



Waste Management of masks due to Covid-19 Pandemic

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Abstract. The outbreak of Covid-19 disease has had many repercussions in everyday life, including restrictions and domestic lockdowns imposed by governments around the world to safeguard population's health. Preventive measures were taken to reduce the spread of the virus, such as the mandatory use of personal protective equipment (PPE) for medical personnel and for daily use.

The global pandemic had brought many side effects in economic activities, market demand, as well as in the health and environmental fields. There were positive effects in the later field due to the slowdown of social activities reducing greenhouse gasses emissions, air pollution, oil usage. On the other hand, waste management of PPE and plastic disposal has had a negative effect on their conventional operations. The objective of this paper is to conduct a literature review of sustainable waste management methods and offer a holistic view of the outstanding strategies and solutions.

Keywords: Waste Management, Sustainability, COVID-19.

1 Introduction

The coronavirus is an infectious disease caused by SARS-Co-V-2. It is part of an extended family of viruses and is called coronavirus due to the surface of the virus that has crown-shaped tips biologically known as the spike proteins, the part that infects humans (Basics of COVID-19, 2021). The origin of this virus was known in December of 2019 in Wuhan, China (WHO, 2020).

The Covid-19 can bring different respiratory infections, the range of symptoms in everyone can be from a common cold to a serious illness, causing severe acute respiratory syndrome. It spreads from person to person through droplets from the nose or mouth of an infected person when they cough or sneeze. It is important to keep a safe distance between people of more than 1 meter to not get infected in case someone nearby is infected with the virus. The symptoms of Covid-19 are mild, mainly for children and young people; however, they can be serious for the elderly, people who suffer from some pre-existing diseases such as diabetes, high blood pressure,



cardiovascular diseases. According to the (WHO), one of five infected patients ends up hospitalized (Coronavirus, n.d.).

On March 2020, The World Health Organization (WHO) declared the COVID-19 epidemic a public health emergency of International Concern (WHO, 2020). Since the virus was released thousands of people have been infected and millions have lost their lives. The Covid-19 affected almost every country in the world, leading to act, some of the global measures that governments took to prevent people from being at risk were the following: social and distance restrictions, domestic lockdowns, the suspension of work activities, school, and non-essential activities (OECD, n.d). Another essential measure to stop the spread of the virus for health care personnel, other workers and the rest of the population are the Personal Protective Equipment (PPE) that consists of masks, gloves, goggles, aprons, face shields among others (Australian Government, 2022) .Also being fully vaccinated against the coronavirus is important to reduce the risk of serious illness and death.

The medical masks are divided into two: the surgical face mask and the Respirator face masks. The function of the masks is to cover the nose and the mouth to contain the droplets that people scatter when they cough, sneeze, or just breathe, which is a barrier between the persons and the contaminants in the environment. There are many types of masks done with different thickness and different materials such as cloth that consists of many layers of breathable fabric that can be reusable if after one day use wash with soap and water and preferably boil it (WHO, 2019). (Then the surgical masks are done by multiple layers of non-woven material (Centers for disease Control and Prevention, 2020). The materials to manufacture masks are polymers like Polypropylene (20 or 25 gsm grams per square meter), Polyester, polyurethane, polystyrene, polycarbonate for protection against viruses (Aragaw, 2020). To have a higher probability of not being contaminated by the disease, masks with certifications that guarantee their performance are recommended. Thus, it was concluded that the most recommended masks are the following: surgical masks, masks KN 95, N95, N95, KF94, P95, N100, R99 and R100. These types of masks are made to be disposed of after use and replaced with a new one. Although this was the international recommendation, the demand for masks since the COVID-19 pandemic has increased. In 2021 a study estimated that the monthly demand for masks was 129 billion, there were limitations for the acquisition of these masks due to supply, supply price and demand, leading to the preference on fabric masks by most of the population. Most of the massive quantity of masks do not have good waste management, ending up in the environment and oceans (See Fig 1.). Additionally, the masks are considered as Biohazardous waste because is contaminated with body fluids. (Svennevig, 2021).



Fig. 1. Face masks in a beach taken by Brian Yurasits. Published on July 21, 2020, on unsplash.com

Waste Management is defined as the recollection, transportation, distribution, and disposal of waste products. These activities include the collection of waste from every home, fabric, and facility of any type in the world. Recycling is also a part of waste management. Is a fundamental sustainable development strategy around the world (III. WASTE MANAGEMENT, n.d.).

2 Analysis of Contamination due to COVID-19

While the Covid-19 pandemic has generated several advances for the medical field, such as being able to generate effective vaccines in the short term, it has also given the entry to the existence of its counterpart, where the excessive use of protective and medical material to counteract the pandemic has increased the amount of waste from hospitals, medical centers, and individuals globally and exponentially. Such waste includes (potentially contaminated) face masks, disposable gloves, disposable goggles, face masks, COVID-19 fast tests, among others. It is important to know that such wastes can be divided into two main branches: indirect waste (not related to medical equipment) and waste related to Covid-19 (Liang et al, 2021). This paper will discuss the waste directly related to Covid-19.

