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Municipal Infectious Waste during COVID-19 Pandemic: Trends, Impacts, and Management

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ABSTRACT (10 PT)

COVID-19 shifts the characteristics of municipal waste. This review aims to provide an overview of trends, impacts, and management during the COVID-19 pandemic globally. The increase in the generation of plastic waste and infectious waste is a new challenge during the COVID19 pandemic. It was found that the emergence of plastic waste due to the consumption of food delivery becomes an issue in several countries. Despite the increment of plastic waste generation, the mass layoffs contributed to the decrease in the total urban waste generation in general. In addition to plastic waste, a surge of infectious waste from health facilities and household waste originating from residents infected with the SARS-COV-2 virus was observed. This infectious waste potentially leads to environmental disturbances to the rivers and oceans. To tackle global environmental concerns, sustainable waste management is required especially in the development of biodegradable personal protective equipment.

7

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5

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1. INTRODUCTION

Economic Development Zone officials claimed that they collected around 200 kg to 300 kg of masks, discarded every day from 200 allocated trash bins in Wuhan alone, a city considered the epicentre of the virus [1]. Particular bins in the city area are even damaged due to overload mask disposal in residential areas, streets, and other public areas, although it is difficult to obtain an exact figure on the number of masks discarded. However, the Environment and Health Authority estimates that the volume of medical waste in Wuhan as a whole has increased four times by more than 200 tonnes a day [1]. Various environmental problems can occur due to infectious waste management from personal protective equipment during the COVID-19 virus outbreak. An initial strategic study and the latest issues, especially changes in waste generation and characteristics, are needed. This study aims to analysis the environmental impacts caused by this personal protective equipment and to determine sustainable and safe waste management for the environment and health.

2. RESEARCH METHOD

This paper presents review regarding the characteristics of waste and some of the issues caused by the generation of infectious waste from COVID-19. Reviews are taken from news sources during the COVID-19

2

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pandemic, along with scientific articles from both journals - as well as proceedings that highlight the problem of infectious waste COVID-19. Comparison of literature and policies and regulations issued by governments was discussed.

3. RESULTS AND DISCUSSION (10 PT)

11

3.1. Characteristics of Municipal Solid Waste

China, in the beginning of the spread of the COVID-19 virus, produced 6066.8 tons/day of medical waste [2]. With such a large generation and inadequate medical waste disposal during COVID-19, the use of municipal solid waste incinerators to treat medical waste collectively might be a key to emergency disposal method [3].

When the pandemic hit the United States in mid-March, the number of online purchases increased across all ages [4]. The same trend was encountered in Thailand. Food delivery is now commonplace and more convenient option. Although the generation of municipal waste in Indonesia during the work from the home period decreases [5], production of plastic waste is predicted to increase. Another research report also mentions that the use of single-use plastics is getting worse during the COVID-19 pandemic because of enablement home delivery of food and essential goods [6]. In contrast, COVID-19 causes mass unemployment; it may lower spending capacity and possibly reduce waste generation [7]. Therefore, COVID-19 will bring both indirect positive and negative effects on the environment. The latter will even worsen unless a sustainable approach is implemented to keep our environment clean [8]. Other research also mentions an increase in the number of solid waste generation during the COVID-19 pandemic in Brazil [9], Nigeria [10], Tehran [11], and South Korea [12]. This might be due to the habits and lifestyle related to shopping frequency and types of items purchased before and during the sanitation lockdown period.

3.2. COVID-19 Overload Pollution

Despite the unfavorable impact of COVID, stay at home restriction brings positive changes to the environment. Satellite data have indicated that air quality has improved in many cities worldwide due to suppressed human mobility [13]–[15]. On the contrary, conservationists have warned that the coronavirus pandemic could trigger a spike in ocean pollution. Large numbers of masks and gloves were found floating like on the seabed.

Despite the fact that the necessity to use Personal Protective Equipment (PPE) is of utmost importance to overcome COVID-19, public awareness has not been followed. As a piece of evidence, the research team from the Indonesian Institute of Sciences (LIPI) discovered the change in the composition of waste that entered Jakarta Bay during the COVID-19 pandemic such as PPE waste (masks and face shields). In the year before the COVID-19 pandemic, the results of other studies showed that plastic was one of the main factors in marine debris [16]–[18]. Changes in the characteristics of marine debris after the COVID-19 pandemic is one of the most recent challenges and issues in Indonesia. This is also supported by research conducted in Cilincing and Marunda Rivers which shows that PPE waste such as medical masks, gloves, hazard suits, face shields, raincoats reach 15-16% [19]. In addition, the latest findings in Southern Bali Province also contain the potential for marine debris from PPE, especially medical mask waste [20]. Changes in the composition of waste during the COVID-19 pandemic will present new problems to aquatic biota and waste treatment.

