Indian Journal of Advances in Chemical Science

Review Article

Bio-medical Waste Management during COVID-19

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ABSTRACT

The COVID-19 pandemic has escalated the problems of plastic trash management and disposal. Existing condition of living in fear of transmission of the COVID-19 virus has further transfigured our behavioral models, such as regularly using personal protective equipment kits and single-use applications for day to day needs and so on. It has been calculated that with the passage of the coronavirus pandemic every month, there is anticipated use of 300 billion pieces of single-use facemasks and gloves. Furthermore, the poor framework and lack of human resources have aggravated this situation. To combat this serious issue in a timely manner, people have identified several strategies, techniques, and even government have given specific guidelines for the management of waste generated during diagnostics and treatment of COVID-19 suspected or confirmed patients.

Key words: Pyrolysis, Glycolysis, Digitization, Biomedical plastic

1. INTRODUCTION

At present, the world is facing a major devastation due to the emergence of pandemic COVID-19. Due to its high communicability, the global community has adopted preventive measures to control its transmission and unfold. One of the potent measures adopted by health workers and the general public all around the world is the use of masks, gloves, face shield, and gowns. The WHO listed the use of masks to stop the spread of virus in public [1]. The world mask production rate has seen explosive growth and will linger (continue) to rise. The global market for face mask was 0.79 billion USD in 2019 now it has reached to approximately 166 billion USD in 2020 [2]. Hence, what we considered a way to decrease the transmission rate has become a new environmental threat. Every country is protecting public health over environmental health [3]. With the rise in consumption and production of personal protective equipment (PPE) kit has become topic of concern for the waste management system in both developed and developing countries [4]. Many local and international organization designed many policies for the safe disposal of COVID waste. Improper management of only 1% face mask of PPE kit may lead to waste of 30–40,000 by per day [5]. Components of these PPE kits under abiotic factors degrade into smaller sizes (<5 mm) particles which leads to microplastic pollution [6]. These microplastics enter land and water bodies and causes severe threat to all type of environments [7]. Being small in size it can easily enter food chain of both land and water ecosystem [8]. Their consumption effects on human health such as chromosome alteration, obesity, cancer, and infertility [9]. COVID-19 pandemic and the increasing usage of PPE kits and face masks have increased challenges in plastic waste management especially for developing countries, so we do not have exact estimates on how much plastic will enter oceans from COVID plastic. This review article aims to analyze the bio-medical waste (BMW) management with newly framed guidelines, policies, and techniques which will make the management of the exponential increase in BMW easier and safer for the environment and community.

2. BMW MANAGEMENT PROCESS IN INDIA

Healthcare workers involved in the treatment of COVID-19 patients are more susceptible to get infected. A strict guideline has to be followed by all the stakeholders. In this war against COVID-19 [10,11], where the largest focus is on saving life, managing BMW is critical. Unscientific management of BMW possesses a great danger not only to humans but to the environment at large. The Central Pollution Control Board (CPCB) has issued guidelines in accordance with the BMW management rules 2016 [12-15]. There are four color coded bin into which BMW is segregated. This should be done at one point where waste is generated. Yellow and red coded bin have color coded bags (Figure 1). The bin has the COVID-19 labels. Non chlorinated bags of not <50 microns with bio-hazardous symbols must be used. As a prevention double layered bags are used for collection of waste to ensure adequate strength and no leak.

3. SEGREGATION OF COVID WASTE

Infectious wastes such as tissue, cottons, dressings contaminated with blood and body fluids, swabs taken from patients and suspect must be discarded in yellow bins, U seal blood bags must be autoclaved in autoclave safe bags or microwave and discarded in the yellow bins. All utilized masks including triple layer mask N95 mask, etc., head cover/cap, shoe cover, disposable linen, gown, non-plastic, or semi plastic coverall in yellow bag. All used PPE's such as face shield, goggles, splash proof aprons, hazmat suits, and nitrile gloves into the red bag. Tubings, syringes without needles, Foley's Catheter and IV Tubings and any other recyclable material must be discarded in the red bin.

Viral transport media, vacutainers, Eppendorf tubes polypropylene (PP), plastic cryovials, pipette tips, used testing kits must be autoclaved or chemically treated as per BMW rules 2016 are collected in red bags [16]. Collected waste in different bins must be handled orderly.

