Environmental Research, Technology Demonstration and Conference Project

ECF Project:	ECF 2020-54
Project Title:	Wood waste derived anti-bacterial and biodegradable nano-fibers for filtration applications
Principal Investigator:	Dr Tsang Chi Wing, Department of Construction Technology and Engineering, Technological and Higher Education Institute of Hong Kong, Vocational Training Council
Total Approved Grant:	$499,555.60 (ECF & WWGF: 50/50)
Duration:	1/6/2021 to 31/5/2024
Project Status/Remarks:	Completed
Project Scope:	This project aims to investigate the potential use of renewable biopolymers as electrostatic and anti-bacterial materials from discarded wood wastes collected in Hong Kong. Lignin, which can be extracted from wood waste, is one of the most abundant biopolymers on the earth and its biodegradability, renewability, strong mechanical properties make it suitable for use in a number of applications. Through functionalisation, lignin can carry anti-bacterial functions. The polymeric materials can then be further electrospun with electret materials to prepare nanofibrous materials which can capture particulate matters such as $PM_{2.5}$. They can also be used for indoor and outdoor air filtration purposes to stop the widespread of contagious diseases such as the recent COVID-19. The operating parameters of the electrospinning process will be systematically explored to achieve the optimal bacteria, viral and particle filtration efficiency (BFE, VFE and PFE), with the aid of functionalisation and electrospinning techniques. Overall, this project will demonstrate great potentials of valorisation of wood wastes as uses in filter materials and as an alternative to the current use of non-renewable and non-biodegradable polypropylene materials. The environmental problem including wood wastes, microplastics and public health problem will be simultaneously alleviated for the future sustainable development of Hong Kong.

Summary of the Findings/Outcomes:	This project investigates the use of renewable biopolymers derived from discarded wood waste in Hong Kong as antibacterial materials. Lignin, an abundant biopolymer found in wood, possesses desirable properties such as biodegradability and strong mechanical characteristics, making it suitable for filter applications. By blending with suitable additives, it acquires antibacterial properties. These materials are then transformed into nanofibrous materials through the electrospinning process, enabling them to effectively capture particulate matter like PM2.5. The operating parameters of the electrospinning process was systematically explored to optimize the filtration efficiency (BFE, VFE, and PFE) for bacteria, viruses, and particles. The project team demonstrated the significant potential of utilizing wood waste for the production of filter materials, offering an eco-friendly alternative to non-renewable polypropylene materials. The environmental issues related to wood waste and microplastics, as well as contributing to public health were simultaneously addressed for a more sustainable development of Hong Kong. The best formula of the filter was found to be 7.35 wt% PAN/PVDF/Lignin40/30/30 (95%) Triclosan (5%), with BFE, PFE and VFE all reaching 77-99.9%. Overall, this project demonstrates the versatility of renewable lignin, in developing high-performance antibacterial filtration materials, while also providing a sustainable solution for wood waste management in Hong Kong.