

## Chapter One - Introduction

As the demand for drinking water increases water supply companies in the United Kingdom may need to look at previously unused sources of water as a potential resource for the future. For example river waters previously thought to be unsuitable for drinking water abstraction due to higher than average pollutant levels may now need to be considered.

Industrial, agricultural and/or municipal wastes are constantly being discharged into watercourses, resulting in the water bodies having a constant threat of contamination. If the levels of these potentially toxic pollutants are not monitored and kept to a minimum safe level they could impact upon the aquatic environment and/or limit the utilisation of the water resource. The level of monitoring required will depend on the likelihood of the water becoming polluted, the level of treatment undertaken and the intended end use of the water.

Drinking water guidelines set minimum limits for many potential water pollutants in the UK, these guidelines are regulated through Council Directives such as 75/440/EEC, concerning the quality required of surface water intended for the abstraction of drinking water, and Directive 79/869/EEC, concerning the methods of measurement and frequencies of sampling and analysis of surface water intended for the abstraction of drinking waters. They are in place to protect public health and do so by either eliminating or reducing potentially hazardous water pollutants that could potentially have a detrimental effect on the quality of water being supplied to the community.

The accidental discharging of agricultural, industrial and domestic sewage into water abstraction sources has been reported by the UK Environment Agency as the main cause of pollution within drinking water systems (Environment Agency report 2000). Pollutants may enter the water system at several points;

- Sewers can overflow into water courses or excess run-off from roads and land carrying fuels and fertilizers into waters (Hrudey *et al.*, 1988, Domagalski 1997, Komai *et al.*, 2002)
- During the summer months when algae blooms flourish in lakes or reservoirs (Jones and Korth 1995, Kajino and Sakamoto 1995, Montiel *et al.*, 1999)
- During periods of heavy drought, when water levels are low, the natural dilution rate of a body of water is reduced.
- During water treatment in the form of disinfection by-products (Hrudey *et al.*, 1988, Levi and Jestin 1988, Bruchet *et al.*, 1992, Davi and Gnudi 1999, Froese *et al.*, 1999)
- After treatment within the distribution systems (Karlsson *et al.*, 1995, Welte and Montiel 1999).

The presence of undesirable pollutants in abstraction water can impact upon the taste and odour quality of the water (Ventura *et al.*, 1995, Romero *et al.*, 1998, Clark *et al.*, 1990, Noblet *et al.*, 1999, Schweitzer *et al.*, 1999a, 1999b) leading to an increased number of public complaints received by water supply companies (Bruchet *et al.*, 1995). Taste and odours will continue to be a problem for water supply companies as consumers generally link taste and odour problems to poor water quality (Zoeteman *et al.*, 1980, M<sup>c</sup>Guire 1995, Levallois *et al.*, 1999). An increasing consumer perception believes that water should be aesthetically appealing (i.e. free of colour, turbidity, tastes and odours) as well as being safe for human consumption. Additionally as legislation surrounding water quality standards tighten, the requirement for water companies to produce water that is acceptable to the consumer, with no abnormal change, also increases.

A variety of analytical techniques and sensory methods have been used to detect and identify the source of taste and odour causing compounds. These include analytical systems such as gas chromatography-mass spectrometry (GC-MS) and sensory gas chromatography (sensory-GC) (Khiari *et al.*, 1992) and sensor methods such as Flavour Profile Analysis (FPA) (Suffet *et al.*, 1999). These techniques and methods provide an accurate description of the chemical composition or provide a total olfactory assessment for solving taste and odour episodes in drinking water. A limitation to their wider

application is their need to be mainly laboratory based. Field applications of different analytical systems and sensory methods have been developed and applied for continuous and rapid online monitoring of taste and odour episodes (Drage *et al.*, 1998). Such applications are limited in number due to high inauguration and operational costs. In the UK, field based semi-continuous sensory monitoring is achieved at a number of water treatment plants by using “smell bells”. These systems provide a manual odour examination by smelling a sample of aspirated water at 60 °C, which is usually conducted daily for raw and treated water (i.e. with and without chlorine).

There is a need for a continuous sensory technique for water quality monitoring. Smell bells are theoretically ideal for continuous monitoring however it is not feasible to manually sample and characterise samples continuously in the manner this equipment dictates. Laboratory studies (Stuetz *et al.*, 1998, Bourgeois and Stuetz 2000) have shown that sensor array technology can offer a repeatable and reproducible methodology for assessing headspace gasses above a water sample. They have the potential to provide a non-intrusive, fast and effective means of inlet protection through automated olfaction principles. Combining the smell bell principles with sensor array technology should enable continuous monitoring of the abstraction waters allowing routine assessment indicating the presence or absence of tainting compounds within the water.

This study was based on a continuation of work by Stuetz *et al.* (1998) where an eNose model D (Neotronics Scientific, UK) was operated using batch sampling with no facility for on-line application or multi-sample analysis. Samples to be analysed were placed in the chamber using a glass vessel, which allowed a static headspace to form prior to analysis. Manual sample change over limits its capabilities for continuous monitoring. Advances to Stuetz’s study are investigated.