day, is only 0.33 foot per second. In this chamber the coarser and heavier part of the suspended matter is deposited, the amount removed depending upon the character of the suspended matter, as well as upon the amount present in the water. The efficiency of the grit chamber is shown in the fineness of the material removed, over 50 per cent. of the matter deposited passing a 100-mesh sieve. The tons of matter removed by the grit chamber during the past year was 63,703, or 23 per cent. of the total suspended matter present in the water.

Chemicals Pumped to Mixing Chamber

Leaving the grit chamber, the water flows through a short conduit to the mixing chamber, where milk of lime and a solution of sulphate of iron are added. These chemicals are prepared in the coagulent house for addition to the water, and are pumped a distance of 900 feet to the mixing chamber.

The lime is weighed out in automatic scales, and is dumped into circular slaking tanks, which are provided with revolving rakes. The temperature of the milk of lime in the slaking tank is kept at 200° F. This is accomplished by keeping up the temperature of the fresh water supply by passing it through the coils of a heater tank into which the milk of lime at 200° is drawn. From 4 to 4½ pounds of water per pound of lime are used in slaking. The water overflowing from the water tank is run into a cooling and diluting box, where the temperature is reduced to as low as 64° in winter time to 108° in summer. The strength of the milk of lime as pumped is 38,600 parts per million of CaO.

A slaker tank is kept in service until the accumulated unslakeable material is great enough to impede the motion of the rakes. From 50 to 150 tons of lime are slaked before a tank is taken out of service, the amount depending upon the purity of the lime. Tests made to determine the effect of limes of varying percentages of CaO upon the amount of lime that could be slaked before a slaking tank had to be taken out of service showed that for every increase of 1 per cent. in the available CaO, above the lowest lime tested, an additional 10 tons could be slaked. Contracts for lime are let under a specification requiring a lime of 85 per cent. CaO, with a bonus or penalty of 1.5 per cent. for each 1 per cent. above or below the required 85 per cent.

The Mixing Conduit

The sulphate of iron is measured by passing it through an adjustable orifice on to the surface of a cylindrical drum, revolving at a constant speed, and is discharged in a continuous flow into a tank, where it is dissolved without stirring by water entering through a manifold at the bottom of the tank, the solution being drawn off through an overflow.

The mixing conduit, into which the chemicals are delivered, is a reinforced concrete box, 2,382 feet long, 32 feet 1 inch wide and 12 feet 6 inches high, divided longitudinally into four compartments, each 7 feet wide and 11 feet high. The four compartments are supplied with stop-plank openings so that they may be thrown in parallel, used in series or withdrawn from service for cleaning. In normal operation the water enters the west channel and travels the full length four times, a total of 9,528 feet, having an average velocity of 3.3 feet per second when the rate of pumping is 150,000,000 gallons a day.

Provision is made so that the lime or iron may be added to either of the four compartments, but the lime is added, for the greater part of the time, to the raw water as it enters the mixing conduit and the sulphate of iron as it leaves the conduit. The period of mixing averages about one hour. The sides and bottoms of the first two compartments are bady coated; the coating on the sides is practically all calcium and magnesium carbonate, and magnesium hydroxide while the bottom coating consists of the sand and unslakeable material present in the lime added bound together by the precipitated calcium carbonate and magnesium hydroxide.

The value of the mixing chamber is shown by an occurrence of last year. A leak in the south end of the mixing conduit, due to the failure of the contractor to properly plug a drain, caused the conduit to be taken out of service. The water was passed from the delivery well direct to the first of the sedimentation basins the sulphate of iron being added in the tunnel at the coagulent house and the milk of lime at the delivery well.

Value of the Mixing Chamber

The turbidity of the water in the delivery well was 2,500 at the time and the turbidity of the water in the last of the sedimentation basins was 20, the amounts of chemicals added being 6.25 grains of lime per gallon and 0.25 grain of sulphate of iron. After the mixing conduit was taken out of service, the sulphate of iron was increased to 2.50 grains per gallon, the lime remaining the same. In forty hours the turbidity of the water, in the last of the sedimentation basins, increased to 40, the turbidity of the river water remaining practically the same as on the preceding days. By adding ten times the amount of sulphate, the results were still inferior to what was accomplished with the mixing conduit in use. The additional cost due to the use of a larger amount of sulphate of iron while the conduit was out of service, one and one-half days, was $390.

The points of application of the milk of lime and sulphate of iron depend upon the condition of the raw water. With a water high in color and low in turbidity the iron is added before the lime with good results. If the high color is accompanied by a turbidity of 200 to 300 parts per million, better results are obtained by adding the sulphate of iron as the water leaves the mixing conduit. With high turbidity the lime is always added at the first opening and the sulphate of iron at the last. With low color and low turbidity due to colloidal matter, the sulphate of iron is added at the third opening, which allows a mixing through one-half of the conduit. At times, with finely divided suspended matter in our raw water, the only sedimentation that takes place is accomplished in the first basin, the turbidity of the water in the last of the sedimentation basins being as great as that of the water leaving the first basin.

Color is Increased Sometimes

With high stages in the Mississippi and Illinois Rivers and a low stage in the Missouri, we encounter our worst condition. The high color of the Mississippi, together with the colloidal matter in the Illinois, make a water hard to handle. The use of sulphate of iron as a coagulant at these times is accompanied by some difficulty. The coloring matter of the water combines with the iron, and instead of a diminution in color, the color is increased. The suspended matter being really colloidal and some of the iron hydroxide remaining in the colloidal condition, the turbidity of the water after sedimentation is greater than that of the river. This highly-colored and turbid water is much less amenable to treatment with sulphate of alumina. The amount of sulphate of alumina required to give the required flocculation of the suspended