

by a "total removal" process, that is, evaporation plus distillate "polishing," which handles only about half of the total flow. Following this step, the completely purified water (the distillate) is blended with the flow from which all impurities except the salts have been removed.

In FIGURES 8 and 9, the unit costs are estimated for both a series-flow and a parallel-flow system at a scale of 10-20 mgd. First, the projected total system costs are so close (\$.56 vs. .58/1,000 gallons) that one type of system cannot, at this time, be omitted in favor of the other. Second, the costs of conventional and advanced treatment steps can be compared.

In contrast to the present cost of \$.10/1,000 gallons for primary-secondary treatment (FIGURE 8), coagulation-sedimentation, which very efficiently removes suspended solids and phosphates, costs an additional \$.08-.10/1,000 gallons (certain biological treatment modifications being studied may be able to remove up to 80 per cent of the phosphates for a lower cost). If the adsorption step is incorporated to eliminate BOD and refractory organics, the additional cost is raised to \$.18-.20/1,000 gallons. This total waste treatment cost of about \$.30/1,000 gallons is almost three times the present level.

To complete the renovation with electrodialysis would add another \$.25/1,000 gallons to give a total renovation cost of more than five times the cost of existing waste treatment. This is clearly not an illustration of "something for nothing." Yet, the cost picture is not really so dark. First, the AWT estimates were made intentionally high so that they should not be exceeded under normal circumstances. Second, costs should be reduced significantly as research and development programs bring us closer to the most efficient designs. Third, substitute processes now being investigated may reduce costs considerably. The powdered carbon process, for example, could conceivably replace both coagulation-sedimentation and granular carbon adsorption, which cost \$.18-.20/1,000 gallons, at half their cost.

Another point is that cost comparisons would perhaps be more fair if made not just between waste-treatment processes, but also between advanced waste treatment costs and conventional waste treatment plus water supply. Water supply plus waste treatment costs, based on historical data and including source development, transmission, water treatment, and waste treatment, have been estimated to be about \$.23/1,000 gallons on the average and to be nearly \$.30/1,000 gallons in prevailing high-cost areas of the country.² Future costs for extending conventional treatment and for augmenting water supplies will undoubtedly be higher.

Now, what could be the physical impact of waste water renovation on our future water pollution and water supply problems? To derive an answer, FIGURES 3-6 were redrawn in FIGURE 10, incorporating the assumption that during the next 25 years, AWT processes of the type now available are applied to every municipal effluent in the land. For municipal BOD pollution, instead of facing a temporary reduction in national BOD discharge levels until the turn of the century, we could be very close to President Johnson's recent pledge to "doom water pollution in this century." With respect to phosphate and refractory organic loads entering our streams, no reductions can be expected with the use of present treatment methods. However, with the use of AWT, the first reductions in history could be accomplished. For nitrogen forms, on the other hand, even available AWT processes will not be highly effective. Processes still in development must meet this need.