

Municipal Wastewater Concentration Device: Design and Optimization for the COVID-19 Sampling and Primary Concentration

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1. Introduction – In last two years, the outbreak of novel coronavirus SARS-CoV-2 has posed significant effect on global health negatively effecting also social and economic fields. Wastewater-based epidemiology (WBE) and monitoring of the SARS-CoV-2 virus has been showed as a promising tool for health officials and researchers to predict outbreaks and provide additional surveillance data, contributing to community-level screening and prevention efforts. However, there are still critical challenges that have to overcome before WBE can be fully applied to accurately reflect the real-time situation of the COVID-19 appearance in wastewater sample. Among all the challenges, the most urgent one is concentration and detection of the relatively low viral particle loadings in large volumes of wastewater. Therefore, the sampling design, including sample concentration, is a important step for detecting SARS-CoV-2 RNA in wastewater thus more investigation on optimizing the concertation methodology must be done. The objective of this study was to design and optimize mobile wastewater concentration device.

2. Experimental – In this study, the concentration device for the wastewater sample to detect RNA of SARS-CoV-2 virus was designed and optimized (Image 1 A). The main components of the concentration device were: (1) feed pump, (2) pressure gauge, (3) ultrafiltration membrane, (4, 5, and 6) flow meters with controllers, (7) concentrate tank, (8) permeate tank (Image 1 B).

3. Results and Discussion – The study demonstrated that concentration device can be design and used for wastewater sample concentration. The previous studies for wastewater sample concentration have used methods such as ultrafiltration, polyethylene glycol precipitation, ultracentrifugation, filtration with an electronegative membrane [1-3]. Therefore, for optimization, more investigation and testing of selected membrane has to be done and results should be compared with most common used concentration methods such as polyethylene glycol precipitation and ultracentrifugation.

4. Conclusions – The literature study showed that rapid, efficient (i.e., high recovery), and cost-effective SARS-CoV-2 concentration method are needed to monitor the wastewater samples for successful application of WBE. For this study, mobile concentration device for wastewater sample was design. In the further study, the most promising concentration device membranes will be selected, tested and compared with conventional concentration methods.

5. References

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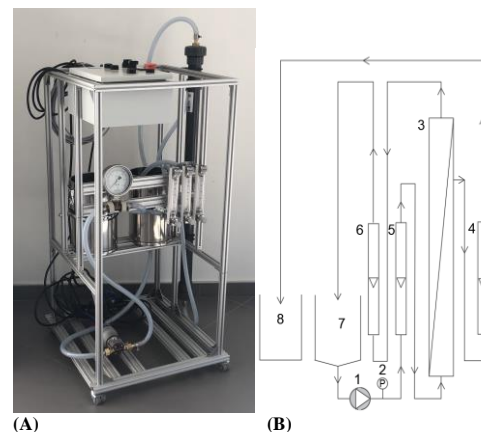


Image 1. Conceptual (A) and schematic (B) design of the concentration device for wastewater sampling.