

CoVid-19 Action

Adapting dishwashers to medical-grade PPE sterilization

P. A. Giuliano Albo, V. Fernicola, S. Lago, G. Cavuoto
INRIM - Istituto Nazionale di Ricerca Metrologica, Italy

Abstract

During CoVid-19 epidemic, safety protocols are jeopardized due to contingent conditions such as the lacking of Personal Protective Equipment (PPE). Being able to safely sterilize PPE, it would reduce its demand, the risk of transmission of the virus, as well as limits its diffusion and contributes to the safety of health personnel and workers. Considering laboratory results already published on peer-reviewed journals, there are evidences that SARS-CoV-2 can be inactivated by means of suitable thermal cycling of the PPE [1-5]. Emergency use authorization (EUA) are already granted by several Health Authorities to use such thermal sterilization protocols using expensive medical-grade dry air sterilizers [6]. To make the thermal sterilization process cheaper and thus available to a broader public, we propose to use commercial off-the-shelf (COTS) dishwashers without, or with very limited, adjustments to the operating cycle. This project proposal is part of an application submitted to the Call for Action "*Innova per l'Italia*" supported by *Italian Government*.

Background and needs

In Italy, the request of medical-grade FFP2 and FFP3 face masks is estimated to reach 90 million pieces per month, both during the epidemic peak and in the aftermath (A. Borrelli, Head of the Italian Civil Protection) while today production cannot satisfy this demand. When the lockdown will be partially reduced, economy and industry will restart production, the demand of PPE will likely grow by a factor of 3 or even 4. Considering that, now, the availability of a PPE represents a critical tool for limiting the Corona virus spreading, it is necessary to find a way to extend the life-cycle of a PPE while preserving its filtration performance.

Sterilization of PPE is particularly difficult when it deals with filter materials that are designed for disposable single-use devices. Some of the decontamination methods (autoclave, 160 °C dry heat, 70 % isopropyl alcohol, soap and water) are known to degrade the filtration efficiency [3]. Stanford AIM Lab [4] showed that widely used methods such as chlorine-based disinfection (5 min) and 75 % alcohol soaking and drying, albeit have more than 99 % disinfection efficiency, reduce the filtration efficiency to 74 % and 56 %, respectively. Better results were obtained using ethylene oxide (EtO), microwave oven irradiation, ultraviolet germicidal irradiation (UVGI) and hydrogen peroxide vapors [3]. Even when effective decontamination methods are available, in many cases they are not designed to sterilize a very large number of PPEs.

In this frame, the possibility to adapt commercial off-the-shelf (COTS) dishwashers without, or with very limited, adjustments to sterilize PPE is investigated in the project, as an emergency measure to increase the safety of health personnel and workers when medical-grade PPE availability is limited.

Project Objectives

This project aims to:

- verify whether published thermal sterilization protocols [3-6] can be reproduced by COTS dishwashers with reasonably simple washing cycle adjustments;

- verify whether the filtration specifications of different PPEs are maintained after repeated sterilization cycles;
- in conjunction with biological labs. and health institutions, characterize the degree of sterilization when PPE are contaminated by SARS-CoV-2 and sterilized with the investigated protocol;
- collect and submit the scientific and technical findings of the project to seek authorization of relevant Health Authorities to use modified dishwashers for sterilization of medical-grade PPE.

Technical Objectives

The project aims to equip COTS dishwashers with one or more sterilization and/or washing cycles such as:

- direct/indirect heated dry air sterilization cycle for surgical masks and FFP2 and FFP3 face masks;
- humid air sterilization cycle exploiting natural evaporation of warm water for surgical, FFP2 and FFP3 face masks;
- a sterilization cycle for the sterilization of goggles, face shields and water-resistant PPE;
- a sterilization cycle for the sterilization of the dishwasher itself.

References

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