

Sustainable and Smart Incinerator for Women of Modern India

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Abstract

In India, 30 percent of its population comprises menstruating women which accounts for nearly 355 million. Menstrual Hygiene Alliance of India (MHAI) reports that 36 percent i.e. 121 million women use commercial sanitary napkins. Improper disposal of menstrual waste is a major blockade in making a clean India and achieving the goal of the Swachh Bharat Mission. Further, improper disposal of soiled pads presents health and environmental hazards. The present work addresses the challenge of the disposal of soiled pads through automation. In this work a smart sustainable incinerator is proposed which facilitates the hygienic disposal of soiled pads. Further, the incinerator ensures complete conversion to ash least carbon emissions during incinerating process by the employment of a smoke control unit for its filtration. The device can be remotely controlled with the help of an app on the android platform. The present work contributes to all the three dimensions of the Triple Bottom Line (TBL) approach.

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1. Introduction

World Health Organization (WHO) considers any person aged between 10 to 19 years as a teenager. This transition period from childhood to teenage is called adolescence. The human body undergoes many changes during this transition both physically and biologically. Menarche marks the beginning of a multitude of physical, physiological and psychological changes in the lives of adolescent girls[1]. Especially the female body requires special attention as this is the age during which the menstrual cycle starts. The girl/woman uses sanitary pads during menstrual cycles. The Knowledge of perception and behavior on the use of sanitary pads during menstruation among adolescents of school age is a vital aspect of health education[2]. She has to change at least 4 times a day the sanitary pads as to help herself maintain personal hygiene.

However, Menstrual Hygiene Management (MHM) is a largely overlooked issue in respect of sustainability dimensions. Good menstrual hygiene practices imply that women and adolescent girls are employing a clean menstrual management material to soak up or collect menstrual flow, that may be changed in privacy as often as necessary for the duration of a menstrual period, using soap and water for cleaning the body as required, and having access to safe and convenient facilities to eliminate used menstrual management materials. Poor menstrual hygiene management (MHM) can negatively impact the health and psycho-social well-being of ladies and girls. Previously women used various menstrual products like cloth etc. owing to lack of awareness but as time passed and awareness increased women started using sanitary napkins. Menstrual cups etc. as shown in Figure 1.

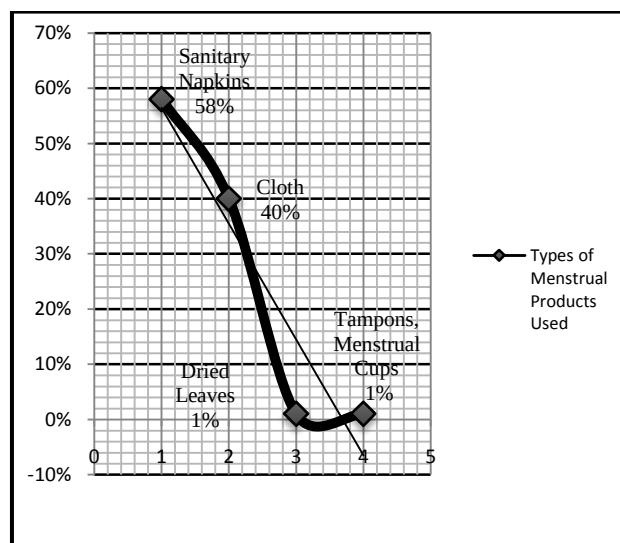


Figure.1. Pie-Chart on Various Menstrual Products used by women

Every day, millions of menstruating girls and women produce soiled pads without a proper or standard process for disposal. As a result, they are forced to dispose of these soiled pads secretly because still today menstrual cycle and related issues are taboo in India. As a result, the improper disposal and throwing away of used pads causes a threat to the environment and the public health of the society and nation at large.

