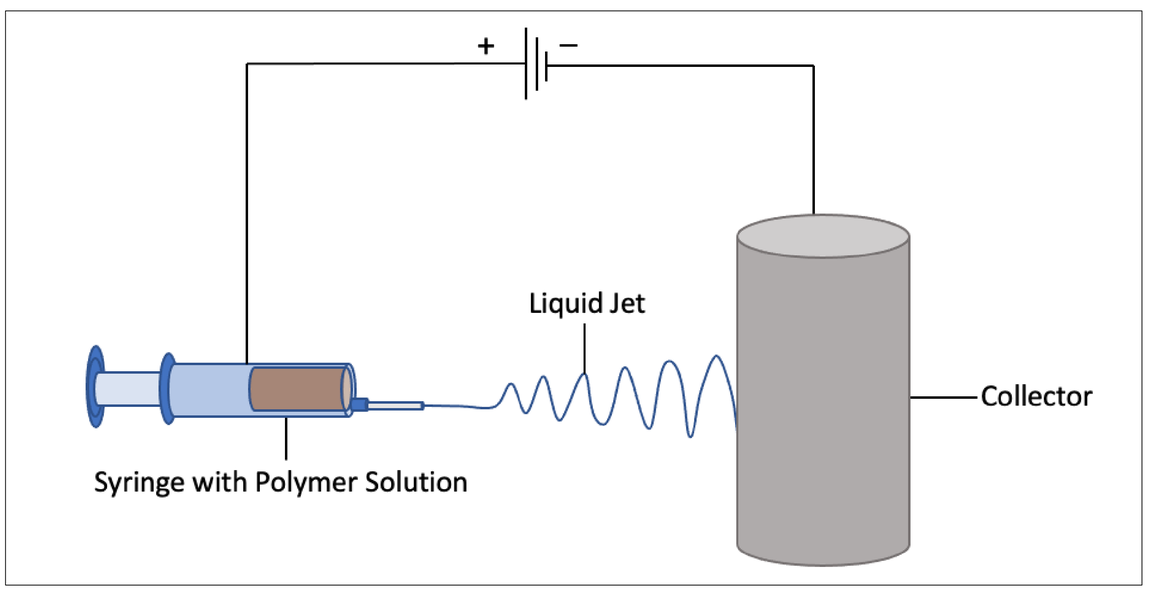
Bio-based Filter for Face Masks (Experimental)

Miss CHOI Man Yan, BEng (Hons) in Environmental Engineering and Management, Faculty of Science and Technology

Supervisor: Ir Dr TSANG Chi Wing Alex, Assistant Professor

Introduction

In Hong Kong, no facility can treat yard waste with rich lignocellulosic biomass, and they end up in landfill. At the same time, people's awareness of public health issues rose after Covid-19, and the demand for medical personal protective equipment thus increased. It is valuable to investigate the feasibility of using upcycled biodegradable material like lignin as a solution to reduce Polypropylene used in conventional face masks through an electrospinning process.



Objectives

In this study, the depending parameters of the electrospinning process are studied and compared, aiming to work out the most suitable condition for forming an evenly distributed fibre. And the antibacterial property of the nanofiber formed is tested to confirm that the fibre produced in the experimental section can fulfill the requirement of being used as face mask materials.