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ISSN NO: 2320-0898 (p); 2320-0928 (e)
DOI: 10.22607/IJACS.2021.904015

Received: 09th October2021;
Revised: 18th October2021;
Accepted: 28th November 2021

Table 1: Advantages and disadvantages of biomedical waste [19].

Advantages	Disadvantages
Requires relatively little disposal area compare to land burial	Solid waste left after incineration go ultimately to landfill
Cost of operation will typically be reduced or offset for the utilization or sale of energy	Dioxins occur as in the incineration of chlorine containing products. It affects human health causing abnormalities and disorders in human

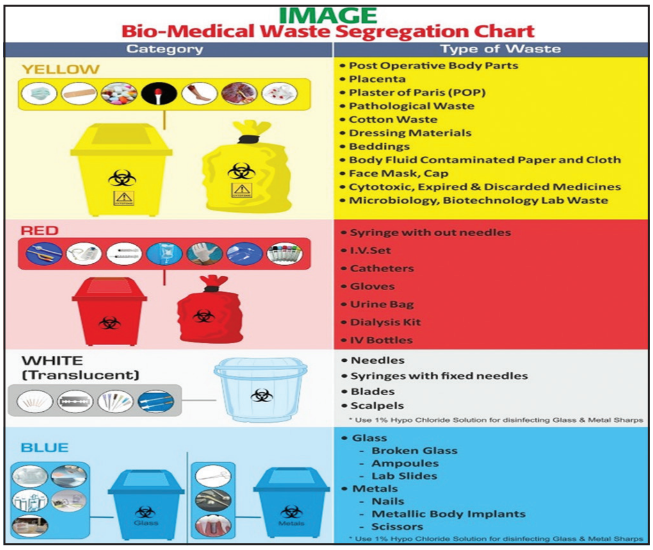

Figure 1: Bio-medical waste management chart.

Both inner and outer surface of the containers, bins or trollies used for storage of COVID-19 waste should be disinfected using 0.9% sodium hypochlorite. The use of dedicated vehicle to gather COVID-19 ward waste is critical. It is not necessary to position separate label on such vehicles. These vehicles should be sanitized with sodium hypochlorite or any appropriate disinfectant after every trip. The qualitative method and quantitative information on the generated and disposed of BMW ought to be accurately documented and reported to the state pollution board [15,16]. In spite of uncompromising rule and liability, the country reports a high degree of non-adherence to these guidelines. According to the annual report, 2018/19 published by the CPCB, 23, 942 Health Care Facility (HCF's) violated the BMW rules 2016, and 18, 210 HCF's were issued a warning for their violation [12,16].

The report describes that the large quantity of BMW generation per day and around 12% of HCF's have profaned BMW rules that show the poor medicine handlings and management in Republic of India [12].

4. DIGITALIZATION IN BMW MANAGEMENT DURING COVID-19 PANDEMIC

The Agency to blame for in operation Quarantine Centre/Camp shall assign a nodal one that is in control of waste management and for maintenance of its record. The assigned nodal person of the Quarantine Centre/Camp ought to register the Centre/Camp on CPCB's medicine waste pursuit App "COVID198BWM" (available on Google Play Store) (Figure 2) and update the small print of Figure 2.

Waste generated on usual (Table 1). Persons in operation Quarantine centers/camps ought to decision the Common Medicine Waste Treatment Facility operator to gather medicine waste as and once it gets made. The persons taking care of Quarantine home pass on the yellow baggage containing medical specialty waste to approve waste collectors at those steps engaged by native bodies [17].

5.CHEMICAL TECHNIQUES USED IN BMW MANAGEMENT

5.1. Glycolysis

Glycolysis is an important and commercial process for chemical depolymerization of PET. During this molecular breakdown of PET chemical compounds by glycols within the presence of trans-esterification chemical change whenever the organic compound linkages break and replaces with group terminals [18]. The product we get is bis2-hydroxyethyl terephthalate (BHET). The produced BHET can be used further for manufacturing such as foams, unsaturated resins, and acrylic coatings.