The most common practice of disposal of soiled pads is throwing them in the public dustbin or flushing them. However, both these practices are not safe and can dump tons of hazardous plastic and hazardous petrochemicals which can cause environmental pollution and health hazards. Because the sanitary pads are made up of non-compostable, synthetic materials which remain unchanged even after 600 to 800 years in a landfill.

However, this situation is still not out of control as only 1 out of 6 women in India uses sanitary pads and pad waste generated is 150,000 ton. If all the women in India start using sanitary pads, the pad waste may scale up to 1,000,000 tons of pad waste annually. Safe disposal will become a growing problem across India As per the Solid Waste Management, 2016 released by the Central Pollution Control Board (CPCB), in India only 2% of the women burn the soiled pads.

Contrary to our belief, the rural women are burning more pads than the urban woman, who is simply throwing it away without giving a thought to the consequences of improper disposal methods.

As per the reports, over 1 billion non-compostable sanitary pads are making their way into urban sewerage systems, landfills, rural fields, and water bodies in India every month. The soiled pads dumped in landfills are picked by animals and birds which in turn pollutes land and water. The microscopic plastic particles that reach the ocean end up in higher levels of food chains and can end up affecting our health.

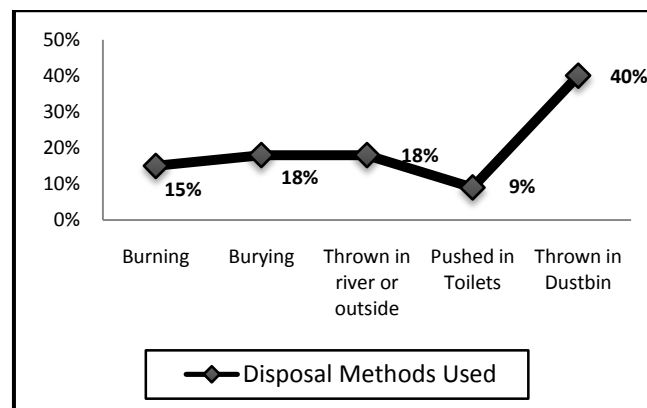


Figure.2. Graph on various Disposal Methods in practice

As per the guidelines of CPCB it has been recommended to follow the methods to dispose of sanitary as per the rural and urban setup. The guidelines areas:

- (i). Low-cost incinerator – Rural setup – Sanitary napkins preferably without SAP.
- (ii). Electric incinerator – Rural/Urban setup,
- (iii) High-temperature incinerator for bio-waste – Urban setup with central collection and disposal with another biowaste.

Incinerating the soiled pads is currently the best way of disposal in comparison to landfills and flushing. However, the incineration of soiled pads presents the following challenges:

- (i) Availability of an incinerator at an appropriate place.
- (ii) Cost of electricity for burning the pads.
- (iii) High carbon and toxic emissions into the environment.

To meet these challenges and at the same to handle other requirements like tracking the number of soiled pads inside the incinerator, managing the time of burning, and most importantly controlling all the functions of the incinerator with an android based device. This will facilitate the operation of incinerators and will reduce power consumption and will help in achieving the objectives in the economic, social and environmental sustainability dimensions

The rest of the manuscript is an architect as: section 2 presents the literature review. In section 3 the objectives of the proposed work are presented. Section 4 covers the design of the proposed work. And in section 5 conclusions are presented.

2. Literature Review

Garg, R., Goyal, S., & Gupta, S. (2011) reported that In India, about 300 million females are aged between 15–54 years and they use an average of ten thousand pieces of sanitary napkins within 30–40 years of her life which results to 58,500 million pieces each year. One aspect that has received a lot of attention is menstrual hygiene management (MHM) or the ability to manage one's monthly period hygienically, with dignity and safety. Although today there is a greater access to sanitary pads than ever before, menstrual hygiene continues to be a pressing issue that affects the health and well-being of girls and women across the country[3].

