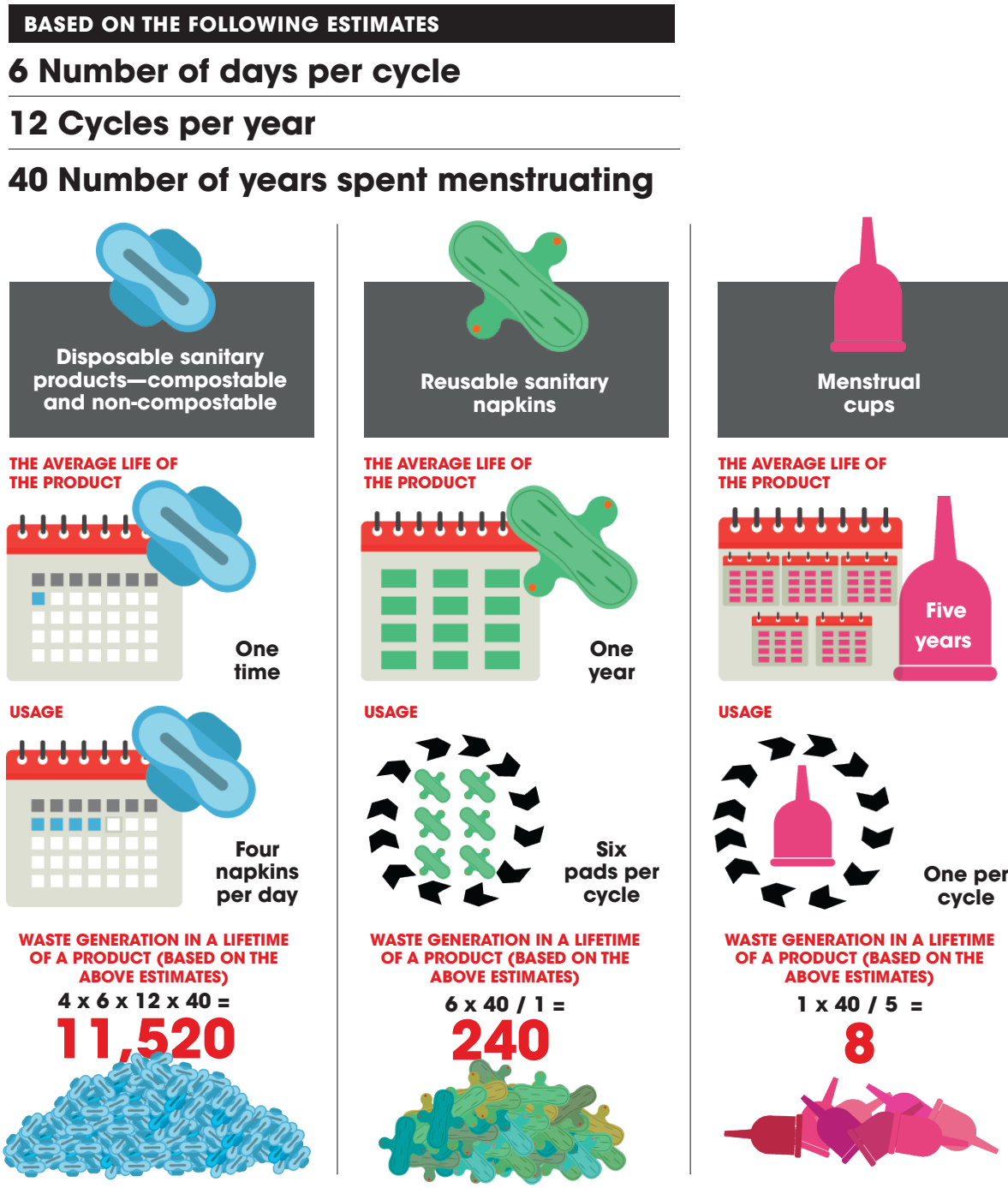
Before discussing how environmentally friendly our biodegradable sanitary napkins are, it is essential to understand why disposable pads are environmentally damaging. Aside from waste generation from treatment and disposal techniques, carbon emissions are generated during the manufacturing process and the product's active lifespan. When we use a reusable product, on the other hand, we may optimize the value of the emissions by utilizing it for an extended period due to its prolonged active lifespan. We produce less trash, emit less CO_2, and spend less on products like menstruation cups, reusable cloth pads and period panties.

