CHAPTER 1

INTRODUCTION

1.1 Theoretical background

The shrimp aquaculture industry in Thailand has expanded greatly over the last two decades. Between 1976 and 1991, the area covered by shrimp farms increased at a rate of 14.7% annually and the number of shrimp farmers rose by 21% per year (NACA, 1994). The last decade saw a rapid expansion of marine shrimp farms and in 1999, marine shrimp farms covered approximately 80,000 ha and produced 253,300 tons of shrimp, whereas freshwater shrimp farms produced only 8,500 tons of shrimp (Fisheries Economic Division, 1999).

Marine shrimp farms generally release more pollutants than freshwater farms due to the use of more chemical substances during cultivation. For this reason, an uncontrolled expansion of shrimp farming has led to environmental impacts on the coastal environment and freshwater resources (Tookwinas, 1996). Contaminants from shrimp farms, such as nutrients, fertilizers, pesticides and other chemicals can impact and deteriorate water quality in coastal and river areas in the vicinity of the farms (Tunvilai, 1993). To reuse or make use of the effluent from shrimp farms it is necessary that these contaminants be eliminated. One common way for this is to use oxidants/disinfectants such as chlorine or chlorine-compounds such as calcium or sodium hypochlorite. Approximately 50,000 tons of chlorines are used annually by farmers for the disinfection of shrimp farms in Thailand to oxidize organic matters and reduce the biological oxygen demand (Graslund and Bengtsson, 2001). These additions of chlorine present negative consequence as chlorine might react with different organic substances resulting in an increasing level of concentrations of potential carcinogenic/other health-adverse effects disinfection by-products (DBPs) e.g., trihalomethanes (THMs), haloacetic acids (HAAs), benzaldehyde, trichlorophenols, organic chloramines and many more. Hence, the use of this treated water contains the risk of potential health hazard assimilation.

Trihalomethanes belong to a group of organic chemicals formed in water when chlorine reacts with natural organic matters (such as humic acids from decaying vegetation). The mechanism of trihalomethanes formation is can be explained in the following manner (Symons et al., 1981):

Free chlorine (or bromine) + Precursors (Humic substances) ⟶ THMs + Other by-products (1.1)

Total trihalomethanes (TTHM) is the sum of the concentrations of chloroform ($CHCl_3$), bromoform ($CHBr_3$), dichlorobromomethane ($CHCl_2Br$) and dibromochloromethane ($CHClBr_2$). The level of trihalomethanes formed upon chlorination of natural waters depends on several operational conditions, such as chlorine dosage and free chlorine contact time, as well as water quality conditions, such as organic contents, bromide concentration, temperature, and pH.

There is no evidence from investigation on the trihalomethane formation potential (THMFP) in shrimp cultures in Thailand as there is yet to be a standard established for controlling THMs in natural water courses. This study aimed to investigate the formation potential of THMs from shrimp farm effluents particularly in the Chachoengsao area. Specific emphasis was placed on the effects of salinity. Furthermore, the functional groups of contaminants in shrimp farm effluents would be identified to determine whether there were relationships between them and THMFP.

1.2 Objectives

1. To determine the relationship between salinity, chloride, bromide and the trihalomethane formation potential (THMFP) in shrimp farm effluents.
2. To determine the functional groups of compounds in shrimp farm effluents which react and result in the formation of trihalomethanes.
3. To compare the amount of total trihalomethanes in shrimp farm effluents with that of the Bangpakong River.
4. To construct a simple statistical model for the prediction of trihalomethanes formation potential (THMFP) in shrimp farm effluents.

1.3 Hypotheses

1. The trihalomethane formation potential (THMFP) in shrimp farm effluent increases with bromide and chloride concentrations.
2. Certain functional groups of compounds in shrimp farm effluents have a higher THMFP than others.

1.4 Scope of the study

1. Locations of freshwater shrimp and marine shrimp cultures are along the Bangpakong River in Chachoengsao province.