A municipal wastewater treated with the two preceding processes in series will, with one exception, have been restored to a chemical quality generally comparable to that of the city's tap water before it was used. The exception is the dissolved inorganic salts which are added during each use of a water but which are not removed by these two processes. A single municipal use of water adds about 300–400 mg/1 of dissolved salts. Since many water supplies contain dissolved salts at approximately this same concentration, one municipal use of the water roughly doubles the dissolved solids or mineral content of the water. Fortunately, a single pass through a treatment process called electrodialysis can reduce the concentration of dissolved minerals by about half; the removal achieved, therefore, is roughly equal to the salts added to the water during use. Electrodialysis is one of the most promising methods for removing these inorganic pollutants from water.

Other processes

Other potential advanced processes are on the drawing boards or in various stages of development. Bio-denitrification is a process in which microorganisms reduce harmful nitrates to elemental nitrogen under certain process conditions. The use of finely powdered activated carbon instead of granular carbon is being studied. The adsorption rates for powdered carbon are much higher than for granular carbon. The foam separation process makes beneficial use of the unwanted foam so common in many municipal and industrial wastewaters. Organic contaminants may be removed from waste by deliberately generating a foam and then physically separating the foam from the liquid.

Chemical oxidation can selectively destroy the refractory or highly resistant organic materials which are only partially degraded by conventional biological treatment. Oxidants such as ozone, chlorine, and even oxygen from the air itself are under investigation. Chemical oxidation has the advantages of removing organic contaminants without producing a residual waste concentrate and of simultaneously destroying all microorganisms, bacteria and viruses.

Experimental work on distillation of wastewaters is in an early stage of development. From studies to date it has been established that volatile contaminants will carry over into the distillate. Fortunately, it appears that these materials may be removed by activated carbon treatment or by ion exchange, but considerably more research and development is needed to assess the applicability of distillation as an advanced waste-treatment process.

Reverse osmosis, in which highly pure water is actually squeezed through specially made plastic membranes, is one of the more intriguing processes now under study. Laboratory and small-scale pilot plant tests to date have produced product water containing less than 50 mg. per liter of dissolved solids.

Finally, the ion exchange process, which was earlier given low priority because available ion exchange resins tended to become fouled by organic materials commonly found in wastewaters, is being given new emphasis. As a result of new developments in resin technology, this process shows considerable promise for removal not only of dissolved minerals in general but potentially of specific impurities also both organic and inorganic.

Using processes already developed and now being operated in pilot-scale installations, it is possible to achieve any degree of waste treatment desired and, in fact, to purify wastewater to drinking water quality. The water in this container was wastewater from the City of Lebanon, Ohio, near Cincinnati. At Lebanon we are operating an advanced waste-treatment pilot plant incorporating coagulation-sedimentation, filtration, activated carbon adsorption, electrodialysis, and disinfection. This water is potable. In fact, it exceeds in quality the tap waters of a great many communities in the United States at the present time.

Our present research is aimed at bringing these processes to full-scale embodiment and confirming through full-scale demonstrations their cost, performance, and operating reliability. It is also our aim to explore and develop new and improved systems capable of achieving these treatment goals at even lower costs and with even greater efficiency.

Pilot projects

The FWPCA is operating pilot plants at Pomona (fig. 19) and Lancaster (fig. 20), Calif., as well as at Lebanon, Ohio (fig. 21). Additional pilot plants are being designed or constructed at Piscataway, Md., and Manassas, Va., as well as right here in Washington, D.C. Advanced waste-treatment projects now being supported by research and development grants include those at Santee, Irvine, and San Jose, Calif.; Lake Tahoe on the Nevada-California border; Dallas, Tex.;