Table 6: Current alternative sanitary products and their lifespan

Product	Material	Usage
Sanitary napkins and tampons	Contains superabsorbent polymers (SAPs) and plastics	One time
Cloth-based sanitary napkins	Cloth and hemp (plant material)	Reusable for one to two years
Menstrual cups	Medical grade silicone	Reusable for five to ten years
Biodegradable sanitary napkins	• Natural ingredients such as cotton, wood pulp, banana fibre, sugar cane • Organic cotton with bio-plastic layer in some cases	One time

Source: Compiled from WaterAid and MHAI (Menstrual Hygiene Alliance of India).

Figure 10: Comparative analysis of waste generated by three different types of sanitary products



Source: CSE, 2022

These alternative sanitary products are either reusable or compostable products that reduce waste generation. Reusable items, such as cloth napkins and menstrual cups, can be used numerous times before being discarded, resulting in waste reduction. Reusable menstrual cups and reusable napkins have a longer lifespan than disposable sanitary napkins, which directly affects the quantum of waste these products generate over time (see *Figure 10: Comparative analysis of waste generated by three different types of sanitary products).*

Further, we must understand that biodegradable is not the same as compostable. While all compostable material is biodegradable, not all biodegradable material is compostable. Although biodegradable materials return to nature and gradually disappear completely, they can sometimes leave residues. On the other hand, compostable materials produce compost, which is nutrient-rich and beneficial to plants. To summarize, compostable materials are biodegradable, with compost the added benefit, i.e. as they decompose, they release vital nutrients into the soil, helping plant growth.

Most of these "biodegradable" pads claim to be chemical-free and compostable. Many of them eliminate superabsorbent polymers (SAPs) and wood pulp, but some plastic is still retained for waterproofing. How is it better than disposable napkins if the biodegradable, organic-tagged pads have bleached white cotton and plastic liners? It would not be incorrect therefore to say that most pads that claim to be "biodegradable" sanitary napkins are not entirely compostable, and the term can be misleading.

According to a study conducted by Green the Red, a volunteer-led community of healthcare professionals and activists who aim to spread awareness about sustainable menstruation alternatives, some sanitary napkins that claimed to be eco-friendly and compostable were composted. The results were the following:[40]

Sanitary napkin sample 1: These pads were not bleached and claimed to comprise banana fibre. Two pads were composted, one used and the other unused. At high room temperature, the one with blood dissolved and composted in seven and a half months, while the one without blood took roughly five and a half months (see *following image of napkins after two and six months in compost*).

Sanitary napkin after two and six months in compost

Source: Green the Red

Sanitary napkin sample 2: This pad appeared to be bleached white. It took more than six months to dissolve when a used pad was composted. It had a non-shredding plastic coating. It was finally removed from the compost pile. (Corn starch, bamboo fibre and corn-based bio-plastic were among the ingredients.) (see following image for the napkins after two and six months in compost).

Sanitary napkin after two and six months in compost

Source: Green the Red

The results suggest that these sanitary napkins may be biodegradable and may degrade in years due to some plastic coating, but they are not compostable. However, it remains unclear whether they are genuinely an eco-friendly and sustainable option. The components used to make a napkin determine whether it is a green or a conventional napkin. Perforated polyethylene or non-woven polypropylene, utilized as the top sheet, is frequently mistaken for cotton due to its texture and appearance. However, it is not compostable. In addition, the polyethylene back layer and the top layer together make up about 25–30 per cent of the total weight of a sanitary napkin. Non-compostable materials are typically

utilized for the top permeable layer—usually non-woven—the barrier plastic layer underneath—superabsorbent polymer (SAP)—and hot-melt glue in disposable sanitary napkins.[41] Apart from the glue, which is utilized in small amounts, the remaining components must be replaced.

Alternative sanitary products that are reusable or partially compostable products reduce waste generation (see *Table7: Current methods of disposal of alternative sanitary products)*.

Table 7: Current methods of disposal for alternative sanitary products

Product	Material	Disposal method
Sanitary napkins and tampons	Contains superabsorbent polymers (SAPs) and plastics	Electric incineration
Cloth-based sanitary napkins	Cloth and hemp (plant material)	Incineration, deep burial or composting
Menstrual cups	Medical-grade silicone	Incineration
Biodegradable sanitary napkins	• Natural ingredients like cotton, wood pulp, banana fibre, sugar cane • Organic cotton with bio-plastic layer in some cases	Deep burial or composting if made up from only plant-based material

Source: Compiled from WaterAid and MHAI (Menstrual Hygiene Alliance of India)

Reusable items, such as cotton pads and menstrual cups, can be used numerous times before being discarded, resulting in reduced waste (see *Table 8: Recommended disposal options as per CPCB Guidelines for Sanitary Waste Management*).

