Chapter 4-- Swimming and spa pools

4.3.5 Disinfection
Disinfection is a process whereby pathogenic microorganisms are removed or inactivated by chemical (e.g. chlorination) or physical (e.g. filtration, UV radiation) means such that they represent no significant risk of infection. Recirculating pool water is disinfected using the treatment process, and the entire water body is disinfected by application of a disinfected residual, which inactivates agents added to the pool by bathers.

The choice of disinfectant depends on a variety of factors, including compatibility with the source water supply (hardness and alkalinity), bathing load, oxidation capacity, and margin between disinfectant action and adverse effects on human health. Chlorination is the most widely used pool water disinfection method, usually in the form of chlorine gas or sodium or calcium hypochlorite. Ozone in combination with chlorine or bromine is a very effective disinfection system but the use of ozone alone cannot ensure a residual disinfectant capacity throughout the swimming pool.

For disinfection to occur with any biocidal chemical the oxidant demand of the water being treated must be satisfied and sufficient chemical must remain to effect disinfection.

4.3.5.1 Choosing a disinfectant
Issues to be considered in the choice of a disinfectant and application system include:
• Safety;
• Compatibility with the source water supply;
• Type and size of pool
• Bathing load (sweat and urine from bathers will increase disinfectant demand); and
• Operation of the pool (i.e. supervision and management).

The choice of disinfectant used as part of swimming pool water treatment should ideally comply with the following criteria:
• Effective, rapid, inactivation of pathogenic microorganisms;
• Capacity for ongoing oxidation to assist control of contaminants during pool use;
• A wide margin between effective biocidal concentration and concentration resulting in adverse effect on human health;
• Availability of a quick and easy determination of the disinfectants concentration in pool water (simple analytical and test methods); and
• Potential to measure the disinfectant's concentration electrometrically to permit automatic control of disinfectant dosing and continuous recording of the values measured.

Commonly used disinfectants include:
• Chlorination is the most widely used pool water disinfection method, usually in the form of chlorine gas or sodium or calcium hypochlorite. Chlorine is inexpensive and relatively convenient to produce, store, transport and use. The chlorinated isocyanurate compounds are somewhat complex white crystalline compounds with slight chlorine-type odor that provide
free chlorine when dissolved in water. They are an indirect source of chlorine, via an organic reserve (cyanuric acid). The relationship between the chlorine residual and the level of cyanuric acid is critical and can be difficult to maintain. Chlorinated isocyanurates are not suited to the variations in bathing loads usually found in large public pools. However, they are particularly useful in outdoor swimming pools exposed to direct sunlight where UV radiation rapidly degrades free chlorine.

For chlorine-based disinfectants, adequate routine disinfection should be achieved with a free chlorine residual level of at least 1 ppm throughout the pool. Lower residuals (0.5 ppm) will be acceptable in combination with the additional use of ozone, whereas higher levels (2-3 ppm) may be required for spa and hydrotherapy pools.

Ozone can be viewed as the most powerful oxidizing and disinfecting agent that is available for pool and spa water treatment. However, it is unsuitable for use as a residual disinfectant. It is most frequently used as a treatment step, followed by deozonation and addition of a residual disinfectant, such as chlorine. Excess ozone must be destroyed by an activated carbon filter because this toxic gas could settle, to be breathed by pool users and staff. Residual disinfectants would also be removed by the activated carbon filter and are, therefore, added after this step.

4.4.3 Spa pools

Spa pools have different operating conditions and present a special set of problems to operators. The design and operation of these facilities make it difficult to achieve adequate disinfectant residuals. They may require higher disinfectant residuals because of higher bathing loads and higher temperatures, both of which lead to more rapid loss of disinfectant residual.

Hot tubs and whirlpools and associated equipment can create an ideal habitat for the proliferation of Legionella and Mycobacteria. In addition, P. aeruginosa is frequently present in whirlpools and skin infections have been reported when the pool design or management is poor. A P. aeruginosa concentration of less than 1 per 100 ml should be readily achievable through good management practices. Risk management measures that can be taken to deal with these non-enteric bacteria include ventilation, cleaning of equipment and verifying the adequacy of disinfection.

Spa pools that do not use disinfection require alternative methods of water treatment to keep the water microbiologically safe. A very high rate of water exchange is necessary - even if not effective enough - if there is no other way of preventing microbial contamination. In spa pools where the use of disinfectants is undesirable or where it is difficult to maintain an adequate disinfectant residual, superheating spa water to 70°C on a daily basis during periods of non use may help control microbial proliferation.