

needs vary from location to location. Considerable effort is being expended, therefore, in developing optimized "systems" of processes which will meet whatever localized requirement may be specified. This research is being carried out both by in-house scientists and engineers of FWPCA and through contracts and grants with outside organizations. As with any "process development" program, effort normally starts at the desk or in the exploratory laboratory. With successful results, the development then moves to bench-scale or bread-board studies and thence to the pilot plant, the field evaluation, and ultimately to full-scale demonstration.

Within the last year or two, substantial progress has been made in moving a number of AWT processes well along in the above process development sequence. In total, some 60 separation or ultimate disposal processes have been evaluated. Approximately 25 percent have been rejected for technical or economic reasons; another quarter are undergoing laboratory or bench-scale study, almost a third are at the pilot-scale; and the remainder, some dozen processes, are now being field evaluated or actually demonstrated. Examples of progress within the last 12-18 months include the following:

- a. A joint study with the City of Los Angeles to evaluate improved operational methods for the activated sludge process is scheduled to begin this month.
- b. A 7.5 mgd demonstration plant including granular activated carbon adsorption, ammonia stripping, lime coagulation and precipitation of phosphates, multi-media filtration, absorbate incinerations, lime recalcination and recovery, and disinfection is under construction and nearing completion.
- c. Cost of the granular activated carbon adsorption process for achieving 98-99% removal of organic pollutants from secondary sewage effluent was reduced by 20% to an estimated 8.3¢/1000 gal. (at 10 mgd plant size.)
- d. A new method for high-efficiency removal of phosphates from municipal wastes through addition of small amounts of chemicals has been developed and proven effective in bench-scale tests. Preliminary tests at 2 full-scale waste treatment plants were completed with promising results.
- e. Solutions have been found to the serious membrane fouling problems which have been prevalent in electrodialysis treatment of wastewater. Pilot-scale verification of these techniques is now underway.
- f. Pilot plant studies of the powdered activated carbon adsorption process have shown high quality, reliable performance and give promise that this technique for refractory organic removal may be lower in cost than granular carbon adsorption. Very recent results indicate that the process might even be a substitute for conventional biological secondary treatment.
- g. Consistent biological nitrification-denitrification has been achieved in bench-scale studies of a new type two-stage biological process. It has been discovered that effective denitrification can also be achieved through use of a feed supplemented packed column contractor.
- h. The existence of a high efficiency phosphate removal phenomenon within certain existing activated sludge plants was brought to light. Some controlling variables have been established, others are now being confirmed.
- i. The effectiveness of organic polyelectrolytes as additives in primary treatment was demonstrated in a full-scale plant.
- j. Pilot-scale studies of several types of reverse osmosis equipment have been initiated.
- k. The technical feasibility of two new oxidation processes, involving ozone and light-catalyzed chlorine, was established.
- l. Anion exchange resins were found to be effective in removing up to 50% of the soluble organics from secondary effluents without irreversible fouling.
- m. A comprehensive summary of capital and operating costs for both conventional and advanced waste treatment processes has been completed.
- n. Studies of various methods for powdered carbon regeneration were initiated. Preliminary results are quite promising.
- o. To predict and control the performance of waste treatment processes by computer, mathematical models for these processes are being formulated. A preliminary model for the activated sludge process was completed.
- p. Arrangements have been made for field evaluation of pipelining and surface spreading of digested sludges to revegetate and reclaim disturbed