Table 8: Recommended disposal options as per CPCB Guidelines for Sanitary Waste Management

Sanitary waste	Disposal into a pit latrine	Deep burial	Composting	Pit burning	Incinerator
Used tissue, paper, cloth, cotton	✓	✓	✓	Less recommended	Low-cost or electric incinerator
Cotton napkins (reusable or commercial)	Less recommended	✓	✓	Less recommended	Electric incinerator
Commercial napkins with plastics and liners	Less recommended	✓	Not possible	Less recommended	Biomedical incinerator

6.1 Disposal in latrine pits

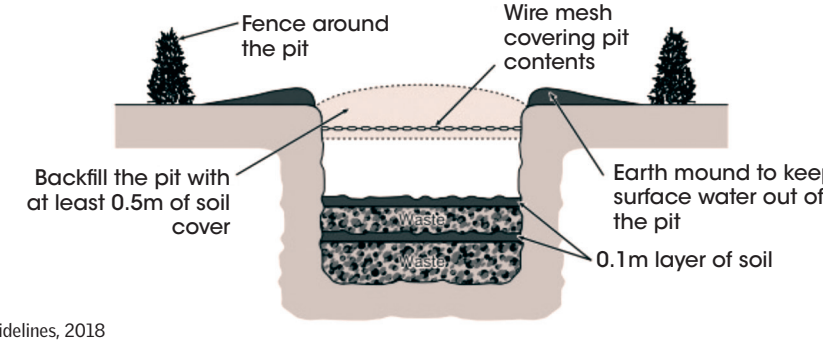
Flushing in latrine pits is a method of sanitary waste disposal. CPCB recommends this disposal method for tissue paper, cotton and cloth-based sanitary napkins but less for commercial plastic-based sanitary napkins. As per the MHM Guidelines, however, commercial sanitary napkins should not be disposed of in latrine pits. The multiple methods of disposal recommended by various organizations create ambiguity in the implementation process. Lack of coordination between different government entities is a significant concern with regard to existing sanitary waste disposal options, making resolving inconsistencies in legislation a challenge.

According to a study done by international non-profit WaterAid, 9 per cent of women flushed their sanitary waste in toilets or latrine pits as they considered this a more discreet option.[42] Non-biodegradable pads made of synthetic materials were disposed of in latrine pits and toilets, jeopardizing the biological processes that break down faeces in the pit. Disposable sanitary pads using superabsorbent polymers (SAP) pose a challenge since SAP absorbs liquids, causing pads to expand and clog sewer pipes. This has ramifications for sanitation workers and cleaners who clear blockages from sewers and clean septic tanks and their health and social status.

6.2 Deep burial

Deep burial is a low-cost method of sanitary waste disposal that can be used in rural areas. According to the CPCB guidelines, once the sanitary material has been placed inside the burial pit, it is covered with soil to avoid foul smell and exposure to the open air. The pit should be built at least 5–7 metre away from any drinking water sources. At the village and panchayat levels, homemade cotton or cloth-based sanitary waste can be disposed of in burial pits of at least 50 cm depth. Deep burial is not the best disposal option in areas with a low groundwater table or frequent rains.

Figure 11: Deep burial pit



Source: CPCB Guidelines, 2018

Deep burial may cause women embarrassment and privacy concerns along with the inconvenience of collecting and taking sanitary waste to a burial site. Further, sanitary products made of plastic should not be considered for deep burial.

6.3 Composting

Composting is a viable alternative for compostable sanitary waste (such as those composed of natural fibres), not bleached cellulose, SAP or plastic liners. According to CPCB, compostable sanitary waste should be covered with biodegradable materials such as leaves or dried plants. After the pit is filled, it should be covered with soil to avoid foul odours. Many sanitary products composed of synthetic fibre rayon with antibacterial compounds such as organochlorines are now available in the market. When composted, these partially biodegradable sanitary napkins destroy the soil microflora and slow the decomposition process due to their chemical composition.

A study by Green the Red suggests that these sanitary napkins may be biodegradable—they could degrade over several years due to the plastic coating—but they are not compostable. It however remains unclear whether composting of sanitary napkins is really an eco-friendly and sustainable disposal option as we envisage.[43]

6.4 Clay-pot or matka burning

Pit burning is a viable option in remote areas where no other options are available. Cotton-based sanitary products can be disposed of by burning in a clay-pit. According to CPCB guidelines, the burning should be done at a depth of around 1 metre. At villages and panchayat levels, low-cost incinerators like clay-pot incinerators can also be utilized to dispose of only cotton-based sanitary waste.

