each thirty minutes of the plant's operation; but the current generated was three-phase and the readings had been taken from one ammeter and one voltmeter connected to one phase only.

These instances are not exceptions in the average small plant; indeed, many more serious mistakes are known to every plant operator. Water systems with no water supply, filtration plants that fail to filter, and many other such mistakes are matters of common knowledge. Practically all of these things can be traced back to a desire to save a few dollars of the original investment, at the expense of comparatively greater cost of operation and maintenance. Even in the power plant, that part of the system where efficiency might be expected, and in plants where tests are made on the equipment at the time of its installation, provision is seldom made so the superintendent can run an overall efficiency test at any time, and the guaranteed efficiencies under which simple equipment is often purchased are frequently impossible of determination by the superintendent, after the plant has been turned over to him. Power plants are installed with separate guarantees on engines, boilers and generators; motor-driven pumps with separate guarantees on motors and pumps. In the small plant and in many large ones, an "overall" efficiency guarantee is possible, and it is the only guarantee for which the superintendent has a great deal of use.

Efficient equipment in a plant counts for little unless you know that that equipment is maintaining its efficiency through efficient operation.

The man never lived who thoroughly enjoyed writing reports and weighing coal, or even changing record cards on recording instruments, but no plant can operate successfully and economically without an accurate and detailed record of its operation. In the small plant, recording instruments and labor-saving devices, or even proper valves and meters are sometimes entirely lacking. How can an operator know what his plant is doing when he only knows how much coal he uses and how much money he takes in each month? Nearly all owners object to the size of the coal bill or to the amount paid out for chemicals for the filtration plant, but very few offer their superintendents expert assistance in cutting down the size of these bills. Business management does not entirely consist in keeping the operating cost within the receipts.

Two years ago the writer visited a privately owned waterworks plant, and inquired of the engineer in charge how much alum he was using, and how often he analyzed the water. His answer was that he used from three to six grains and that in the two years he had been connected with the plant no analyses had been made.

Perhaps one of the hardest problems for satisfactory solution from the standpoint of results, is the operation of filtration plants of small size, for practically every plant of 5,000,000 gallons or less per day has to be operated intermittently, thus presenting added difficulties over the operation of a large plant. Obviously more attention should be given to the design and operation of such plants. It is certainly of prime importance that this phase of the question should be given study it has not been given in the past.

The large waterworks system is not the only one entitled to efficient operation, to dividends and to the enthusiastic support of its patrons. Perhaps the system using the extra line to the top of the standpipe had other much more serious defects in its construction, and with these corrected, it might have operated at a profit instead of a loss. In all probability the owner of the system, the superintendent of which increased the size of the lower sections of the flow line to avoid friction, wondered why his investment was greater than necessary to accomplish a given result. The owner of the filtration plant where no analyses had been made for at least two years probably considered himself abused when patrons objected to the quality of water furnished.

There are good and sufficient reasons for about 99 per cent. of the defects of design and operation of the small waterworks system, and the successful owner or operator is the one who removes these defects by careful and intelligent design and operation. There is little real excuse to-day for poor design or unintelligent operation of the small sized waterworks systems. The various state boards of health have done, and are doing, a remarkably efficient work in the education of the owners and operators of plants from these standpoints, and associations such as the American Waterworks Association, through publications and conventions, make it possible for every waterworks superintendent to get ideas adaptable to the proper solution of the problems of his own plant, and surely no engineer, owner, or superintendent is worthy of his position who fails in demanding the best design and best results of operation for the small as well as for the large system.

AMHERSTBERG, ONT., SEWAGE DISPOSAL.*

THE city of Amherstberg, Ont., is the farthermost downstream municipality on the Detroit River. It possesses no manufacturing establishments of consequence and has had an erratic trend as to growth in past years. The population was 1,936 in 1871, 2,672 in 1881, 2,279 in 1891, 2,222 in 1901, and 2,560 in 1911. There is no apparent reason to expect that it will grow rapidly in the future, and it has been assumed that interceptor provision for 4,000 people and treatment-plant provision for 3,000 people will be ample.

No regular records are kept of the water pumped, but from a statement of the pumping-station engineer as to the number of times the water tank is filled during a day, it appears that the daily per capita consumption is about 165 to 170 U.S. gallons. As this information is of meagre nature, and as Amherstberg is a very old city, so that the water mains are probably in a very leaky condition, the interceptor has been designed on an assumed water consumption of 125 U.S. gallons per capita daily, with a sewage contribution therefrom of 100 U.S. gallons per capita per day, to which has been added a ground-water allowance of 1,000 U.S. gallons per acre per day, and a further allowance of 100 U.S. gallons per capita per day to cover drainage which enters the existing sewers from the rural districts back of the city.

The estimated cost of the project is shown in Table 1, on the next page.

The existing sewerage system has two outlets, one in Richmond Street and the other in Park Street. There is a suitable site for a treatment plant just south of Park Street, which permits the use of a short interceptor line. A short outfall from the proposed treatment plant to the Detroit River will be required.

It has been estimated that the pumping station should operate automatically by means of electric power, and on

*Abstract from report of H. C. McRae, district engineer, to Prof. Phelps, consulting sanitary engineer to the International Joint Commission.