

ABSTRACT: Coronavirus disease 2019 (COVID-19) has become a global pandemic. The personal protection equipment (PPE), especially medical face masks and N95 filtering face piece respirators (FFRs) are typically worn by people at home/office/working place/outside to protect from infection. Thus, the increase in consumption of face masks and FFRs across Qatar has given rise to a new environmental challenge, adding to the vast plastic waste in the environment. Our team has already established the baseline levels of marine litter (ML) including plastic waste along the west coast of Qatar based on November 2019 ML survey (Veerasingam et al., 2020a). To study the impact of COVID-19 on ML, we have conducted another survey along the west coast of Qatar in July 2020. The distribution of PPE is higher on the southern part of west coast of Qatar than the northern part. Attenuated Total Reflectance - Fourier Transform Infrared (ATR-FTIR) Spectroscopy was used to characterize the polymer types of surgical face masks, N95 FFRs and gloves. Polypropylene (PP) and Polyamide (PA) were the abundant polymer types of PPEs. This study confirmed that the PPE could be a potential source for microplastic contaminant in the environment, especially if the present situation continues. Therefore, proper waste removal measures have to be followed.

1. INTRODUCTION

COVID-19 pandemic is impossible to predict, with many countries experiencing second or successive waves of infection. Therefore, the usage of PPE, especially surgical face masks will increase significantly world wide. This will lead to leakage of mismanaged plastic waste into the environment, thus triggering a new environmental crisis. The State of Qatar is no exemption. This study is an attempt to shed light on the challenges brought by the pandemic on the current waste management systems in Qatar.

2. MATERIALS AND METHODS

The marine litter survey was conducted in 12 beaches along the west coast of Qatar in July 2020 to study the impact of COVID-19 (Figure 1). At each beach, three transects (low tide, high tide and berm line) measuring 100 m x 1 m of the strandline were surveyed. The boundaries of each transect were geo-referenced using GPS. Marine litter items were sorted and classified according to the Master List of categories of the guidance document (TGML/JRC) (Veerasingam et al., 2020a). In addition to usual ML, the new personal protection equipment such as surgical masks, gloves and N95 masks were also found (Figure 2).

To characterize the polymer types of various PPEs, the new surgical masks, N95 and gloves were purchased and examined through Attenuated Total Reflectance - Fourier Transform Infrared (ATR-FTIR) Spectroscopy. Absorbance spectra were recorded in the mid-infrared region (4000-600 cm^{-1}) using 32 scans at 2 cm^{-1} resolution. A background atmospheric spectrum was subtracted from all PPE spectra. Peaks were integrated using Omnic software (Veerasingam et al., 2020b).

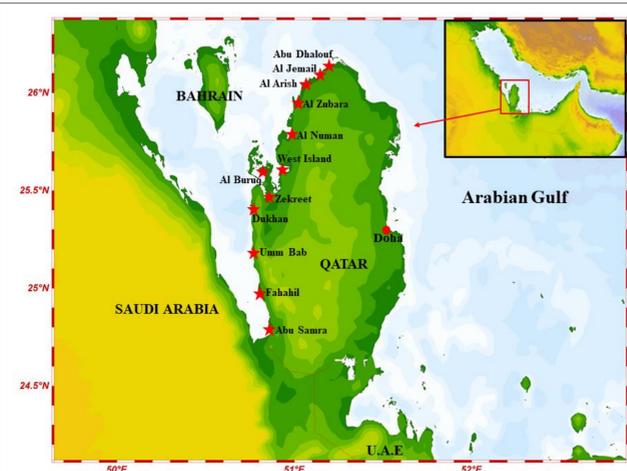


Figure 1. The study area and sampling locations



Figure 2. (a-f) The prevalence of PPE including gloves and masks along the west coast of Qatar; (g) Characterization of different layers and components of surgical mask using Attenuated Total Reflectance - Fourier Transform Infrared (ATR-FTIR) Spectroscopy.

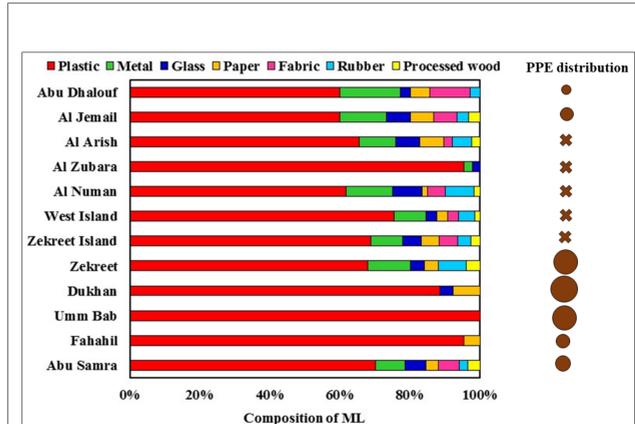


Figure 3. Distribution of ML and COVID-19 PPE at different beaches along the west coast of Qatar.