Clay-pot or matka incinerator

Source: Vatsalya Foundation

Table 9: Overview of different sanitary waste disposal options

Disposal option	Type of use	Advantages	Disadvantages	Examples of use
Deep burial	Households (rural)	• Low cost • Easy to use	• Feasible option only for sanitary pads made of plant-based material or cotton or cloth • Not a good option for areas with low groundwater table and frequent rains	• Households in Uttarakhand
Composting	Households (rural and urban)	• Low cost • Easy to use • Generates additional resources, i.e. compost	Composting a feasible option only for compostable sanitary pads, e.g. made of natural fibres), not pads made of bleached cellulose, SAP, and plastic covering.	• Households in Tamil Nadu
Incineration—clay pots (matka)	Household (Rural)	• Low cost • Easily available • Easy to use • Uses locally available fuel	• No emission controls • Burn at low temperature, hence waste may not burn efficiently • May not work for pads with high moisture content and high content of superabsorbent polymers (SAPs) • Ash might not be safe to use for gardening • Design not standardized and highly variable • Feasible option only for home-made cotton or cloth-based sanitary napkins	• Households in Papna Mau village, Uttar Pradesh
Low-cost locally made incinerators	Institutional/ public settings, households (rural/urban)	• Low cost • Easy to install • Built from locally available materials • Easy to use and maintain • Uses locally available fuel	• No emission controls • Burn at low temperature, hence waste may not burn efficiently. • May not work for pads with high moisture content and high content of superabsorbent polymers • Ash might not be safe to use for gardening. • Design is highly variable and not standardized	• Schools in Nepal • Schools in Uttar Pradesh • Rural schools in Tamil Nadu • Households in Tamil Nadu • Communal EcoSan toilets, Tamil Nadu
Electric incinerators	Institutional/ public settings (Urban)	• More expensive and some models have emission control features such as filters • No need for fuel • Some models have quality certification	• Dependent on electric supply • High cost • May release toxic gases if temperature below 800 degrees Celsius • Unclear if they can efficiently burn pads with high moisture content • Variation in design • No standard quality certification • Ash might not be safe to use for gardening	• Public toilet, Chennai Central Railway Station • Public toilet, Dindigul Bus Stand, Tamil Nadu • Schools in Tamil Nadu, Kerala, Delhi, Rajasthan, Madhya Pradesh, Maharashtra and West Bengal

Source: Compiled from PATH (2017) and Menstrual Waste Disposal in Low- and Middle-Income Countries, 2018.

In the case of burning plastic-coated sanitary products, the ash is likely to contain residues of toxic chemicals that should not be mixed with soil or water because they can be detrimental to individuals who come into touch with them. The matka or clay-pot incinerator must be kept in open places, such as the backyard or terrace of the house, and may not be used to dispose of commercial sanitary waste.

There are a variety of disposal options available, ranging from deep burial to incineration systems, each with its advantages and disadvantages (see *Table 9: Overview of different sanitary waste disposal options*).

According to findings from an Indian systematic review and meta-analysis study, unsafe disposal practises such as throwing absorbents in open spaces and burning (open burning, not incineration) were significantly higher in community-based (especially in rural and slum settings) than in school-based settings. According to the study—which also highlighted that in the school-based study girls were observed to discard soiled napkins in latrines, particularly when they did not have access to dustbins—sanitary waste disposal may be more difficult in community settings than in institutional settings because facilities are not as well managed.[44]

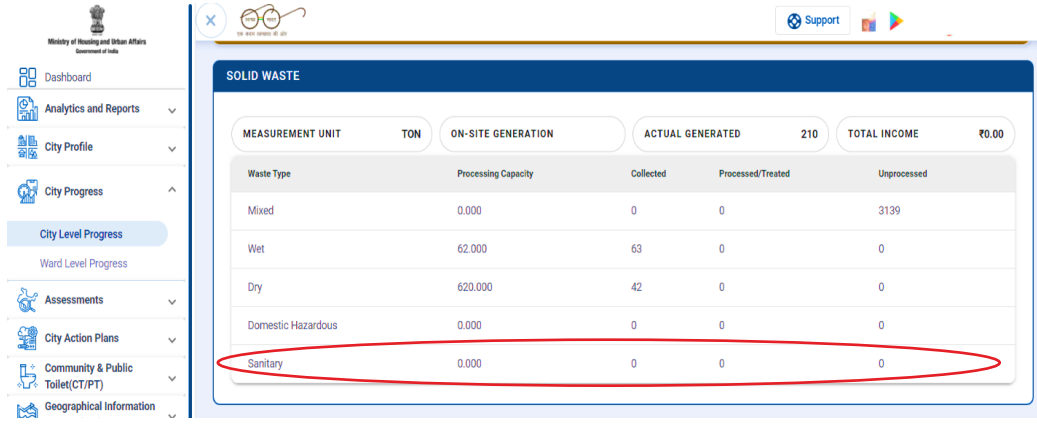
Cultural norms, personal preferences, economic position and socioeconomic pressures influence sanitary waste disposal habits. Menstrual attitudes, knowledge and behaviours are all intertwined, and these conventions might act as roadblocks to proper waste disposal. As a result, regular awareness and capacity building on sanitary waste management should be carried out at all levels, including producers, consumers and decision-makers.

