COST OF WATER SOFTENING BY LIME.

The members of the Metropolitan Water Board, London, England, have recently issued a pamphlet under the title of "Eighth Report on Research Work," by Dr. A. C. Houston,

(10,000 gallons=100,000 lbs.)

Temporary hardness of water as carbonate of lime, or its equivalent in soap destroying power, parts (or lbs.) per 100,000 parts (or lbs.) = lbs. per 10,000 gallons (100,000 lbs).	Cost of quicklime (10 lbs. = 2¢.) and the amount to be added to soften the water.					
	Theoretically, that is 1 lb. of carbonate of lime requires ·56 lb. quicklime.		Practically, that is assuming that from ·75 to 1·0 may actually be required (owing to free CO_2 inert lime, &c.)			
			BASIS 1. 1 lb carbonate of lime requires ·75 lb. quicklime.		BASIS 2. 1 lb. carbonate of lime requires 1 lb. quicklime.	
	lbs. lime.	cents.	lbs. lime.	cents.	lbs. lime.	cents.
1	·56	·112	·75	·15	1	·2
2	1·12	·224	1·50	·3	2	·4
3	1·68	·336	2·25	·45	3	·6
4	2·24	·448	3·00	·6	4	·8
5	2·80	·560	3·75	·75	5	1·0
6	3·36	·672	4·50	·9	6	1·2
7	3·92	·784	5·25	1·05	7	1·4
8	4·48	·896	6·00	1·2	8	1·6
9	5·04	1·008	6·75	1·35	9	1·8
10	5·60	1·120	7·50	1·5	10	2·0
11	6·16	1·232	8·25	1·65	11	2·2
12	6·72	1·344	9·00	1·8	12	2·4
13	7·28	1·456	9·75	1·95	13	2·6
14	7·84	1·568	10·50	1·1	14	2·8
15	8·40	1·680	11·25	1·25	15	3·

and a perusal of its contents would leave an impression that this board had spent considerable time since the issue of the seventh report on the financial economics of softening and sterilization of water and of the effects of time on bacteriological and pathogenic organisms when treated with germicidical agents of varying strengths.

The method of softening water with lime may be explained by the following equation:—

Bicarbonate of lime.		Quick lime.		Carbonate of lime.		Water.
$CaO, CO_2\ H_2O, CO_2$	+	CaO	+	$2\ CaO, CO_2$	+	H_2O
100 62	+	56	=	218	+	18

Fifty-six parts of quicklime (CaO) are required to combine with 62 parts of hydrated carbonic acid (H_2O, CO_2), holding the 100 parts of carbonate of lime in solution. As the hardness of a water, however, is expressed in terms of carbonate of lime, 0.56 part of quicklime is required to precipitate 1 part of carbonate of lime.

In practice considerably more quicklime is required, because the free as well as the combined carbonic acid in the water has to be acted upon and, in addition, part of the quicklime (CaO) may have become hydrated (CaO, H_2O), and therefore less active weight for weight, and part may be inert (carbonate or impurities), and, further, the mixing operations may be imperfect.

The free carbonic acid, of course, is a constant factor, for all degrees of hardness, which it is sought to remove.

The accompanying table shows the working cost of softening 10,000 gallons of water with quicklime, irrespective of interest on capital expenditure, depreciation, labor, etc., and is based on a price of $4.80 for a ton of lime. Lime in this country is somewhat higher, so that this must be allowed for.

The cost remains the same whether quicklime or slaked lime is used, but the above weights of quicklime must be multiplied by 1.32 to obtain the comparative effective weights of slaked lime.

The above results are expressed as parts (or lbs.) per 100,000 parts (or lbs.), which is the same as lbs. per 10,000 gallons. To convert into grains per gallon and "degrees" of hardness, multiply by 7 and divide by 10. No account is here taken of permanent hardness, which requires a different kind of treatment for its removal.

The wastage of lime due to free carbonic acid being a constant factor, the figures in the last two columns are only approximately correct—thus the wastage at 1 and 15 (due to CO_2) being the same, it is proportionately cheaper to soften to 15.

To take an example:—A water has a total hardness of 21, the permanent hardness being 7 and the temporary hardness 14. It is required to soften 10,000 gallons from 21 down to 11 (i.e., 10 parts). The amount of quicklime required would be, theoretically, 5.6 lbs. (costing 1.12 cents), but practically about 7.5 (costing 1.5 cents) to 10 lbs. (costing 2 cents) would be needed. Erring somewhat on the side of exaggerating the cost, it may be said that 10 lbs. of quicklime, costing 2 cents, would be needed to reduce the total hardness from 21 down to 11 (10 parts) for every 10,000 gallons of water treated.

A NEW BRONZE.

The great strength necessary for bronze used in the construction of machinery, the keen competition existing between manufacturers, and the wide fluctuations in the price of tin, have induced metallurgists to study the question of substituting for the rather expensive tin bronze some special brass compositions (so-called zinc-bronzes) which not only have the advantage of being cheaper, but also surpass the tin bronze, so far as the breaking strength and elongation quality are concerned, at the same time offering the same resistance to attacks by acids.

The fact that despite the aforementioned advantages claimed for zinc bronzes, tin bronze still obstinately keeps its ground in most of the large foundries and in nearly all the minor ones, is unquestionably due to rather serious drawbacks, which even the best zinc bronzes, so far known, present along with their above-mentioned advantages.

The principal drawbacks may briefly be summarized as follows:

These zinc-bronzes generally have a very complex composition, mostly containing addition of metals not easily fusible and which unite only with great difficulty. On account of these two features the preparation of the alloy can only be carried out in a very complicated and expensive way, often even necessitating the separate preparation of distinct compositions, so-called "preparatory alloys."

The zinc-bronzes have a strong tendency toward separating when cooling down in the mould: the so-called "sweating" (liquation) takes place, which destroys the homogeneity of the smelted metal, the splitting tendency of which increases, whereas its chemical stability greatly suffers.