age, for the production of hypochlorite with its sterilizing effect. It will be noted that the lime solution used is introduced at a point above the carbon and just below the iron electrodes, for the reason that the electric current passes by way of the electrolyte which predominates, or which is more easily ionized, and the presence of the lime in the passive carbon electrodes would result in the dissociation of calcium hydroxide, rather than the sodium chloride, and no sodium hypochlorite would be liberated.

Description of Electro-Chemical Apparatus.—In the old process the sewage on entering the receiving well at the Elmhurst plant passes through a perforated metal screen with 5/8 in. circular openings, and is pumped to the level of the sedimentation tanks, from which it flows by gravity to sand filter beds. There are four of these old sedimentation tanks used in series, each holding about 65,000 gallons, and enclosed under the roof of the building.

In preparing for the tests on the new electrolytic process, the apparatus was placed on a temporary platform built over one end of the first tank in the old series above mentioned. This platform has a floor area of 18 x 24 ft., which provides sufficient room for a 2-in. centrifugal pump and motor, the electrolytic machine, lime solution tank, effluent sedimentation tank, platform scale and laboratory table. The pump was required only for the purpose of lifting the sewage treated to the higher level above the flow of the old tanks. A 3/8-in. perforated screen is used on the suction line of this pump. The electrolytic machine used is erected vertically, the sewage flowing through the bottom to top, the electrodes being entirely enclosed. It stands 7 ft. 3 in. high from the floor to its outlet pipe flange and is 24 in. x 18 in. in cross-section. The cypress frame enclosing the electrodes is 4 ft. 10 in. high, sets on a cast iron base, which holds also the motor-generator set, is capped with the outlet casting which is bolted through to the base by outside bolts at the four corners. The electrodes are set horizontally one above the other. At the bottom of the electrolytic machine one bank of 10 carbon plates, or electrodes, are placed and connected in series, and above this are four banks, each consisting of 12 iron electrodes. The alternate iron electrodes are connected in groups of three and these groups are then connected in series. The one bank of carbon plates is parallel with the whole set of iron electrodes, so that 9/10 of the current is taken by the carbon and 1/10 by the iron electrodes. The iron plates are connected so as to be automatically short-circuited to a zinc plate in the top when the operating current is shut off. A volt meter and an ammeter are attached to the front of the machine. The motor of the generator set furnishing direct current for the electrodes also rotates two 3/4-in. vertical square steel shafts connected by gearing to the motor shaft. These vertical shafts carry paddles which operate between the electrodes continuously. The shafts are made in sections just long enough to pass through a single bank of electrodes and the sections are keyed together in the spaces between each bank. This arrangement supplies two paddles in each space between the electrodes and they are rotated in opposite directions, one slightly in advance of the other, with high mechanical efficiency since the water pressure generated by one aids in driving the other. The paddles are made of material which is non-absorbent, non-conducting and very durable. In this machine they are 9 in. long, 1/4 in. thick and 2 1/4 in wide at the centre, tapering to 1 1/8 in. at each end, while the shaft opening at the centre is a 3/4 in. square.

The iron electrodes are made of a certain grade of low carbon steel and are 10 in. x 16 in. x 3/16 in. thick and spaced 3/8 in. apart. An opening is left at one end of the lower plate in each bank for the entrance of the sewage or water, which then is divided by the plates into thin films as it passes on to the next bank of electrodes. A space of 3 inches between each bank or section of electrodes facilitates the connection of the paddle shaft sections as they are inserted with each tank of plates when the machine is erected.

Lime Tank.—The lime solution tank used is 3 ft. x 5 ft. and 3 ft. deep, holding about 336 gallons. Lime solution is introduced into the electrolytic machine just above the carbon electrodes and mixes with the sewage as it passes from the carbon to the iron plates. In this instance a small plunger pump electrically driven was used to inject the lime, as there was not sufficient head room to secure a gravity flow into the machine. From the electrolytic machine the sewage flows through a weir box to provide means of measuring the quantity treated. This box is 23 in. x 37 in. x 17 in. deep, with a 3-in. pipe outlet into the sedimentation tank.

Sedimentation Tank.—A small sedimentation tank is provided to take the flow from the electrolytic machine. Its outside dimensions are 11.5 ft. x 7 ft. x 5 ft. and was built as a two-story tank with a false bottom sloping from a line 2 ft. below the top on one side, down to the front bottom edge, but as septic action plays no part in this process, the effluent is permitted to pass through the sedimentation slot and emerge from the 6-in. space between the side of the upper compartment and the outside wall of the tank. This space is usually provided for the escape of septic gases in biological processes when it would be filled with decomposing sewage. Notwithstanding the unsuitableness of the design, this tank has served as well as any, inasmuch as any form of tank properly baffled and with convenient means for removing the sludge, is all that is needed. Its effective capacity is only 1,550 gallons, which, at the rate of 25,000 gallons per day, gives a theoretical retention period of 1/2 hour. However, tests have shown that the clarified effluent leaves this tank in from 10 minutes to 1 hour. This was conveniently tested by the introduction of phenolphthalein, which holds its pink color in the slightly alkaline effluent throughout the flow through the tank. The strongest traces of color usually emerge in about 1/2 hour.

The time of flow through the electrolytic machine when 25,000 gallons per day were being treated, averaged about 2 minutes, though the first traces of color showed in 1 minute and all color of the indicator used had disappeared in 3 or 4 minutes.

The weir box was calibrated by means of a scale fastened to the inside. The flow was measured by weighing the effluent on a platform scale, and a curve was plotted to indicate the number of gallons treated per day for each reading on the scale in the weir box.

The quantity of sewage treated was generally held at 25,000 gallons per day to suit the capacity of the lime tank and the small sedimentation tank and also to maintain uniform character in the effluent, which, after settling in the small tank, was run into the large plant tank below, and there retained for observation.

Amount of Lime Required.—The amount of lime used will vary in each case with the normal free and half-combined carbonic acid contained in the sewage. The softer the water of the public supply, the less the amount of lime required for purification. The lime used at Elmhurst averages about 1,200 lbs. per 1,000,000 gal.