7. Recommendations

This chapter addresses recommendations for policy considerations, effective coordination among stakeholders, implementation protocol and waste governance by local governments to institute a sustainable system for sanitary waste management.

- **Comprehensive assessment**: One of the largest hurdles towards scientific sanitary waste management is the absence of data and lack of comprehensive statistics on the subject, and lack of statistics and measures for collecting and disposing of other sanitary wastes in the country. There should be a clear policy mandate for a comprehensive study to quantify and characterize sanitary waste generation, and local authorities should include correct estimated data—instead of zero—under the column "sanitary waste" in the Swachh Bharat Mission (SBM) Management Information Systems (MIS). City- and/or panchayat-level data can be collated at the district and/or state level to arrive at the national scale to institute a scientific monitoring and management system.

Snapshot of SBM-MIS portal



Source: Ministry of Housing and Urban Affairs (MoHUA), Government of India.

- **Inventory of sanitary products**: In March 2022, the Central Pollution Control Board (CPCB) launched the EPR (Extended Producers Responsibility) portal for PIBOs (Producers, Importers, and Brand Owners) to ease the EPR implementation process and ensure processing of their plastic packaging.

EPR portal

Source: CPCB

CPCB should similarly develop a separate portal where every sanitary product brand owner and manufacturer is required to share their production and sales data for all sanitary products to estimate and assess the quantity of sanitary waste generation and accordingly compute the treatment facility design capacity.

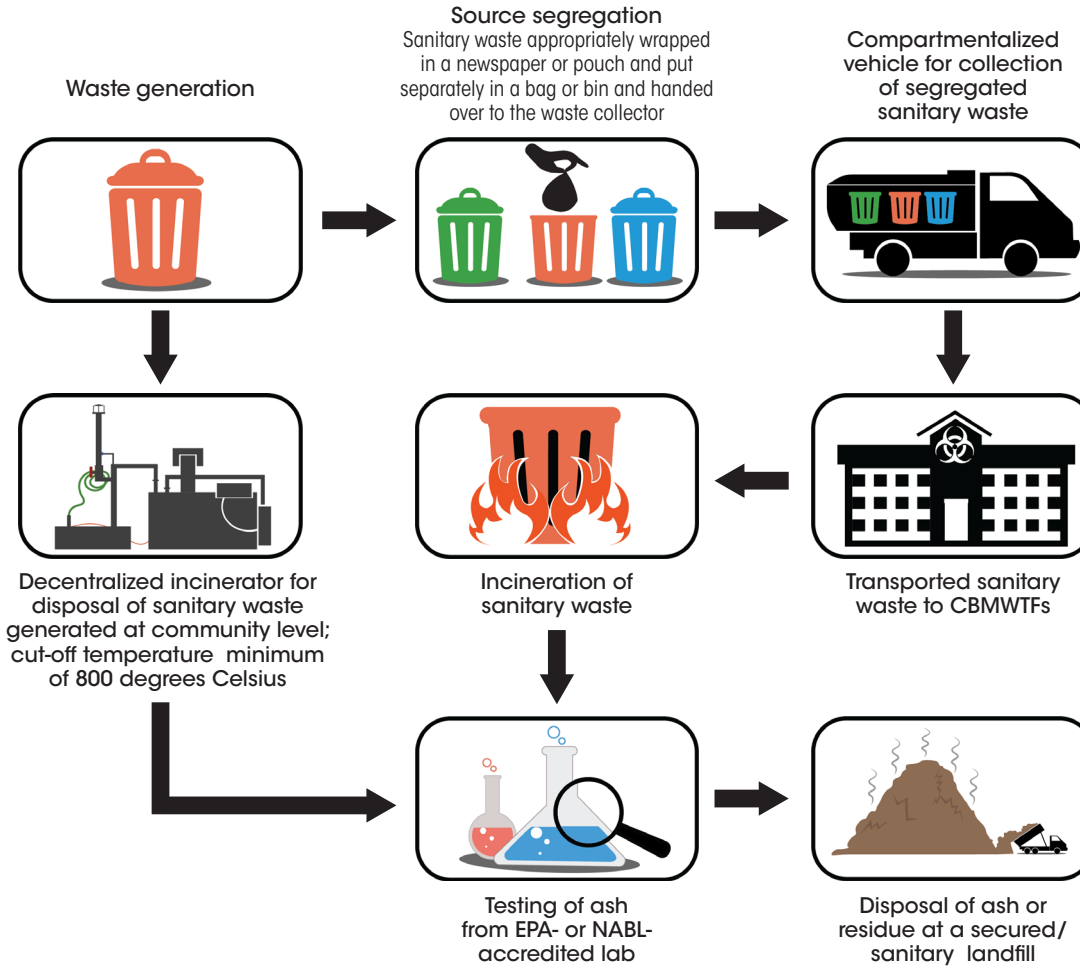
- **Strengthening existing rules and guidelines**: Non-compliance with SWM Rules, 2016 and the provisions of the Guidelines for Sanitary Waste Management, 2018 currently has no consequences. Considering the hazardous potential of sanitary waste—along with magnitude and quantity—and need for an established scientific protocol to deal with it, there must be a dedicated policy for sanitary waste management. Such a policy should provide a legal instrument to local bodies to adopt and enforce by-laws exclusively on sanitary waste management.

