7.6 Reverse osmosis units

Reverse osmosis (RO) has been used in recent years for the production of drinking water from low quality raw waters. Large-scale RO plants are used for the desalination of seawater to produce drinking water in countries where adequate supplies of fresh water are not available. Because of the high concentrations of dissolved salts in seawater, the osmotic pressure is high and operating pressures up to 70 bar are used. Domestic RO units operate at much lower pressures, as low as 1 bar, because of the typically lower concentration of dissolved salts in the water to be treated. RO systems will remove, to varying degrees, a range of physically and chemically diverse substances including dissolved inorganic species (e.g. sodium, calcium, nitrate and fluoride) and organic pollutants including pesticides and solvents. RO can also produce pathogen-free water.

The water to be treated by RO must be of good quality to prevent fouling or scaling of the membrane and a raw water supply will usually require pre-treatment.

Raw water enters the RO unit and treated water flows through the semi-permeable membrane, usually manufactured from polyamide. Some membranes such as cellulose acetate may support bacterial growth and are therefore unsuitable. The flow rate of treated water is very low at the pressures used in a domestic unit and the treated water is collected in a storage tank to buffer supply and demand. Usually a level sensor in the storage tank controls the operation of the RO unit.

The membrane does not become exhausted or saturated although it will require periodic chemical cleaning and replacement, usually after several years. The storage tank must be constructed of a material suitable for potable water and be protected from contamination. Periodic disinfection of the tank is recommended. There is evidence that inadequate cleaning of the storage system and pipework associated with RO units can result in proliferation of bacteria that are of health significance.

Water treated by reverse osmosis will generally be very soft. It is not known whether regular long-term consumption of water containing unusually low levels of dissolved inorganic constituents has any effect on health. Such water will contain insufficient fluoride to protect against dental caries. In addition, although there is no established explanation for the tendency for areas supplied with naturally soft water to have higher rates of cardiovascular disease than hard water areas, it appears sensible to avoid regular consumption of artificially softened water where there is an alternative. However, in the context of private supplies RO may offer the only practicable means of rendering potable a water source containing an excess of dissolved inorganic constituents. Some units have a ‘re-hardener’ system to increase the hardness and alkalinity of the treated water, thus rendering it less aggressive. It is not known whether this is a necessary or effective measure to protect health.

A further disadvantage of RO could be that a relatively high volume of water is wasted. Typically, for each volume of drinking water produced, three volumes must be wasted unless it can be used for non-potable purposes such as toilet flushing. RO should be considered if no alternative treatment could make a raw water safe to drink.