Large rivers in Europe are filled with COVID-19 virus waste, such as disposable gloves and masks. The Tara Ocean Foundation research institute disclosed that corona waste aggravated plastic pollution in most rivers in Europe [21]. The Tara Foundation has recently measured the concentration of microplastics on nine significant rivers in Europe, namely the Elbe, Rhine, Seine, Rhone, Garonne, Loire, Tiber, Thames, and Ebro [21]. The COVID-19 pandemic requires people to wear masks to protect themselves from infection. However, the massive use of disposable masks has had a significant impact on the environment. Medical mask waste, especially the N-95 mask made of several layers of polypropylene plastic polymer and synthetic materials, can only be worn once, causing uncontrolled medical litter. The mask waste is thrown away carelessly and subsequently pollutes the environment and without a doubt, endangers sea animals. On the other side of the American continent, namely 11 beaches along the coast of Lima, Peru, 138 PPE items were found [22].

3.3. Waste Management for COVID-19

In China, the Environment and Health Authority declared that masks and other protective equipment, especially items worn by medical personnel and people infected with the virus, must be treated as clinical waste and sterilized before being burned at high temperatures with special tools [1]. Combustion

waste treatment was preferred in China, although industrialized countries were phasing out combustion treatment due to health and environmental concerns [1]. In addition to combustion, medical waste processing in China also encourages the waste-to-energy (WTE) and waste-to-material (WTM) approaches supporting zero waste[23].

1 The management of infectious waste in Indonesia refers to Circular Letter of Minister of Environment and Forestry No. SE.02/PSLB3/PLB.3/3/2020 concerning Management of Infectious Waste (B3 and Household Waste from Handling COVID-19 and Circular Letter of Director-General PSLB3 Number S-194/PSLB3/PLB.2/4/2020 concerning Implementation of Hazardous Medical Waste Management from COVID-19 Handling Activities to Heads of Provincial Environmental Services throughout Indonesia. Infectious waste is mostly originating from health service facilities. Infectious waste must be stored in packaging and closed for a maximum of 2 (two) days before transporting and further processing. Processing means can be performed using an incinerator with a minimum combustion temperature of 800°C, or an autoclave equipped with a customarily shredder. The residue resulting from combustion or shredded autoclave is packed and marked with a symbol of "Toxic" and label for hazardous waste and then stored in a temporary designated storage place for hazardous waste prior to be handed over to the hazardous waste manager. The handling stage starts by collecting infectious waste in PPE waste, including masks, gloves, and personal protective clothing, then continues by packing separately using a closed container. Following that, transporting, destroying the hazardous waste, as well as conveying information to the public about managing infectious waste from the community, such as PPE waste, including masks, gloves, personal protective clothing and packaging separately using a closed container labeled with "Infectious Waste" are required. The agency, responsible for the environmental, hygiene, and health sectors, collects it from each source and transports it to the designated location before being handed over to the hazardous waste processor. Lastly, municipal waste, including household waste and similar waste, needs to be properly handled [24]. The dumped waste must be treated with UV-C light[25]–[27], ozone gas[28], [29], ionized hydrogen peroxide [30], or dry heat [31] to prevent the spread of viruses in PPE waste.

This pandemic encourages a policy to ban single-use plastics. Several businesses have replaced the use of non-reusable containers with cloth bags [32]. This has implications for implementing a circular economy, from waste management to new business models to prevent waste. Some countries are also changing the approach of collecting and treating waste. To support zero waste efforts from COVID-19, monitoring is an important task. It is necessary to quickly adjust the monitoring program not only to update the list of waste categories but also to prepare a monitoring team (for example, staff, researchers, volunteers, and citizen scientists) for anticipating a steep rise of PPE waste and how to appropriately handle these items potentially contaminated with COVID-19 [33]. Due to the global adoption of municipal PPE, future research should aim at developing biodegradable and environmentally friendly to achieving sustainable patterns towards a greener environment [34].

Most of the PPE waste from COVID-19 is polymers such as N95 respirators made of polypropylene and standard surgical masks made of polypropylene [35]. The application of waste to energy needs to be executed to reduce the generation of medical waste. The application of waste to energy in PPE waste treatment is a suitable step in starting a sustainable environmental policy[23], [36]. Thermo-chemical conversion is another alternative to reduce PPE plastic waste and to produce value-added products[37]. Using pyrolysis, the face mask waste can be converted aromatic and aliphatic compounds such as 2,4-Dimethyl-1-heptene [38] or oil as high as 80.7 wt%[39].

4. CONCLUSION (10 PT)

COVID-19 shifts the waste composition, due to regulation for the use of personal protective equipment and people's lifestyles during pandemic. This consequently contributes to the increase debris in water bodies, both rivers, and marine. Infectious waste treatment policies need to be implemented, especially innovations in the manufacture of biodegradable personal protective equipment.

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