- **Address inconsistency in terminology**: According to the SWM Rules, 2016, domestic hazardous waste and sanitary waste are considered separate categories of waste and treated differently. According to the Ministry of Housing and Urban Affairs (MoHUA) Swachh Survekshan Toolkit 2022, however, sanitary waste and domestic hazardous waste have been consistently classified in a common waste category.

  To reduce inconsistency and confusion among waste management practitioners and authorities, the standard definition of sanitary waste prescribed under SWM Rules, 2016 should be standardized across policies, guidelines and management protocols for its uniform understanding and management.

- **Redesign infrastructure and services for sanitary waste management**: Appropriate infrastructure and services play a significant role in sustaining waste management operations. Segregation of sanitary waste at source must be enforced as mandatory. Collection vehicles, tricycles and/or pushcarts must have a dedicated compartment for collection and storage of sanitary waste, with a specific colour code. Currently, SBM 2.0 has recommended four-way segregation of waste at source, including segregation of sanitary waste. Similarly, the treatment and disposal system must be made uniform and mandatory regardless of the scale and level of interventions so that the hazardous potential in sanitary waste could be mitigated without harming the environment and public health.

Figure 12: Process flow diagram of sanitary waste management



Source: CSE, 2022

To check for the presence of heavy metals before disposal in a landfill, ash produced by incinerators should be tested in any EPA (Environmental Protection Agency)- or NABL (National Accreditation Board for Testing and Calibration Laboratories)-accredited laboratory. Penalty clauses should be considered for non-compliance to improve enforcement mechanisms and streamline implementation.

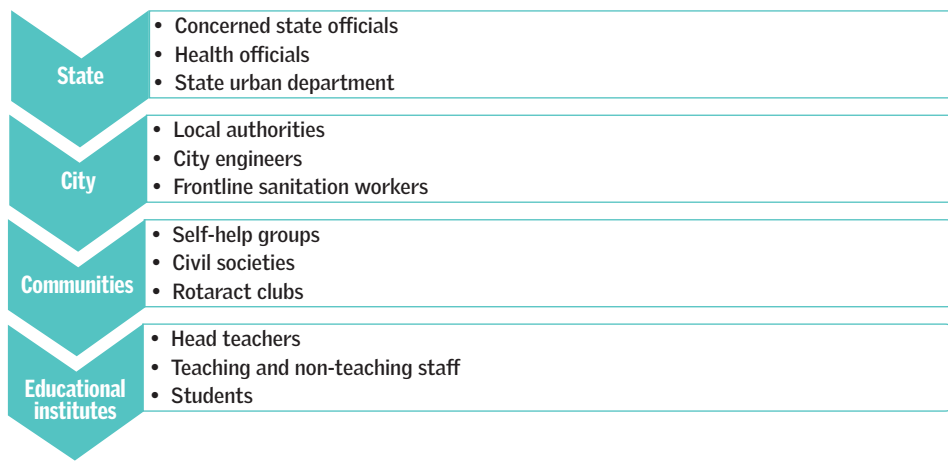
- **Reinforce instructional arrangement to strengthen sanitary waste management**: The policy document should clearly specify the roles and responsibilities of every stakeholder for sanitary waste management (see *Table 10: Roles and responsibility of various stakeholders*).

