

ity of research is invariably the need to develop new and improved techniques for waste treatment and specifically to develop the technology to permit more waste water reuse.

Waste treatment

Present waste treatment methods were devised, generally, for the pollution problems that existed 40 or more years ago. Although there have been improvements in these methods, they are proving to be increasingly inadequate for the concentrations and complexities of many of today's wastes and the requirements being posed by the increased loads on receiving streams. In addition, no satisfactory methods were ever devised for many industrial wastes and some of the impurities found in municipal wastes.

Water supply and pollution trends show that one of the most pressing problems in water quality management is the need to develop new treatment processes which will remove much more of the pollutorial material from municipal and industrial wastes than is possible by present biological methods. The volume, strength, and complexity of future wastes can only result in the discharge of larger and larger amounts of impurities into badly needed water resources if we continue to apply presently known treatment processes only. The sole currently-available solution, in many cases, would be low flow augmentation, i.e., the provision of dilution water from upstream artificial impoundments.

A good part of the municipal pollution problem may stem from the common conception of today's "complete treatment." The use of the phrase has been very misleading to the taxpayer and perhaps even to the technician.

What is accomplished by today's complete treatment? A fairly good job is done in removing oxygen-consuming materials, generally 75 to 90 percent removals are attained. About the same removal is accomplished with respect to suspended materials. In these removals another problem, not yet satisfactorily solved, is created: what should be done with the separated sludge? The algae nutrients, nitrogen and phosphorous, are removed to a very limited extent. Only a fraction of some of the dissolved organics is removed and essentially none of the increment of dissolved inorganics added to water during use is taken out. This has been called *complete treatment* and the receiving stream has been relied on to complete the job through dilution and so-called self-purification. Unfortunately, as water demands increase, dilution water becomes, proportionately, less available and self-purification mechanisms are largely ineffective against the very same classes of contaminants which have successfully resisted treatment.

Each water-use adds increments of wastes that are not removed by biological treatment. If we are to meet our future water needs (as seems inevitable) through repeated reuse of our fresh water resource, much more of the impurities must be removed from waste streams. To do this, new treatment processes are being developed, based, in some cases, on concepts and principles that will achieve complete conversion of waste waters to fresh waters. This will require a major research program and the best scientific minds in government, industry, and universities. It will require the utilization of physicists, physical chemists, chemical engineers, and other scientific resources not yet fully brought to bear on water pollution problems.

The Nation has already entered the water reuse phase but increasing needs will require multiple reuse of the same waters, particularly in the water-short Southwest and the Southwest-Pacific areas and in the highly populated and industrialized areas of the Midwest, Northeast, and Middle Atlantic.

Multiple reuse of water will not be possible unless much more economical, effective, and efficient waste treatment processes are developed than those available now. These will need to be basically new processes, probably utilizing chemical and physical techniques.

The objective of our Water Purification and Reuse Program is to develop these new treatment processes (Advanced Waste Treatment). More broadly, the goal is to develop a new arsenal of treatment tools which will permit not only total pollution control but also deliberate, controlled reuse of water. Reuse, greatly augmenting our natural fresh water supplies, will be possible through recharge of ground waters with treated waste effluents and, more directly, through the complete renovation of waste waters for deliberate recirculation in municipal or industrial water systems.

More answers to more difficult pollution problems can be achieved through a successful Water Purification and Reuse Research Program than through any other research.