CHAPTER I

INTRODUCTION

1.1 Motivation

A number of processes, e.g. coagulation, sedimentation, and filtration are considered important for the production of potable water in the water treatment systems. As a common practice, disinfection processes are often provided as the final treatment stage to eliminate potential pathogenic organisms such as viruses, bacteria, and protozoa that can otherwise be carried away with the effluent and cause serious illness and death. Although a number of disinfectants such as ozone and ultraviolet irradiation can be used for disinfection, chlorine is the most widely used disinfectant because it is extremely efficient and cost effective. Most municipal water supply systems in Thailand apply chlorination for water disinfection. However, chlorination was discovered to be potential health risks due to the subsequent generation of carcinogenic compounds called as disinfection by-products (DBPs) that form when water containing organic matters is chlorinated. Organic matters are important from a water treatment perspective due to their role as precursors to the formation of chlorination DBPs such as trihalomethanes (THMs), haloacetic acids (HAAs), haloacetonitrites (HANs), haloketones (HKs), and chloripicrin (CP), etc. A large amount of researches have investigated various aspects on the formation potential of THMs such as the effect of environmental parameters on their formation, quantitative estimation, and their toxic effect. In contrast, only small amount of work have been done on HAAs. This might be due to the complication and lengthy time requirement in HAAs estimation. Nevertheless, the World Health Organization and Environmental Protection Agency enforced the regulation of maximum contaminant level (MCL) for HAAs at 60 μg/L (U.S.EPA, 1994). Although there is no such regulation for the control of disinfection by-products in Thailand at the time of this report, it is possible that risks of having disinfection by-products will soon be closely looked upon by various Thai government environmental management agencies.

There are investigations on the minimization of HAAs in drinking water by appropriate precursor removal techniques, e.g. alum coagulation, activated carbon adsorption, and membrane technique. Inevitably, the design of such abatement technologies requires the knowledge of the properties of organic matters in the water sources. This necessitates a proper characterization method not only for the HAAs, but also for the main reactant, i.e. organic matters in the water sample. Such investigation will also allow an evaluation of a proper management and control of water treatment plants.

Bangkhen Water Treatment Plant (WTP) is the main source of water distribution of Bangkok which produces an average daily water of about 3.1 million cubic meters for the needs of more than a million people. Personal communication with a researcher who had been working on the formation HAAs indicated that there existed HAAs in the tap water from this treatment facility at the level more than the standard of 60 μg/L, and therefore this could have potential adverse effect to human beings. Thus, the understanding of the formation of HAAs in this water source is significant as the inadvertent release of such compounds along with other disinfection by-products could have serious health effects. The approaches taken with the work presented herein were to isolate complex organic matters in raw water of this water treatment plant into six fractions by resin adsorption method and to investigate the HAA formation potential (HAAFP) of both individual and samples with a combination of organic fractions. In addition, Fourier transform infrared (FTIR) was then provided to examine the active functional groups in the chlorination process. Finally, a regression model for the prediction of the relationship between organic matters and their HAAFP was proposed.

1.2 Objectives of the study

The main objective of this work was to determine the precursor to the formation of haloacetic acids (HAAs) in the raw water. Specific objectives include the determinations of

(i) organic matter concentrations and the contents of such organic compounds in the source water,

(ii) HAAs formation potentials (HAAFP) of the source water and of each organic fraction in the source water,

(iii) functional groups of organic matter that have potential to form HAAs, and

(iv) evaluation of HAA species formation potential of organic fractions.

1.3 Scopes of the study

1. Water samples were taken at the common intake from Bangkhen water treatment plant.
2. The investigation was performed with the water samples collected during March – August 2003.
3. Contents of organic matter were categorized into six groups, i.e. hydrophobic acid, hydrophobic neutral, hydrophobic base, hydrophilic acid, hydrophilic neutral, and hydrophilic base fractions.
4. The total HAAs was determined as a total weight of only five regulated HAA species, i.e. monochloroacetic acid, dichloroacetic acid, trichloroacetic acid, monobromoacetic acid, and dibromoacetic acid.