Table 10: Roles and responsibility of various stakeholders

Stakeholder	Role and responsibility
State-level officials	• A dedicated inventory of sanitary waste generation should be created at the state level, with breakup of sources. Compliance should be monitored at state-level review meetings along with reviews of regular municipal solid waste management performance. Competent state authorities must frame relevant state policies to complement financial allocation, with special focus on sanitary waste management.
Local authority	• Enact by-laws for four-way segregation at source, with a clear mandate to include sanitary waste in the segregated streams of waste. • Providing adequate infrastructure and services for separate collection, transportation and treatment of segregated sanitary waste. • Collaborating with existing common biomedical facilities and waste-to-energy facilities to treat sanitary waste at the required scale. • Getting technical specifications of decentralized incinerators mandatorily vetted by State Pollution Control Boards before any procurement. The procedure may involve the city governments receiving and forwarding applications for installation of decentralized incinerators. • Instituting a stringent system for regular monitoring of installed incinerators with regard to measures to safeguard against pollution and protect the environment and public health. • Ensuring that all vendors submit an NOC (no objection certificate) from the State Pollution Control Board in compliance with the emissions standards as per SWM Rules and CPCB Guidelines prior to any procurement of decentralized incinerators.
State Pollution Control Board	• Ensuring that the site is inspected to ensure all possible safety standards and environmental parameters have been complied with ahead of installing decentralized incinerators in educational institutes and public places. • Creating a mechanism so that the city government officials inspect installed incinerators at least once every year to monitor the ash disposal and emission control system.

State Health Department	• Providing knowledge and healthcare support to women and adolescent girls through IEC campaigns. • Issuing directives to hospitals to allow urban local bodies (ULBs) to send their sanitary waste to their captive incineration facilities until the ULBs are connected to a sustainable sanitary waste treatment and disposal system. • Periodically reviewing the rates for collection, transportation and treatment of sanitary waste so that it remains an interesting proposition for service providers. • Promoting eco-friendly alternative sanitary products to reduce the carbon footprint in the environment. • Creating an enabling environment to encourage women self-help groups (SHGs) to initiate small-scale businesses to make eco-friendly sanitary products using programmes such as the National Urban Livelihoods Mission (NULM).
Educational Department	• Implementing age-appropriate curricula for adolescent girls to educate them on scientific management of sanitary waste in schools and at home. Students must be considered as amplifiers to receive the message for sanitary waste management and educate their family, friends and neighbourhood. • Issuing directives to all the schools on the minimum mandatory standards for installing decentralized incinerators. • Issuing directives to all the schools for scientific disposal of sanitary waste through an authorized vendor deployed by the ULB or entering into an agreement with the common biomedical waste treatment facility, subject to its availability.

➢ **IEC (Information, Education and Communication):** Considering the scale of sanitary waste generation and current practices on sanitary waste management, it is imperative to initiate an IEC drive with a proper roadmap at the national scale. The absence of education contributes to the stigma and lack of awareness of sanitary waste management. Not just women using menstrual products but also administration are often unaware of the science behind the menstrual products and their disposal. One of our long-term priorities in India should be IEC (information, communication, and education) programmes around alternative sanitary products that are more environmentally friendly, with a budget assigned especially for IEC. The IEC initiative should be part of the policy mandate, and the same should reflect as a programme mandate for SBM (Swachh Bharat Mission).



- **Collaborate with other organizations**: Urban local body shall join hands with civil society, private organizations and self-help groups involved in sanitary waste management in their jurisdiction to conduct extensive IEC to promote source segregation and create awareness about eco-friendly sanitary products.

  SWaCH, in collaboration with the Kagad Kach Patra Kastakari Panchayat (KKPKP), a waste pickers' trade organization, and the Pune Municipal Corporation, launched in 2017 the Red Dot Campaign to promote awareness about proper sanitary waste disposal at the household level.[45]

A poster from the Red Dot campaign

Source: SWaCH Pune

- **Promote eco-friendly products**: Looking at the current ecosystem of available sanitary products available in the market and materials used in the process of manufacturing them, there is a clear need to invest on promoting eco-friendly alternatives with health, economic and environmental benefits. To promote environmentally friendly sanitary products, local authorities can partner with non-profit organizations such as Eco Femme, a women-led social enterprise in Tamil Nadu that manufactures and sells reusable, washable cloth sanitary napkins.

- **Disclosure of composition and testing of disposable eco-friendly sanitary product**: Manufacturers must also disclose information on the chemical composition of sanitary products so that appropriate technologies for disposal and treatment can be devised. Consumers need to be given choice of what they are purchasing. Instead of looking for the term "biodegradable", they should look for the term "compostable". A compostable sanitary pad usually takes 90–180 days to decompose. Compostable napkins made up of natural and plant-based material can decompose in the soil within the specified timeframe,

INDIAN STANDARDS

IS 5405:2019: Sanitary napkins are absorbent materials used to absorb fluid discharged during menstruation. As compared to cloth and other materials (husks, ashes, etc.) used during menstruation, they provide better hygiene and protection against leakage. This standard was originally published in 1969 and subsequently revised in 1980. The current revision was made in the light of experience gained since its last revision and to incorporate the following major changes:

