Classification of Ammonia Odor-profile Using k-NN Technique

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Abstract-- **This paper presents the application of k-NN in classifying the low and high concentration of ammonia. High concentration of ammonia in water causes serious problems to the water environment and living things in the water. Instruments that can directly detect ammonia concentration without any chemical treatment added are limited. Thus, this paper presents the classification of ammonia odor-profile using E-nose and the classification of ammonia in water using k- nearest neighbor (k-NN) with 97% success rate.**

Index Terms-- **Ammonia, Classification, k-NN, E-Nose.**

I. INTRODUCTION

Ammonia (NH3) is a combination of one hydrogen and three nitrogen atoms that have characteristics such as easily dissolve in water, colorless, and have a unique pungent odor. Ammonia in the water gives more serious harm because it is very toxic to aquatic organism. Additionally, the concentration of ammonia in the water can increase due to agricultural excess and decomposition of biological waste [1]. The high concentration of ammonia results in the increasing of ammonia toxicity, especially for fish and mammals [2]. Its toxicity effects on the brains of vertebrates that leads to convulsion and death [3, 4]. Nevertheless, monitoring and controlling the ammonia level in the water is very crucial for the water environment, fish and farming industry. The conventional ammonia detection methods that have been used to determine ammonia are Kjeldahl method [5, 6], Nessler's reagent calorimetric method [7], and the most common methods are spectrometers and spectrophotometers [8]. However, these types of detection methods have limitations in labor intensive, expensive, complex operation and not suitable for outdoor use. On the other hand, the samples used for these instruments require samples to be added and treated with toxic chemical reagent. The availability of instrument that can straight away detect the presence of ammonia in water is currently limited.

However, beside these methods, Electronic Nose (E-nose) is one of the electronic-based instrument that is used to detect the ammonia based on the unique profile of an ammonia odor [9]. An E- nose is the intelligent instrument that classifies the chemical odors mimicking a human. It consists of a gas sensor array and various pattern recognition algorithms which are the sensor that are used to produce a unique profile of an odor. This odor will be analyzed using pattern classification methods [10, 11]. The sensor functions as a sniffer of the vapor from a sample and provides a set of measurements data. Gas sensors tend to have very wide-ranging selectivity thus it will respond to many different samples provided. The detection of odors and gases has been applied to many industrial applications such as medical [12], environmental [13], and food product [14, 15] and one of the most important applications is the detection of hazardous gases [16]. Ultimately, the sensor used can be very portable and small for convenience purpose, diverse operations and also have analysis and detecting capabilities [17]. Electronic nose is inexpensive, fast, simple and a convenient method to detect ammonia in the water.

There are several pattern recognition systems that are used for classification such as Principal Component Analysis (PCA) [18], Support Vector Machine (SVM) [19], Discriminant Factor Analysis [20], and Artificial Neural Network [21] and also KNN. In this study, K-nearest neighbor method is used to compare the concentration level of ammonia samples. K-nearest neighbor is known as statistical classification algorithm and widely used for classifying data based on lowest distance training. Previously researchers' results showed that k-NN couple with e-nose produced percentage accuracy above 99% [22-23]. K-nearest neighbor (KNN) characteristics are simple but robust classifier and qualified to produce high performance outcomes even for complex applications [24-26]. This study presents the implementation of k-NN classification technique using sensor reading from the E - nose for Ammonia classification. The E - nose is used to produce a unique profile of ammonia in the water. Using these features and profile of ammonia in k-NN classification will produce the percentage accuracy performance. This accuracy is indicating the reliability of k-NN in the pattern recognition of ammonia.