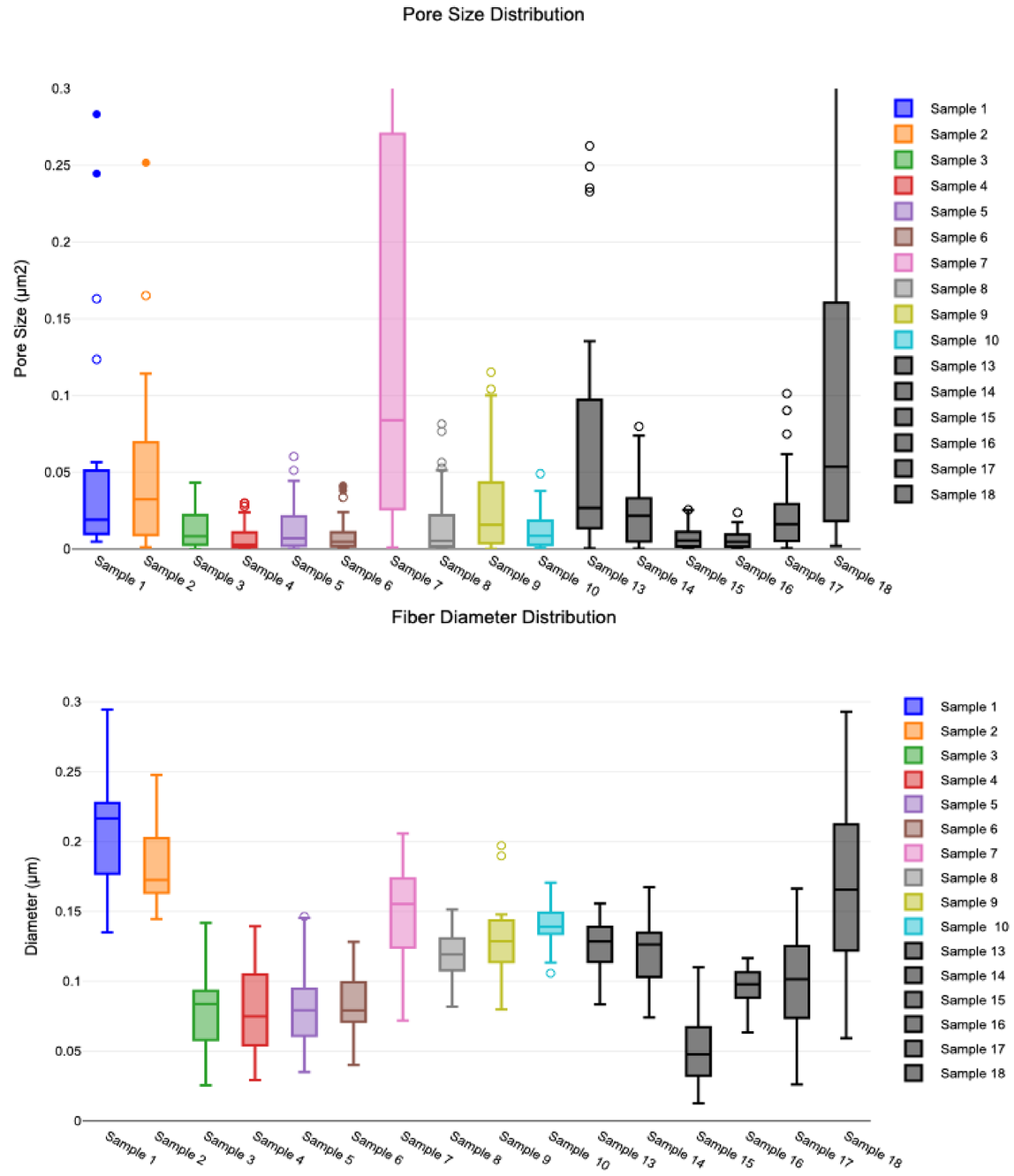
Methodology

Nanofiber samples are produced with electrospinning, a fibre production technique that can produce continuous micrometre to nanometer scale fibre. Polymer solution with various Lignin, Polymers and Triclosan compositions is used to spin fibre samples, and the influencing parameters of the electrospinning process, like voltage and rate, are recorded to study their effect on the nanofiber product. Samples are then sent for Scanning Electron Microscopy and Bacterial and Viral Filtration Efficiency tests.

Findings

From the recorded conditions, the voltage range used in producing the 18 samples is between -14kV and 16kV. The rate used is between 0.038 and 0.09 mm/min. As the electrospinning process is complex, and the parameters are intercorrelated, it is difficult to give a direct and empirical conclusion on the relationship between these parameters and the quality of the fibre produced. While all the samples sent for the test have the result of being able to block at least 99% of bacteria, the polymer solution with lignin content can produce potential bio-filter material with electrospinning fibre.

Furthermore, samples are sent for SEM tests. The pore size and diameter distributions are analyzed. Among all the samples tested, Sample 10, composed of 7.35 wt% PLA/PAN/Lignin 20/70/10 (95%) Triclosan (5%) has a relatively better performance with smooth fibre and a narrower range of pore size and fibre diameter.



Figures 1 and 2 Fiber Diameter and Pore Size Distribution of Samples

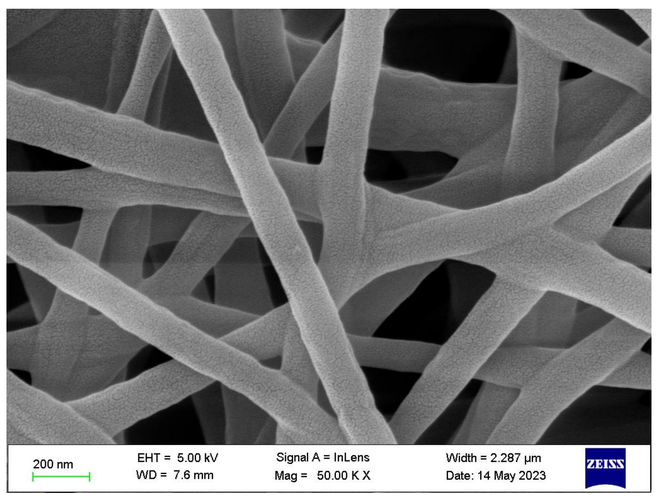


Figure 3 SEM Image of Sample 10

Figure 4 Sample 10 Product

Conclusion

This study proved that adding materials like lignin and PLA in the polymer solution is possible to produce a bio-filter with better biodegradable components and satisfactory antibacterial activity.

Acknowledgement

This work was supported by grants from the Research Grants Council of the Hong Kong Special Administrative Region, China (Project Nos.: UGC/FDS25/E08/20 and UGC/IDS(R)25/20).