3. RESULTS AND DISCUSSION

- The distribution of ML along the west coast of Qatar fluctuate with less discernible pattern between November 2019 (before lockdown) and July 2020 (after unlock).
- The survey during July 2020 showed that the distribution of PPE (especially surgical face mask, gloves and FFRs) is higher on the southern part of west coast of Qatar than the northern part.
- The FTIR spectra of PPE revealed that polypropylene (PP) and polyamide (PA) are the major compositions of surgical face masks and N95 masks.
- All the masks consist of three layers. The middle layer (melt-blown filter) is produced by the conventional fabrication of micro- and nanofibers. Therefore, the leakage of disposable face masks into the environment could be an emerging new source of microplastic fibers.
- Previous studies have already confirmed the abundance of plastic waste (Veerasingam et al., 2020a) and microplastics in sediments (Abayomi et al., 2017) along the Qatar coast.

Therefore, the single use face masks could be a potential source of microplastic pollution in the global environment, including Qatar.

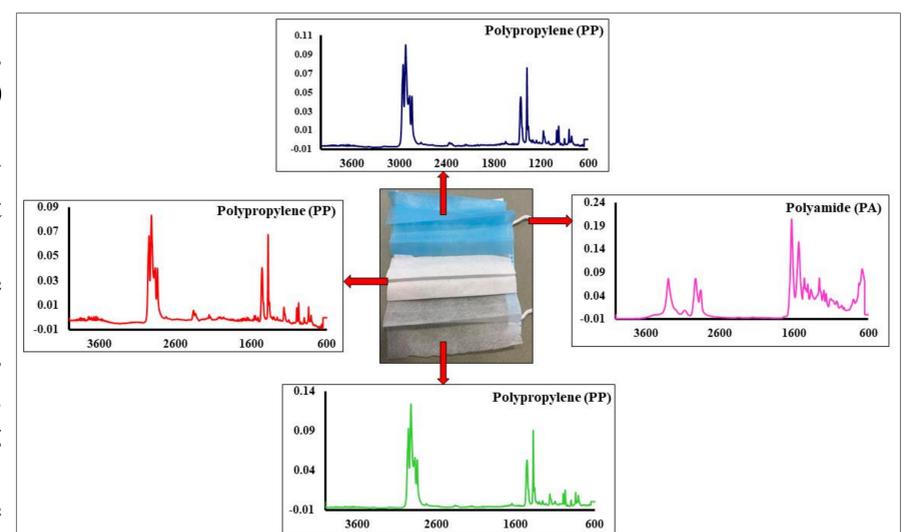


Figure 4. ATR-FTIR spectra of different layers of surgical face mask indicate that PP and PA are the major composition of PPE

4. CONCLUSION AND RECOMMENDATIONS

The ML survey indicated that the north and northwest beaches are highly polluted with plastic litter compared to the southwest beaches. However, the post-COVID-19 survey revealed more accumulation of new PPE (especially single use face masks, N95 masks and gloves) waste in the southern beaches (especially Dukan, Zekreet, Umm Bab and Abu Samra). This new emerging waste could be a threat to the terrestrial and marine ecosystem and also an emerging source of microplastic fibers if the present situation continues.

There is a need for redesigning eco-friendly and bio-based PPEs with an affordable price, and this could be at the highest priority. Initiatives may be taken to seek alternatives to plastic for routine domestic and medical tasks, including alternative reusable products, should be encouraged. Improved recycling streams are also needed to ensure proper end-of-life for PPE products. These actions could help designing new protocols according to environmentally sustainable practices for facing a pandemic in the future.

5. ACKNOWLEDGMENT

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6. REFERENCES

- Abayomi, O.A., Range, P., Al-Ghouti, M.A., Obbard, J.P., Almeer, S.H., Ben-Hamadou, R., 2017. Microplastics in coastal environments of the Arabian Gulf. *Marine Pollution Bulletin*, 124, 181-188.
- Veerasingam, S., Al-Khayat, J., Aboobacker, V.M., Hamza, S., Vethamony, P., 2020a. Sources, spatial distribution and characteristics of marine litter along the west coast of Qatar. *Marine Pollution Bulletin*, 159, 111478
- Veerasingam, S., Ranjani, M., Venkatachalapathy, R., Bagaev, A., Mukhanov, V., Litvinyuk, D., Mugilarasan, M., Gurumoorthi, K., Gunganathan, K., Aboobacker, V.M., Vethamony, P., 2020b. Contributions of Fourier transform infrared spectroscopy in microplastic pollution research: A review. *Critical reviews in Environmental Science and Technology*, doi.org/10.1080/10643389.2020.1807450