METERING AND WATER CONSUMPTION.*

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In considering the effect of the installation of water meters upon the consumption of water, and in comparing the usage in various cities, three elements, which may have an important bearing upon the results, are seldom taken into account. These are:—

1. Pressure upon the water system.
2. Extent of house connections with sanitary sewers, especially the use of bathtubs and water-closets.
3. Effective size of mains and services.

Pressure of Water System

When per capita rates of consumption are published or mentioned, how often is the average pressure at which the water is supplied included? It is a mistake to omit that item, as it is an important one. A city with a higher pressure than another will find that its leakage rate, both through fixtures and underground piping, will be greater than that of another one which maintains a lower average pressure.

In Oak Park the per capita rate of consumption is easily varied between one and two gallons per pound change in pressure within the entire range of rates of consumption. That is to say, 10 pounds' variation either way will make a difference of 10 to 20 gallons per capita daily. Thus the Oak Park rate of 65 gallons per capita at 45 pounds' pressure can be reduced to 45 gallons at 25 pounds. In Niagara Falls, where the per capita rate of consumption was 300 gallons per diem, exclusive of the industrial usage, the writer determined this rate to be from 3 to 5 gallons per capita per pound change in pressure, or 30 to 50 gallons per capita for each 10 pounds. The Niagara Falls consumption was about 6¼ times that of Oak Park, and the average pressure was about 60 pounds, which accounts for the different limits; but the principle is the same and its importance is clearly seen. The pumping units were designed for a maximum rate of consumption owing to the heavy drafts, and, as there were no small units provided, the effect of reducing the fixture leakage by the installation of meters and the house-to-house inspection was to boost the pressure at night some 30 pounds greater, or to 90 pounds; and the effect of reducing the leakage was not evident owing to the greater discharge of water through the remaining defective fixtures.

The following table shows one of the uses of water affected by pressure:—

A ¾-inch hose 50 feet long with nozzle at 60 lbs. consumes 5,000 gallons per day if in form of jet; at 30 lbs consumes 3,600 gallons per day if in form of jet; at 55 lbs. consumes 10,000 gallons per day if in form of spray; at 30 lbs. consumes 7,200 gallons per day if in form of spray.

These figures have been obtained from tables prepared by Manager Sullivan, of the Nashua, N.H., Water Co.

Connections with Sanitary Sewers

Another element which is noteworthy in its effect on water consumption is the use of water-closets and bath tubs, although the number of consumers on the line of pipes are often considered in computing per capita consumption. It is seldom that the number of consumers which have the use of faucets only are separated from those which have all the sanitary conveniences.

In Oak Park, from numerous experiments, we determined that the average number of gallons per capita consumed by water-closets where no leaks or waste existed was 20; while under the same conditions the average family consumed 15 gallons per capita through bath tubs. An interesting fact connected with the use of bath tubs is that a person who takes cold baths every morning is very likely to consume 40 gallons per day in this item alone. A psychological effect of the lack of pressure, consequently an increase in length of time required to fill bath tubs, oftentimes reduces the quantity of water used for baths.

The records from the following cities show the effect of the installation of sewers upon the general water consumption:—

City.	Before Installation of Sewers.	After Installation of Sewers.
Marlboro, Mass. .	21 g.p.d. per capita	38 g.p.d. per capita
Newton, Mass. ..	31 g.p.d. per capita	63 g.p.d. per capita
Waltham, Mass. .	32 g.p.d. per capita	70 g.p.d. per capita

In Madison, Wisconsin, the per capita daily consumption in residences with sewer conections was 68, while in residences without sewer connections it was 14.

In Rochester, N.Y., services with water-closets consumed 22 g.p.d. per capita; services with water-closets and no baths, 18 g.p.d. per capita; services with water-closets or baths, 14 g.p.d. per capita.

The limited extent of services and sewer connections in foreign cities, thus cutting down the number of outlets for consumption and fixture leakage, is responsible for the low per capita consumption in those cities. From figures obtained three or four years ago, it was noted that the large European cities of over 2,000,000 population had about as many service connections as the average city of 300,000 in this country, while the number of services in foreign cities of about 350,000 population equalled that of our cities of 40,000 population.

Effective Size of Services and Mains

The data on this subject is limited, but difficulty is experienced through loss of pressure by friction from the reduced area of corroded lime-coated service pipes and water pipes filled with algae, crenothrix and tubercles, indicate the importance of the effective size of service pipes and mains on leakage and waste. Water bills on metered premises in which leakage and waste exist often double in size after the renewal of service pipes, both in the ground and in the interior of the house especially when iron pipe has been replaced.

The following table compiled from some experiments conducted by the New York Department of Water Supply, Gas and Electricity, throws more light upon the subject:—

Pressure in street mains required to give the tabulated discharge through a corporation cock and 30 ft. of lead service pipe.

Gals. per Min.	1-in. Service.	¾-in. Service.	⅝-in. Service.
5	.....	2 lbs. sq. in.	3 lbs. sq. in.
10	.....	5 lbs. sq. in.	10 lbs. sq. in.
15	3 lbs. sq. in.	11 lbs. sq. in.	23 lbs. sq. in.
20	5 lbs. sq. in.	18 lbs. sq. in.	38 lbs. sq. in.
25	8 lbs. sq. in.	28 lbs. sq. in.	54 lbs. sq. in.

This table also gives the difference between the pressure at the main and the house side of the service under pressure.

Use of Water Meters

Having considered the items which affect domestic water consumption as governed by local conditions irrespective of industrial and other usually recognized conditions, we may now discuss the meter question.

Can one imagine a gas company or an electric utility selling its commodity without measuring it? Doubtless though, it is easier to tolerate the waste of water because it is not seen or appreciated. Gas leakage is offensive and dangerous. Wasted electrcity is mainfested by motion, light or heat; but water disappears unnoticed into the sewers. Yet the speaker knows that in an Eastern city where electric-light current was sold under the flat rate system, electric-light bulbs on numerous porches remained turned on all day long. Queries brought the answer that it did not matter as there was no meter. What can the effect be on the water consumer of this type when the water consumption is not metered? In fact, in this same city, which

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