5.2. Landfilling

This strategy seemed uneasy with the aim to handle the lumped up COVID-19 related waste which was found to be highly contagious and dangerous as the waste filled in land got shipped into water bodies causing huge destruction to marine lifeforms.

5.3. Incineration

Incineration of plastics is the process in which plastic is burned in the presence of oxygen. This process consists of controlled burning of waste at high temperature (1200–1500°C) [19]. By doing so lot of energy is evolved which is used to make steam which generates power. While, the facilities are known as "waste to energy." The primary purpose is to destroy material and reduce the amount of waste sent to landfills [20].

6. PYROLYSIS

It is a thermo chemical decomposition of plastic material into liquid, gases, and char (solid residue) at elevated temperatures in the absence of oxygen [21]. An alternative thermal medical care approach that is on the market and sensible for the treatment of COVID-19 associated waste. The end products obtained are collected and repurposed into usable outputs. It creates less pollution, was an excellent technique for the conversion of plastic waste into usable by products [22].

7. TYPES OF PYROLYSIS

Based on the operating conditions, including pyrolytic temperature, heating rate, and the time of residence of the volatile matter, three primary pyrolyses are:

7.1. Slow Pyrolysis

Pyrolytic decomposition that occurs as a lower operating temperature, with a low heating rate and extend and vapor residence times longer stays cause secondary conversion of primary products good for the production of coke, tar, and char [23]. It is recorded that slow pyrolysis of PPP products with 10 L/min heating rate yielded 10% solid char than with fast pyrolysis with 2% char.

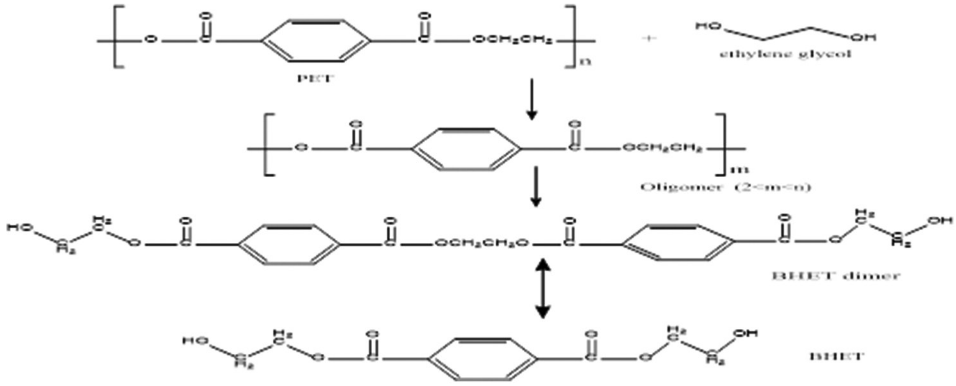

Figure 2: Glycolysis of PET.

7.2. Fast Pyrolysis

Pyrolysis includes rapid decomposition with higher heating rates or high process temperature. Liquid fuel with high calorific value was yielded [24]. Plastic waste of polyethylene and PP was decomposed under high process temperature around 668–746°C 2% was char residue and about 32% and 66% of oil and gas was yielded [25].

7.3. Catalytic Pyrolysis

The presence of catalyst speed up chemical reaction while lowering the activation energy of the process that helps to save energy. Most extensively used catalyst are ZSM-5, Zeolite, Y- Zeolite, FCC, and MCM-41 [26]. Amount of aromatic and light hydrocarbons in the gasoline and diesel were increased suitable for bio-oil application.

8. CONCLUSION

BMW generation in bulk during COVID-19 is a serious health concern. The BMW which was remained untreated becomes a potential source of pathogens. It has been reported in the literature that more than 40 species of noxious micro-organisms to possess the potential to transmit and cause human illness. The etiological factor of the pandemic is highly communicable and rapidly transfers from one person to another through various routes. The risk of getting infected is persistently high because of its high transmission rate. Noticing the risk of disease, State and Central Boards in association with AIIMS New Delhi have framed various guidelines. These guidelines issued by the government of India are fascinated on the prevention of health-care personals and workers involved in its handling and management. This improvement has allowed the preparation of policies for the temporary centers and has highlighted the roles and responsibilities of the concerned persons and officials. Strict abidance with these newly framed guidelines will make the management of the expanding BMW easier and safer for the environment and community.

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