6.9 Disinfection

6.9.1 General

Contamination by sewage or by human or animal faeces is the greatest danger associated with water for drinking. This is because sewage from human or animal sources may contain the causative organisms of many communicable diseases. The use of disinfection to kill or inactivate pathogenic micro-organisms is necessary if the raw water contains such organisms.

Surface waters may contain between a few tens of *E. coli* per 100 ml in a source derived from a protected upland catchment and many thousands of *E. coli* per 100 ml in a source derived from a lowland river containing treated sewage effluents. Groundwaters are less prone to contamination.

Several disinfection methods are used in water treatment. Disinfection with chlorine is the most widely used method for large water supplies but its application is less common in small supplies. Other methods that are increasingly used include ultraviolet irradiation and ozonation.

Different micro-organisms have different susceptibilities to disinfectants, and disinfectants vary in their potency. For a given micro-organism, disinfection efficiency is affected especially by disinfectant concentration and contact time, and also by disinfectant demand of the water, pH and temperature. The product of disinfectant concentration (C in mg/l, measured at the end of the contact period) and time (t in minutes) is called Ct (in mg/l.min) and is an expression of exposure to the disinfectant:

$$Ct = C \times t$$

The greater the Ct value, or exposure, the more effective disinfection is. Either concentration or contact time, or both, can be manipulated to obtain a desired Ct value. Values of Ct can be useful for comparing the efficiency of disinfectants – the lower the value of Ct to attain a given kill of micro-organisms, the more effective the disinfectant. The Ct value can also be used to rank the relative susceptibility of different micro-organisms – the higher the Ct value necessary to achieve a given level of kill the more resistant the micro-organism.

In the case of ultraviolet irradiation, Ct cannot be calculated in the same way and the exposure is expressed as UV radiation energy density, which is equivalent to (power x time) per unit area, expressed in milliwatt seconds per square centimetre ($mW.s/cm^2$).