Viruses and reclaimed water

The quantity of water a person uses each day varies from five litres for the more primitive nomads to 500 litres in economically developed countries. Yet only 20%, of the world’s population has a direct supply—and for the population of the developed nations the figure is only 5%.1 The demands on water are increasing so rapidly because of population expansion and industrial needs that recycling of domestic waste and sewage is practically inevitable in the future. The presence of viruses in sewage effluent, streams and rivers, lakes, and other waters is an important health hazard with the increasing contamination of surface water.

Over 100 viruses are excreted in human faeces, including poliovirus, echoviruses, coxsackieviruses, hepatitis A virus, viruses causing gastroenteritis, and certain adenovirus serotypes. In fact, well over one million virus particles may be excreted per gram of faeces, and concentrations as high as 500 000 infectious virus particles per litre have been detected in raw sewage.2 Furthermore, sufficient numbers of enteric virus particles survive the customary secondary treatment of sewage and chlorination to be easily detected. Some of these viruses can survive for 25-125 days in soil, 2-168 days in tap water, and 2-130 days in sea water. Indeed, human viruses adsorbed to soil are infectious for animals and in tissue culture. Methods for removing or inactivating viruses that are adsorbed on to and within solids are therefore also important.

Inactivating viruses is clearly preferable to simply removing them from water by processes such as sedimentation, adsorption, coagulation and precipitation, and filtration. The mainstay of water disinfection has been chlorine treatment, but its effectiveness depends on many factors including temperature, pH, and the presence of organic matter. High doses of chlorine are a hazard to various forms of life when the effluents are discharged: carcinogenic chlorinated hydrocarbons may be produced, and possibly (to judge by recent laboratory findings) a progressively more chlorine-resistant poliovirus strain could develop.

We know less about viruses in drinking water. Enteric viruses have been detected, however, in 181 of 200 samples in Paris; virus has been isolated from drinking water in the USSR, South Africa, and Romaniaa; and poliovirus has been detected on several occasions in treated drinking water containing free residual chlorine in the United States.4 But viruses may be transmitted to man not only by contaminated drinking water but also by shellfish and crops; and swimming and other water recreations may provide further sources of infection. Moreover, spraying crops with waste water in agricultural settlements in Israel has recently been found to produce aerosols contaminated by virus.4

Reported waterborne outbreaks of virus infection are largely confined to hepatitis type A (infectious hepatitis),5 mainly because of the dramatic nature of the outbreaks. For example, an explosive outbreak of hepatitis A occurred in New Delhi in December 1955 and January 1956, when after heavy rainfall and flooding sewage contaminated a major water supply for several days. Over 30 000 cases of clinical hepatitis among a population of some two million occurred during the next six weeks, despite a presumably high level of immunity in the general population. In the United States 66 waterborne outbreaks of hepatitis A were reported during 1946-71, and another 13 during 1971-4. Many enteric viruses, however, cause inapparent infections, and even clinical illness often shows too variable a picture to enable identification of a common source.

What can we do? Firstly, we now have much evidence that coliforms or enterobacteria are unreliable indicators of viral contamination, and viruses have been found in water in which faecal coliforms are absent. Moreover, treatment methods may destroy faecal bacteria more rapidly than enteric viruses. We therefore need a sensitive virus-indicator system. Suitable methods are indeed being developed—new techniques will detect a single infectious unit in samples as large as 4000 litres of drinking water. Secondly, animal enteric viruses can get into our water supplies, and we need to know more about their effects on human or animal health. Finally, there are important differences in water purification procedures in different parts of the world, and we must establish standard criteria for economic, physical and chemical methods of eliminating viruses to maintain the quality of water even when we have to recyle it.

Preventing immersion hypothermia

About 25 000 people are working in the North Sea in oil and gas production, and perhaps another 5000 or 10 000 on merchant and fishing vessels. An unknown number of these people suffer each year from accidental immersion and a few die of hypothermia.

The causes of the incidents are many and complex and such accidents will never be totally preventable. Nevertheless, the hypothermia could be almost eliminated. The most obvious protective measure is adequate clothing. Many so-called “immersion suits” used by sailors, deep-sea fishermen, and particularly passengers in oil-rig helicopters are virtually useless for preventing hypothermia; some are actually dangerous when worn in the water because they are positively buoyant in the legs. A suit that provides excellent protection against atmospheric cold may be quite inadequate for the cold of immersion.

To be really effective in cold water any survival suit must keep the survivor dry. A suit working on the diver’s wet-suit principle by trapping a layer of water next to the skin is second best, but not much better than a layer of good, thick woollen clothes. Although a dry suit may allow a little water to seep in from the neck seal, this does not matter provided that the water cannot circulate.

1 British Medical Journal, 1977, 1, 1430.

Prevented immersion hypothermia

About 25 000 people are working in the North Sea in oil and gas production, and perhaps another 5000 or 10 000 on merchant and fishing vessels. An unknown number of these people suffer each year from accidental immersion and a few die of hypothermia.

The causes of the incidents are many and complex and such accidents will never be totally preventable. Nevertheless, the hypothermia could be almost eliminated. The most obvious protective measure is adequate clothing. Many so-called “immersion suits” used by sailors, deep-sea fishermen, and particularly passengers in oil-rig helicopters are virtually useless for preventing hypothermia; some are actually dangerous when worn in the water because they are positively buoyant in the legs. A suit that provides excellent protection against atmospheric cold may be quite inadequate for the cold of immersion.

To be really effective in cold water any survival suit must keep the survivor dry. A suit working on the diver’s wet-suit principle by trapping a layer of water next to the skin is second best, but not much better than a layer of good, thick woollen clothes. Although a dry suit may allow a little water to seep in from the neck seal, this does not matter provided that the water cannot circulate.