Further the awareness of menstrual hygiene in the urban areas of India is around 21–25% while it is negligible in rural areas. Menstrual Hygiene Management (MHM) needs to be strengthened in India. However, in the last five years, the emergence of menstrual hygiene management (MHM) is

enabling public health issues specific to women to reach national and international agendas. Education and awareness about MHM need to be imparted to all women in India [4], [5]. One of the survey outcomes reported that nearly twenty-five percent of school-going females discontinue their studies when they reach puberty because of lack of sanitation facility during menstruation cycles. Stuti Chakraborty (2019). Instead education regarding reproductive health and hygiene should be included as a part of the school curriculum [6]. Used napkins need to be disposed safely in environment-friendly manner [7]. In India, the majority of menstruating women are faced with the challenge of disposal of soiled pads in a sustainability-friendly manner. This problem of disposal is more critical for school-going girls.

It has been found that due to the scarcity of sanitary facilities at school, the girls are forced to throw away the pads in toilets which results in the choking of the drains [8].

Most disposable sanitary pads will eventually biodegrade except for the thin plastic liner that virtually all of them contain [9]. Moreover, with the increasing number of soiled pads thrown in bins presents waste management problems in the urban areas and produces ill effects on the general public health Avinash A. Patil; (2014). Incineration of soiled pads through incinerators provides a better solution to this problem especially in schools, organizations and institutions [10], [11]. Incineration means the act of burning something until there is nothing left but only the ashes [12]. The benefit of incineration is that it reduces the solid mass of organic wastes by 80–85% and volume by 95–96% which is commendable [13]. It is known to be the best available option for treating such wastes particularly the pathological related waste or clinical waste like blood or any other body fluids, excretions etc. [14].

Hence Disposal of soiled pads is of major concern as it affects health and environment. There is a need for an effective menstrual material disposal method that is economic and fulfils the sustainability objectives of the society. Research of world experience in waste management showed the presence of three main options for the disposal of municipal solid waste (MSW): Incineration, landfill, and recycling. The application of these options is directly dependent on and closely related to the waste collection procedure [16]. Incineration of soiled pads has proven to be an effective method of disposal. In any case, most environmentally responsible way to dispose these pads is to burn them. So, finding a way to burn the pads while protecting girls' privacy is required [9].

The incinerator operation results in harmful gases and also consumes power. After pollutants from

an incineration facility disperse into the air, some people close to the facility may be exposed directly through inhalation or indirectly through consumption of food or water contaminated by deposition of the pollutants from air to soil, vegetation, and water [15].

To overcome these challenges in this work an incinerator has been automated with the help of an android app to operate the incinerator only when it is having sufficient load to burn in contrast to the general practice of operating it 2 times compulsorily irrespective of the load (generally 15 soiled pads capacity). Also filtration has been provided to prevent harmful gases or pollutants from mixing into the atmospheric gases.

3. The Objective of the Study

Based on the comprehensive literature survey done the objectives for the present work has been established as follows:

- To automate the incinerator for disposal of soiled pads in higher education institutes.
- To facilitate the user with the information of soiled pad count in the incinerator.
- Facilitate the user to operate the incinerator through the use of an android app.

4. Design and Fabrication of the Machine

Already certain machines are available for the burning of sanitary napkins which are witnessing some issues regarding wastage of energy and hygiene. In certain machines, counters are available which after the insertion of the certain number of pads then it starts burning but the problem with it was that what if till a week the number of pads doesn't reach that amount which is required to start the machine then the pads inside the machine will stay in which causes the hygiene issue as if it not disposed of properly then it will cause the germination of certain bacteria.

Hence in this work, an incinerator based on Mobile Application is proposed i.e. the total working of the machine (Figure 3) is based on the application. One can easily monitor the number of pads that are inserted on the machine through the application, not only this one can also power on the incinerator with the help of the application. The machine gets connected with the Mobile Application with the help of the Bluetooth module HC-05. With the help of this Bluetooth module, the sending of data and signals between the machine and mobile application takes place. This module plays a crucial role in this project.