Since the beginning of the pandemic outbreak, the use of personal protective equipment (PPE) and, consequently, the generation of medical waste has increased to alarming levels. At the beginning of the pandemic, the amount bought of this type of products reached a minimum of 20% increase in supermarkets alone (Asumadu et al., 2020). A clear example of such increase is in the United States, where it has been estimated that medical waste is increasing from 5 million tons per year to 2.5 million tons per month (Ilyas et al., 2020). The pandemic has altered the dynamics of waste generation that even its proper management has been inefficient worldwide.



During the pandemic, personal protective equipment (PPE) has been one of the safest and most accessible resources for defense against the virus and one of the most widely used resources for the sanitary protection of everyone was the mandatory use of face masks (Liang, 2021). Clear examples of excessive use of face masks are as follows: Barcelona has reported an increase in PPE disposal of around 350%, which is about 1,200 tons compared to 275 tons pre-pandemic (Asumadu et al., 2020); Ireland, at the end of 2020, used about 9 million masks per week among the country's health care workers alone; Africa had an estimated 700 million masks per day in a population with 80% acceptance of masks and use of two masks per capita per day; Tehran (Iran) estimated the use of 5.5 million masks daily only counting residents willing to use protective equipment (32% of the population) and, finally Italy with an estimated 40 million daily used masks (Liang, 2021).

In addition to the enormous amount of PPE used globally, there is an inappropriate waste management of these materials around the world. Lack of awareness and education on good disposal practices (potentially contaminated) has been a vital and important factor in the levels of environmental impact we see today. One of the possible consequences of uncontrolled disposal of these materials is a higher public health risk, from mass incineration causing the release of toxic agents into the environment to air transmission of the same diseases (Asumadu et al., 2020). Similarly, mishandling of personal protective equipment leads to cross-contamination between humans and animals, which increases the spread of diseases and even the creation of new variants (Asumadu et al., 2020).

The high amount of waste has come to encompass and pile up contaminated waste on nature trails and beaches, damaging and disturbing not only the terrestrial but also the marine environment. However, the disposal of these types of materials are not only the problem, but the refineries that usually manufacture this product have reported an alarming increase in exposure to toxic chemicals whose repercussions are seen in chronic (long-term) health problems (Asumadu et al., 2020).

3 Waste Management methodologies

The dumpsites are a high-risk site for both the people who work here and for the communities around them (Junias, 2022). One alternative in the Peruvian Case is to use the heat as energy. Using Pyrolysis as one way to reduce the materials, with the risk by itself, and use the remaining such as gas fuels, high-density liquids (biofuel), and solids (biochar) with another purpose. (Torres, 2022). Instead of separating the garbage, and endangering the lives of people, the pyrolysis burns the mask to get different kinds of fuel. For example, pyrolyzed a KF94 grade face mask in a tubular reactor to have gaseous fuels and the recovery rate was ~75 wt% of crude oil and 10 wt% char. (Torres, 2022). Also, these are studies only, but it gives the gap to introduce in the day to day these technologies.



Another alternative is changing the high polypropylene-based masks, into a mask made by chitosan nano whiskers-coated PBS filter. PBS- microfiber and nanofiber mats were prepared by electrospinning and assembled. The outer microfiber layer was coated with positively charged chitosan, which allowed for electrostatic attraction to take place. (Torres, 2022) These concepts help to let the mask degrade into the environment as a natural waste, don't contaminate and don't erode it. With biodegradable options, the kind of necessities are going to change and give the opportunity to change the way humans use their products.

Recycling is a method of waste management since it helps to know what to do with the material, or product that can no longer be used and will be thrown away. Recycling plays an important role since it brings benefits to the planet, such as the reduction of pollution and greenhouse gas emissions.

Now, speaking of the recycling of face masks, it is of the utmost importance given that the use of this product has grown exponentially since the pandemic began. The generation of medical waste from the pandemic as mentioned before has increased significantly, growing from 18% to 425% (Liang, Y 2021). Having said the above, it can be said that the demand for personal protective equipment has increased, and they have become a necessity. That is why, to prevent them from being discarded and generating waste, the issue of recycling plays a fundamental role.

The surgical masks that have been used the most are the most effective ones in preventing the wearer of the mask from inhaling toxic particles. This product is considered disposable. Having mentioned that, it can be said that a person uses a mask per day, which would generate enormous waste. Considering that the use of masks has increased and continues to be important, the amount of waste generated is catastrophic.

To prevent waste from being generated and to be able to use the product again, some alternatives have been proposed. Among them are: "1) use of other materials, 2) purification and reuse of masks and 3) use of biodegradable materials (Crespo, 2021). All these alternatives are viable; however, some are more expensive than others. However, any option is good since it will help the planet because pollution will reduce as well as the consequences that this entails.

On the other hand, it has been shown that face masks can be recycled using the same technology as in the recycling of thermoplastics. This would help reduce plastic contamination.

Conclusion

Thus, the COVID 19 pandemic has severely impacted environmental development due to the increase in products centered on personal protective equipment and its derivatives. This equipment provides greater safety because of its efficiency in restricting the transition of the virus, which causes people to want to use it.

Despite being a health benefit for people, the uncontrolled waste management of these products has led to the environment deterioration, so it is highly necessary to take preventive actions for waste management. These actions should be prioritized and standardized by organizations and governments around the world, as it implies the global social welfare.

It was found, in the research, that the recycling of PPE manufactured with plastic or resin can reduce and better control the waste they generate and, at the same time, have the capacity to be a sustainable process from the creation of other products with the same raw material base.

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