fore the mass was released for placing. In all concrete work poured for the district special attention was given to the securing of a concrete as free from airholes and stone pockets as possible by working and spading the mass continuously during the pouring of any particular section. In concrete in which soap and aluminum sulphate were used it was found that, after setting, the top of the concrete was covered for a considerable depth with a powdery material which had no cohesion, being readily crushed in the hand. This layer of material had to be removed and the concrete cleaned free from such material before a good bonding surface could be secured for further pouring. The spading of the concrete had caused the fine precipitates to come to the surface, possibly along with some laitance and some of the very fine sand of the aggregate. As it was considered better to leave out the chemicals than sacrifice the spading, the use of soap and aluminum sulphate was discontinued.

To obtain some data as to the effect of alkali solutions on mortar treated with soap and aluminum sulphate, a series of mortar tests was made. We made 1:2 and 1:3 mortars, using the same sand throughout. One set was made without chemicals; one set contained one per cent. aluminum sulphate and one per cent. soap; and another set contained one per cent. aluminum sulphate and seven per cent. soap. The chemicals were added as a percentage of the mixing water used. One complete series was cured 24 hours in the moist closet, and one set cured 48 hours in steam at 150 degs. F. These briquettes were placed in 10% $MgSO_4$ solution and in 10% Na_2SO_4 solution and in distilled water.

Briefly the results of tests were as below:—

The only mortar which resisted the attack by the alkali solutions was the 1:2 mortar without addition of chemicals and cured in a moist closet. The steam curing caused even this mortar to disintegrate. Action on the steamed briquettes was greater than on those not steamed. The addition of the soap and aluminum sulphate decreases the strength of the mortars and renders them more liable to disintegration. The sand used was similar in grading to the Indian Bay sand used in the first series, previously referred to. It is a sand giving mortars of relatively low density.

The addition of bulky chemical precipitates due to the soap and aluminum sulphate reactions greatly disturb the density of mortars from this sand. It must not, however, be assumed that a reduction in density means a more porous mortar, since the addition of cement to a mortar usually reduces its density but greatly decreases its porosity. The bulking effect of the precipitates, however, is worthy of note. The photographs illustrate the effect of the solutions on the briquettes.

Before concluding this paper I would refer to some of the most recent work of Prof. Abrams, regarding the effect of excess water on concrete mixtures. See Figure 7. You will note that a rich mix does not necessarily insure good concrete, since everything depends on the amount of water used. Professor Abrams argues that the grading of an aggregate is a secondary consideration and is only a means to an end. For instance, he says the reason why a rich mix gives a higher strength than a lean one is that a workable concrete can be produced by a quantity of water which gives a lower ratio of water to cement. If an excess of water is used we are simply wasting cement. Rich mixes and coarse, well graded aggregate are as necessary as ever but we now know how these factors affect the strength of the concrete. It

Effect of Sand Content on the Strength and Absolute Density of Concrete from McCorkel Pit Materials

Sand—Passing 1/8" Sieve Stone—Held on 1/8" Screen and Passing 2 1/2" Diam. Holes

Mix by Wt.	Per Cent. Sand	Density	Strength	Wt. per Cu. Ft.
1 Part Cement to 6 Pts. Aggreg., or 14.3 Per Cent. of Cement				
1:1:5	16.7	.838	3640	152 lbs.
1:2:4	33.4	.824	3160	150 "
1:3:3	50.0	.809	2920	147 "
1:4:2	66.7	.786	2520	144 "
1:6 mortar	100.0	.711	1140	133 "
1:7 Aggregate or 12.5 Per Cent. Cement				
1:2:5	28.6%	.838	2850	150½ "
1:3:4	43.0	.818	2570	148 "
1:4:3	57.2	.787	2040	144 "
1:8 Aggreg. or 11.1 Per Cent. Cement				
1:2:6	25.0%	.851	3030	153 "
1:3:5	37.5	.830	2540	160 "
1:4:4	50.0	.816	2180	147½ "
1:5:3	62.5	.780	1274	144 "
1:9 Aggreg or 10 Per Cent. Cement				
1:3:6	33.4%	.842	2490	151 "
1:4:5	44.5	.825	1965	149 "
1:3½:5½	39.0	.833	2250	149 "