The next important thing is the limit switch. The role of the limit switch is that it works as a counter. Whenever the door of the incinerator is closed it increases the counter value by one. The next component is the relay this module is connected to the main circuitry of the machine which is used to switch on and off the incinerator (Table 1).

Table 1. Components and their role in the project

S. No.	Components Used	Font Type
1	Arduino Uno	Reception and Transmission of data, Operation Controller, Storage of Program
2	Bluetooth Module (HC-05)	Sending and receiving the signals from Mobile Application
3	Single Channel Relay Module	Helps in Automatic ON/OFF of incinerator machine
4	Limit Switch	Acts as a counter for the no. of napkins being

inserted

All these components are connected to the Arduino Uno R3 Module shown in Figure 2. The working of the working of the machine is as:

Step 1: At the doors of the machine the limit switch is present which is used to count the number of pads that are inserted.

Step 2: After each opening of the machine the counter value gets increased. And checked whether it has reached a certain limit or not.

- a) If not, then the device waits for the condition to get satisfied.
- b) If the condition gets satisfied, then the machine starts burning automatically and after a certain amount of time the machine stops.

Step 3: The incineration produces fewer fumes and ash content is very low. It can be disposed of as a landfill.

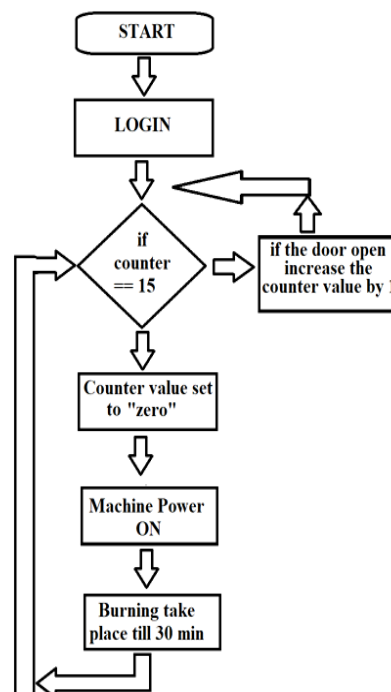


Figure.3. Flow Diagram of working of Incinerator Machine

4.1. Detailed Working of the Android Application

- The application opens with a login window wherein a valid username and password has to be entered.
- The moment valid ID password is entered and verified it redirects the user into the homepage of the application.
- Now a Bluetooth connection is to be established with the machine by clicking on the option “Click here to connect” shown in Fig.5. The page opens up a no. of available Bluetooth devices. The User has to ensure that our bluetooth’s name HC-05 is to be selected in order to establish a successful connection. Once connected the user receives a notification about connection with the machine.
- Now a slider button (Fig.5) is used to switch on/off the machine using the application itself.
- The screen also reports the information about no. of napkins present inside the combustion chamber of the machine.
- An About button present in lower portion of screen conveys information about the machine and gives an insight of the application.

4.2. Detailed Working of the Machine

The dedicated staff for machine has to switch ON the main AC supply the moment they want to get it ready for use of public.

- Once machine is ON, a sensor is installed on the door opening in inner lining that keeps a check on the no. of napkins being put inside. The count is updated on the mobile application when door is closed i.e. upon two clicks of sensor one count is recorded.
- The user can now insert the soiled napkin inside the chamber and close the door and let the combustion chamber burn the napkin(s). However, it is to be noted that the combustion chamber starts burning the napkins only when the count reaches its threshold value of 15.

- Upon reaching the value the incinerator combustion chamber takes around 20-30 minutes to completely reach upto the minimum temperature sufficient enough to burn the soiled napkin(s).

