this trouble to cease. There are, however, many cases where copper sulphate cannot be used in sufficient quantities or where it is not useful at all. Where the percentage of sewage is very high, it will be found that there is much undecomposed and unprecipitated organic matter in the water, and to get really satisfactory results it must be consumed in some manner. Calcium hypoehlorite recommends itself but must be judiciously used, as a very faint excess would produce disastrous results in dyeing.

At Passaic, N.J., using Passaic River water, which runs about one million bacteria per cubic centimetre, or equal to ordinary sewage, it was found that with two parts per million of calcium hypochlorite and five hours' sedimentation the bacteria ranged from twenty-seven to one hundred per cubic centimetre, and that so long as the hypochlorite was used there was no tendency whatever of the sludge at the bottom of the basin to ferment.

In most plants the amount of calcium hypochlorite employed ranges from one to three parts per million. Where fermentation is interfering with sedimentation it must be applied as the water enters the sedimentation basin but if sedimentation is reasonably good an economy can be effected by applying the calcium hypochloric after sedimentation is completed. By following this procedure much of the oxidized matter that would be precipitated by the alum has settled to the bottom and the principal oxidizing activity of the hypochlorite is directed against the dissolved matter and the bacteria.

Another action of the calcium hypochlorite is to decolorize the dyes that may have resisted action of the aluminum sulphate. This action, however, is not especially important as the strength required to produce this result is usually greater than is safe to use.

Needless to say, the treated water must show no trace whatever of free calcium hypochlorite and the only logical way of attaining this result is to keep the quantity of chemical applied at such a point that its energy will be entirely expended upon the organic matter. An accurate chemical feed is of the utmost importance when using the calcium hypochlorite.

With certain waters it is found that although a suitable degree of precipitation is obtained by the use of the aluminum sulphate the precipitate is of a flocculent, buoyant nature and will not settle. In fact it has a tendency to come to the surface of the water. On examination it will be found that the buoyant tendency of the precipitate is due to small bubbles of carbonic acid gas given off in the reaction between the sulphate of alumina and the earthy carbonates. If the water is soft this tendency is corrected by adding either shortly before the application of the aluminum sulphate, or shortly after, a small quantity of calcium hydrate.

The quantity of water required in the various industries is very great in comparison to the requirements of municipalities. For instance, a supply of two million gallons per day would furnish a town of 20,000 inhabitants, a small paper mill of say twenty tons daily output, a very small bleachery, or a small silk dye-works. The largest silk dye-works in this country consumes 23,000,000 gallons of water per day and a contract has just been let for a bleachery in the New England States requiring a filter plant having a capacity of 36,000,000 gallons per day. This is approximately the amount of water used by the city of Philadelphia west of the Schuylkill. These figures seem stupendous to the person who has not studied industrial requirements.

A pound of muslin, or similar cotton fabric requires in the bleaching process about twenty-seven gallons of water. A pound of paper requires about fifty gallons of water, and a pound of silk not less than one thousand gallons of water. Moreover, many of these processes in which water occupies such an important part include very delicate chemical reactions in which strong acids and alkalis play their part.

There are two kinds of filters, pressure and gravity. Really they are identical in operation, the only difference being in their application. The pressure filter is the same device as the gravity filter, excepting that it is placed in an enclosed steel tank and operates under whatever pressure the service main may carry, delivering its water filtered and still under pressure with a loss of head ranging from two to ten pounds, depending upon the make of filter.

The gravity filter on the other hand relies upon the weight of water on it to drive the water through the bed and the water is discharged at the bottom under no pressure.

Taking the detailed parts of a gravity filter plant for an example, we find that they consist of a chemical feed, a settling basin with the necessary baffles, the filter proper and the machinery for washing the filter. As the consumption of every industry varies more or less from moment to moment there are fluctuations in the rate of flow of the raw water coming to the settling basin. The chemical feed must be an apparatus that will regulate whatever chemicals are being applied to meet this fluctuation. For instance, if the feed is set to apply two grains of sulphate of alumina and one-eighth of a grain of calcium hypochlorite per gallon of water it must do that and exactly that, whether the plant is running at full speed, one-quarter speed or a twenty-five per cent. overload. It is a small but vital part of the entire plant and might be compared in its way to the governor of a steam-engine. Of course, chemicals are applied in the form of solutions of a definite strength.

The water after receiving its dose of chemicals flows through the settling tank in a continuous process, in at one end and out at the other. To stop the tendency of the water to flow directly across the basin from inlet to outlet leaving a large eddy on either side, baffles are placed so as to compel the entire body of water to take a circuitous course through the basin. Much of the solid substance in the water has already been coagulated by the action of one set of impurities upon another, and the applied chemicals have produced further precipitation and have, moreover, gathered together the finer particles and suspended matter into comparatively large masses so that all settle with considerable rapidity toward the bottom of the basin, where they remain until such time as it is convenient to remove them.

The three essential parts of a filter are the case, the filter bed proper and the strainer system, which consists of a series of pipes leading to all parts of the bed terminating at their outer end in strainers or sand valves, devices which have slots or perforations of too small size to permit the sand to pass through, but sufficient in number to allow a definite quantity of water to leave the sand bed.

Calcium hypochlorite, chloride of lime or bleaching powder, as it is variously known, on being mingled with the organic matter is decomposed into calcium chloride, and ozone is liberated in sufficient quantities to produce the necessary oxidization. Calcium chloride, being an inert salt and existing in such minute quantities has no significance from any industrial standpoint whatever. We thus see elimination of the applied chemicals or their metamorphosis into harmless and insignificant substances.

In addition to economy in the use of chemicals the other costs of operation, such as attendance, power, etc., must be reduced to a minimum. One hour per day for each million gallons of water treated is sufficient to cover the attendance of a well designed industrial plant. The sedimentation basins are so arranged that the sludge drains into a channel