Action of Sulphate Solutions on Mortars Treated with Soap & Aluminum Sulphate

Briquettes immersed in Solutions 8 Months

No	Composition of Mortar	Absolute Density	Tensile Strength: 24 Hrs. Moist Closet & 48 Hrs. Steam @ 150° Age 3 Days	Tensile Strength: 8 Months in Distilled Water	Cured 24 Hours in Moist Closet: 10% Sodium Sulphate Solution: Strength of Individual Briquettes				Average Lbs/□"	External Condition of Briquettes	Condition of Centre Section	Cured 24 Hours in Moist Closet: 10% Magnesium Sulphate Solution: Strength of Individual Briquettes				External Condition of Briquettes	Condition at Central Section
9	1:2 No Chemicals	0.685	—	512	540	520	530	595	546	No apparent action	No apparent action	605	430	365	655	No apparent action	No apparent action
10	1:3 No Chemicals	0.687	—	306	265	295	270	300	282	No apparent action	No apparent action	145	285	190	—	No apparent action	Completely penetrated with alkali
11	1:2-1½ Al_2SO_4+1½ Soap	0.652	—	527	420	295	405	395	379	No apparent Action	No apparent action	145	—	—	—	Swollen Distorted and Disintegrated	Penetration of Alkali greater at ends than centre section
12	1:3-1½ Al_2SO_4+1½ Soap	0.643	—	323	300	340	360	315	329	No apparent Action	No apparent Action	—	—	—	—	Swollen Distorted & Cracked the briquette Disintegrated	Complete penetration of Alkali & Internal Cracks
13	1:2-1½ Al_2SO_4+7½ Soap	0.612	—	445	235	290	260	220	251	No apparent Action	No apparent Action	105	90	398	—	Swollen and Disintegrated at ends	Completely penetrated with Alkali
14	1:3-1½ Al_2SO_4+7½ Soap	0.620	—	297	230	235	240	220	231	No apparent Action	No apparent Action	—	—	—	—	Swollen — Distorted and Disintegrated at ends	Completely penetrated with Alkali
	Cured 24 Hours in Moist Closet and 48 Hrs. in Steam at 150°F.																
9	1:2 No Chemicals	0.685	360	514	500	510	385	440	459	Cracking at Ends	No apparent Action	170	290	—	—	Swollen (cracked and disintegrated at ends	Completely penetrated with Alkali
10	1:3 No Chemicals	0.687	240	340	0	220	260	190	223	Cracking at Ends	Penetrated with Alkali	—	—	—	—	Swollen — Badly cracked distorted & disintegrated	Completely penetrated with Alkali
11	1:2-1½ Al_2SO_4+1½ Soap	0.652	320	444	340	395	275	415	356	Two Briquettes only Cracked at Ends	No apparent action	—	—	—	—	Swollen — Disintegrated at ends	Penetrated with Alkali but Hard
12	1:3-1½ Al_2SO_4+1½ Soap	0.643	225	401	376	300	285	335	324	Small Crack on one Briquette Only	No apparent Action	—	—	—	—	Swollen — Cracked Distorted & Disintegrated	Completely penetrated with Alkali
13	1:2-1½ Al_2SO_4+7½ Soap	0.612	226	433	250	300	275	275	275	Cracking and Disintegration at ends of 4 Briquettes	No apparent Action	75	—	—	—	Swollen — Cracked & Distorted	Completely penetrated with Alkali
14	1:3-1½ Al_2SO_4+7½ Soap	0.620	213	339	285	260	355	240	285	Cracking and Disintegration at ends of 4 Briquettes	One briquette penetrated with Alkali other partially penetrated	170	95	—	—	Swollen — Cracking and Disintegration at Ends	Completely penetrated with Alkali

Tested approximately after Steaming

Notes:— Grading of Sand used — Percentage Retained on Sieves #10-2½, #20-17½, #40-67½, #75-12½, #100-1½ Thro. #100-1½ Total 100% Carbonates in Sand = 35%

Quantities of Al_2SO_4 and Soap are expressed as a percentage of the Mixing Water used. Mortar proportions are by Weight.

For 1:2 Mortar 125 ccs. Water, 1.25 gms. Al_2SO_4 and 1.25 gms. of Soap were added to 2½ lbs. Dry Sand and Cement } for 1½ Al_2SO_4 & 1½ Soap

For 1:3 Mortar 93 ccs. Water, 0.93 gms. Al_2SO_4 and 0.93 gms. of Soap " " " 2 lbs. " " " Cement }

Expressed as a Percentage of the Dry Sand + Cement No 11 contains 0.122% Al_2SO_4 and 0.122% Soap — No 12 contains 0.102% Al_2SO_4 and 0.102% Soap

No 13 " 0.122% " 0.857% Soap — No 14 " 0.102% " 0.717% Soap

Most of Briquettes acted on by Magnesium Sulphate Solution were Swollen and could not be tested for Tensile Strength