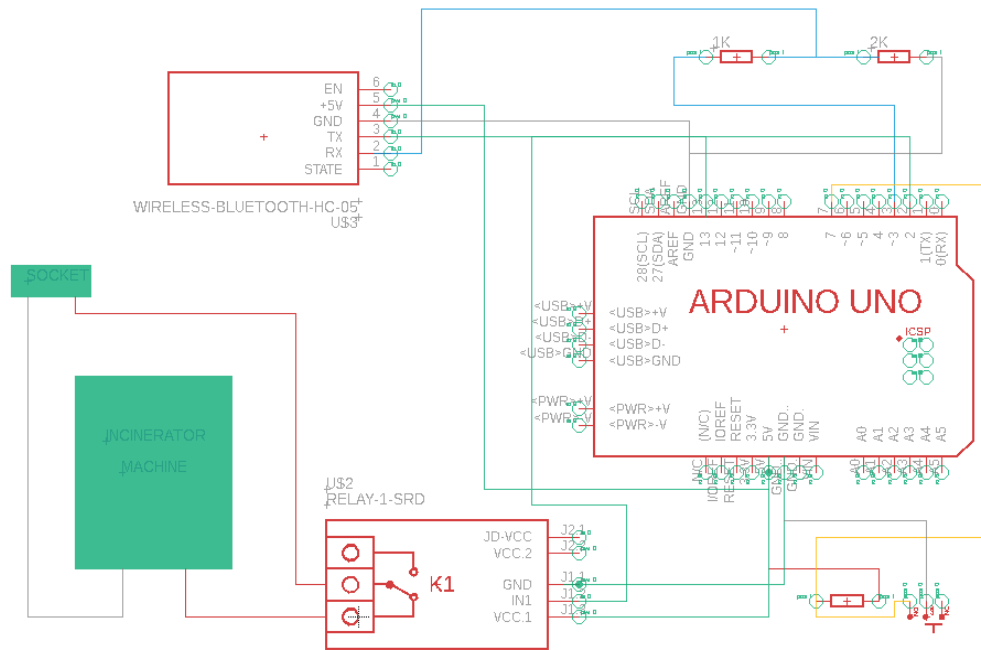


Figure.4. Circuit Diagram of the Incinerator Machine

- One module has been installed inside that collects the information about no. of napkins and temperature and other necessary data and displays it on a LCD module 1602A that displays heater status, machine status and inside temperature(in°C).
- In case, machine hasn't been switched ON even for once in a day in a rarest of the rare case then the staff before leaving will compulsorily switch it ON so that not even a single napkin is left unburnt keeping in view the hygiene of machine and surroundings.
- The Ash collection system has been designed in such a way that it automatically gets collected in another chamber on a plate and before leaving the staff can remove it and collect it in a separate bin for proper dispose wearing gloves.

The main advantages of automating the incinerator are to have (i) Sustainable waste disposal of soiled pads, (ii) Energy conservation during the incineration of the pads.

The uniqueness of the machine lies in the fact that it is not only economically affordable but at the same time, it focuses on achieving its goal of Sustainable Waste Management. Also, it has the feature of Emergency SOS concerned with the safety of females at working place and public places.

The link for the mobile app (Figure 3) is:

<http://ai2.appinventor.mit.edu/?galleryId=6416423190134784>



Figure.5. Mobile Application of the Incinerator Machine

5. Conclusion

MHM and awareness about the safe disposal of soiled pads is a major challenge especially in urban areas. The objective of the work is to enhance the awareness among people about MHM and to provide an economic and feasible solution for disposal of soiled pads. In this work an android based smart incinerator has been developed for disposal of soiled pads which caters to the three dimensions of the sustainability and promises clean and hygienic life for modern women and society. A smart and sustainable incinerator machine for sanitary napkin disposal method has been created based on Internet of Things (IoT) technology. This machine helps for sterile, safe, quick, easy, economic, environment friendly way of disposal of used sanitary napkins through a mobile application app. The machine keeps a track of soiled pads dropped inside and with the help of the app the soiled pads are incinerated with low ash and hazardous fumes. The app operated smart incinerator can be installed at places like schools, HEI, Government/Non-Government Offices, organizations where females can dispose used pads without hesitation and without adversely affecting the sustainability dimensions.

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