- Material and sizes
- Types of sanitary napkin
- The procedure and requirement of ability to withstand pressure after absorption
- The optional requirement of disposability
- Hygiene testing requirement
- Good manufacturing practice guidelines for hygiene requirement
- Bio-compatibility evaluation requirement
- Optional requirement of biodegradability and compostability
  Manufacturers that claim that their product is biodegradable or compostable shall perform the above testing for the final product. The product shall be considered biodegradable or compostable when tested as per IS/ISO 17088. The information regarding whether the product is biodegradable, compostable or oxy-degradable shall be marked on every packet of sanitary napkin.
- Sampling and criteria for conformity
- Marking and packing clause

IS/ISO 17088:2021: These standards specify procedures and requirements for plastics and products made from plastics that are suitable for recovery through organic recycling. The four following aspects are addressed:

- Disintegration during composting;
- Ultimate aerobic biodegradation;
- No adverse effects of compost on terrestrial organisms; and
- Control of constituents.

These four aspects are suitable to assess the effects on the industrial composting process. This document is intended for use as the basis for systems of labelling and claims for compostable plastics materials and products. This specification is intended to establish the requirement for the labelling of plastic products and material as "compostable" or "compostable in municipal and industrial composting facilities". The labelling, in addition, must conform to all international, regional, national, and local regulations.

producing no heavy or toxic metals in the environment. Biodegradable or oxo-degradable sanitary pads are often confused with fully compostable sanitary pads.

Manufacturers must ensure that each eco-friendly-labelled sanitary products must bear the label "compostable" and conform to Indian Standards: IS 5405 and IS/ISO 17088 (as amended from time to time). Their eco-friendly-labelled sanitary products must be tested by the Central Institute of Petrochemicals Engineering and Technology (CIPET) or any other Central Pollution Control Board (CPCB)-recognized government laboratory with adequate testing facilities.

Various sanitary product producers in India include the chemical composition of their sanitary napkins on the package and label their sanitary products with certifications to identify the product's possible environmental impact before releasing it on the market.[46]

Figure 13: Cross-sectional view of disposable eco-friendly sanitary napkin

Source: Anandi compostable sanitary napkins

- **Prescribe standards for manufacturers:** Due to increased demand for decentralized incinerators as a primary choice for sanitary waste disposal, various decentralized incinerator models are available in the market. As

detailed in this report, many or most of these incinerators do not meet the prescribed emission standards. Therefore, policy instruments are needed for the industry with regard to mandatory compliance of emission standards for materials to be used in the manufacture of incinerator unit, feed-in rate and capacity of a given model, emission control system, ash residue disposal process, and a standard checklist for operations and maintenance of the machines post installation.

- **Standardized procurement procedure**: A standard format for tenders for procurement of incinerators must be used by government bodies at all levels. The tender must include manufacturing requirements to be prescribed, compliance with CPCB guidelines, testing through an accredited laboratory, annual maintenance contract, monitoring for a minimum of two years from the date of installation, and training for users on how to utilize the decentralized incinerator unit. To ensure efficient operation, annual maintenance must be incorporated under the scope of work of the selected contractor or agency for at least three years from the date of installation and renewed as needed.

- **Monitoring of sanitary waste management**: Considering the scale in the increment of sanitary waste generation in India, every city and panchayat must comply with the mandate to provide data on sanitary waste generation after systematic characterization of all waste streams. The data should be compiled at various tiers of administration and be part of the agenda-for-development meeting.

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The Solid Waste Management (SWM) Rules, 2016 classifies used sanitary napkins, diapers, condoms, tampons and incontinence sheets as sanitary waste. According to the Menstrual Hygiene Alliance of India (MHAI), 336 million girls and women of reproductive age in India generate about 1 billion sanitary napkins per month, or 12.3 billion sanitary napkins annually. Sanitary waste is voluminous and infectious, and plastic is used as a primary material in the manufacture of disposable sanitary products, underlining the need for sanitary waste management in India.

There are few documented measures in the country for collecting and disposing of sanitary waste. This report highlights the status, challenges and government initiatives in the context of segregation, collection, transport, treatment and disposal of sanitary napkins in India. It addresses recommendations for policy consideration, effective coordination among stakeholders, implementation protocol and waste governance by local governments to institute a sustainable system for sanitary waste management.

Centre for Science and Environment
41, Tughlakabad Institutional Area, New Delhi 110 062
Phones: 91-11-40616000 Fax: 91-11-29955879
E-mail: cseindia@cseindia.org Website: www.cseindia.org