Notice of the Final Oral Examination for the Degree of Master of Applied Science of

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BASc (University of Victoria, 2017)

“Evaluation and Improvement of Coagulant Disinfectant Products for Humanitarian Emergency Relief”

Department of Civil Engineering

Friday, August 28, 2020
9:00 A.M.
Remote Defence

Supervisory Committee:
Dr. Caetano Dorea, Department of Civil Engineering, University of Victoria (Supervisor)
Dr. Vic Neufeld, Department of Civil Engineering, UVic (Member)

External Examiner:
Dr. Stephanie Guilherme, Department of Civil Engineering, University of Ottawa

Chair of Oral Examination:
Dr. Sarah Macoun, Department of Psychology, UVic

Dr. Stephen Evans, Acting Dean, Faculty of Graduate Studies
Abstract

As climate change progresses, the number of extreme weather events are predicted to rise and generate an increase in climate related humanitarian emergencies. These emergencies result in complex displacements of populations, unsanitary conditions, and a corresponding increase in diarrheal disease risks within affected communities. Because diarrheal disease ranks as one of the major contributors to overall morbidity and mortality rates following a disaster, it is critically important that response systems are ready and that aid agencies are prepared to make informed decisions regarding the prevention of disease transmission. As water is one of the main transmission routes of diarrheal disease, providing clean and safe drinking water is acknowledged as one of the most important and effective interventions. Once we acknowledge the importance of this resource, we also acknowledge the need for quick, simple, and effective water treatment solutions.

The term point-of-use (POU) water treatment defines water treatment systems and technologies that are used at the point of consumption. These systems often treat relatively small batches of water and are operated by the consumer or head of household. POU water treatment systems and safe storage techniques have been shown to improve water quality and decrease diarrheal disease incidence and are therefore an effective option in humanitarian emergencies. One type of POU water treatment product – coagulant/disinfection products (CDPs) which are also known as flocculant/disinfectants, have been increasingly used in response to humanitarian emergencies. CDPs are shown to provide microbial and aesthetic (i.e. turbidity reductions) water quality improvements and post-treatment protective free chlorine residuals (FCRs). The relative simplicity of CDPs allows quick intervention for communities with few resources plus CDPs are durable, small, and ready for quick deployment. However, limited research has been completed on the different CDPs on the market or on methods to improve them.

This thesis explores CDPs and their role in emergency response through two interlinked perspectives:

1. First, in an overall review compiled as Manuscript #1 (Chapter 2), I assess the existing and current CDPs, how they perform in comparison to global water treatment guidelines, and where their limitations lie. The outcomes of this study provide a simple analysis for aid agencies to carefully select the CDPs used in emergency interventions; and

2. I take the findings from the research completed in Chapter 2 to develop a computational modelling approach to improving the residual protective capacity of the CDPs. These results are presented in Manuscript #2 (Chapter 3). The outcomes are intended to serve two purposes: (1)
to provide a baseline computational model to guide and encourage improvement and testing of
these products by manufacturers; and (2) to provide an educational tool to facilitate
understanding of these products and the key functions taking place during their treatment.

This thesis addressed the research objective of invoking conversation surrounding effective emergency
response through developing solutions to provide clean drinking water in at-risk communities during
complex humanitarian emergencies.