which is only apparently complicated. The electro-chemical equivalent of one ampere is 1.32 grams of chlorine per hour. Corresponding molecular quantities of sodium hydroxide and hydrogen are simultaneously produced. This chlorine is, of course, all "available." A simple calculation upon the basis of the two reactions will now show that reaction (1) will produce from 1.32 grams of chlorine, 1.39 grams of NaOCl having, as already shown, an "available chlorine" value of 95.2%. The "available chlorine" is, therefore, as in the beginning, 1.32 grams. Making the same calculations upon reaction (2) it is evident that from an initial chlorine value of 1.32 grams the hypochlorite produced would be 2.78 grams, with an "available chlorine" content of 2.64 grams. If this is not evident (without further proof), conceive the addition of hypochloric acid to the products of reaction (2):

$$NaOCl + 2HCl = NaCl + H_2O + 2Cl.$$

The process yields then twice the amount of chlorine with which is started or has an efficiency of 200% based upon electro-chemical equivalents.

As stated previously, the whole matter rests upon the definition of that very unsatisfactory term, "available chlorine," but accepting the common use of the term there can be no excuse for misunderstandings.

Of course hydrogen gas is copiously given off from the cell. The primary electrolytic reaction involves an evolution of hydrogen equivalent to the chlorine produced. If, after this reaction has taken place, reaction (2) should result between the products, then the total amount of hydrogen evolved would be double the amount of chlorine produced, and again the law of electro-chemical equivalents would have been violated.

The writer appreciates the candor of Mr. Shenton's discussion and makes this further explanation with the single purpose of establishing the true facts.

YORKTON COMPRESSED WATERWORKS SYSTEM.

Sir,—I notice in the issue of the Canadian Engineer of April 29th, a letter from "Municipal Engineer" suggesting that further information in connection with the Yorkton Waterworks System might be of some value.

The source from which Yorkton obtains its water supply is from two large wells 15 feet in diameter and from 35 to 40 feet in depth, and also from a number of points about 55 feet in depth which pierce a gravel strata below that which furnishes the water to the large wells. These wells are situated just at the rear of the pumping station.

The distribution system at present consists of 100 feet of 10-inch main; 2,600 feet of 8-inch main; 13,000 feet of 6-inch main; 12,000 feet of 4-inch main, and 46 fire hydrants.

The point was raised by "Municipal Engineer" that where pressure was supplied by mechanically compressed air instead of natural gravity, the actual cost of the pumping must necessarily be increased by the extra machine employed. This is very true, but is a comparatively small item, and is more than counterbalanced by other advantages.

In order to secure the compressed air, it necessarily requires the installation of an air compressor, but very little mechanical energy is consumed by this machine after the storage tanks have once been charged.

The air compressor in Yorkton has not been in operation more than half a dozen times during the past twelve months, and then only for a few minutes each time.

The best possible way to compare the compressed air system with the stand pipe system is to take an example of a particular case, for instance;

The Yorkton Waterworks plant has two storage tanks which have a capacity of over 2,400 cubic feet each. Allowing the half of this capacity for the compressed air, and half for the water, will give a water capacity of 1,200 cubic feet in each tank or a combined water capacity of 2,400 cubic feet, or a little over 15,000 imperial gallons. The tanks are first filled with compressed air to a pressure of 30 pounds, then water pumped against this pressure until the tanks are half full when the pressure has risen to about 65 pounds; we then have the use of 15,000 gallons of water between the pressures of 30 and 65 pounds (as we are able to make use of every drop of water in the tanks without the pressure going below 30 pounds.)

Take another example of a stand pipe located at the pump house. Merely for the sake of comparison, assume the inside diameter of the stand pipe to be 6 ft. 3 inches. This stand pipe would have to be 150 feet high in order to produce a pressure of 65 pounds per square inch when full to the top. The water would have to be pumped to a height of 70 feet before a pressure of 30 pounds per square inch could be reached, and consequently this column of water could not be made use of above the pressure of 30 pounds, and the remaining 80 feet would hold the same amount of water as the two compressed air tanks spoken of above, namely, 15,000 gallons.

I am not prepared to say off-hand the amount the above stand pipe would cost, but it would be in the neighborhood of $6,000.00 at least in this country, while the two storage tanks would not cost, at most, over $2,500.00 installed and ready for use. This shows a decided advantage from the one point of first cost, not to mention the elimination of the ice difficulty, the supply of water to the mains at a more even temperature throughout the whole year, and the compactness and appearance of the plant, which was dealt with in your issue of April 13th.

One will readily see the value of a compressed air system in a locality where the water supply is limited, as every gallon of water which can be secured can be supplied to the mains under pressure.

I might say that our system in Yorkton is rated as first-class by the underwriters.

I trust this will explain the points referred to by "Municipal Engineer," but I will be pleased to give any further information at my disposal regarding the compressed air system to any one who might enquire.

Yours truly,

F. T. McArthur,
Town Engineer.

THE PROBLEMS OF WINTER NAVIGATION ON THE ST. LAWRENCE RIVER.

By H. T. Barnes, D.Sc., F.R.S.C., Macdonald Professor of Physics and Director of the Physical Laboratories, McGill University.

In all northern countries, where the average winter temperature is below the freezing point, the water becomes frozen and attempts to continue navigation are made with great difficulty. As population increases and demands for cheaper and more effective communication grow, the question arises as to the feasibility of preserving the waterways. Hitherto, in Canada, this matter has not been found to be of very serious moment, except in one or two instances. Winter navigation has been maintained for many years across the

*The "Urimak" has recently had the bow propeller removed as it is of little use in the Arctic ice.