



# FATS AND PROTEINS RESEARCH FOUNDATION, INC.

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"THE DIRECTOR'S DIGEST"

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## USE OF INEDIBLE ANIMAL FATS IN PORTLAND CEMENT

One of the promising areas of research sponsored by FPRF is the use of animal fats with Portland Cement in mortars and concrete. This research is being done by R. L. Johnson, Madison, Wisconsin; preliminary results were reported in "The Director's Digest" in April, 1965. Some of the results obtained since then are summarized below.

The compressive strength of cement-sand mortar cubes was definitely improved by adding inorganic-fat emulsions to the mortar as shown in Table I.

Table I. The compressive strength of two-inch sand-cement mortar cubes after air drying for 28 days.

<u>Additive</u>	<u>Compressive Strength-psi</u>
None	3800
Choice White Grease Emulsion(2%)	3700
No. 1 Tallow Emulsion(2%)	4400
No. 2 Tallow Emulsion(2%)	4500
Soybean Oil Emulsion(2%)	3150
Fatty Acid Emulsion( $\frac{1}{2}$ %)	4100
Fatty Acid Emulsion( $2\frac{1}{2}$ %)	3530

(Percentage figures are expressed as the percent of fat or fatty acid of the Portland Cement in the mortar)

The difference in the effect of the various fats on compressive strength is related, in part at least, to the free fatty acid content of the fat. The data suggest that an emulsion containing 2% fat (based on the amount of Portland Cement) with a FFA content of 15-20% gives best results. This viewpoint is substantiated by the observation that a tallow containing approximately 40% FFA, used at the 2% level in inorganic-fat emulsions, yielded mortar of lower compressive strength than was true for tallow containing

18% FFA. The importance of free fatty acid level is also indicated by the improvement in strength imparted by emulsions containing ½% free fatty acids alone but the reduction in strength resulting from the use of emulsions containing 2½% free fatty acids.

Water absorption of mortar cubes was greatly reduced by including the inorganic-fat emulsion in the cement mix (Table II). All of the fats and free fatty acids at the 2½% level were effective in retarding water absorption, particularly during the early part of the period.

TABLE II. The influence of fat-inorganic emulsions on water absorption of two-inch sand-cement mortar cubes

Additive	Water Absorption - %		
	24 Hrs.	72 Hrs.	28 Days
None	5.1	5.3	5.8
2% Choice White Emulsion	0.8	1.4	2.7
2% Soybean Oil Emulsion	1.1	1.7	3.2
2% No. 1 Tallow Emulsion	0.7	1.2	2.2
2% No. 2 Tallow Emulsion	1.0	1.7	3.0
½% Free Fatty Acid Emulsion	2.0	3.3	4.2
2½% Free Fatty Acid Emulsion	1.1	1.5	2.9

It should be emphasized that the results with the fat emulsions are dependent on both the fat and the inorganic salt mixture used in the emulsion. Fat alone might improve the water resistance of cement (in fact there are U.S. Patents stating that this is the case), but the use of fat alone with Portland Cement reduces the compressive strength of the concrete (from 3825 psi to 3000 psi in one test). The use of the inorganic materials alone in certain types of concrete may impart added strength but does not impart water resistance.

In addition to increased strength and improved water resistance, cement mixtures containing the fat-inorganic emulsions exhibit greatly improved workability.

You will recall that research sponsored by FPRF at Battelle Memorial Institute includes studies on the use of fat-derived compounds for waterproofing concrete and as an air-entraining agent (see Director's Digest, October 26, 1965). The studies at Battelle and those being made by Mr. Johnson supplement each other.

It is gratifying that these FPRF-sponsored research projects were covered in an article entitled "Open Road for Concrete Additives" published in the January 15, 1966 issue of Chemical Week. Following publication of this article, many requests for information and inquiries about the research have come to the FPRF office.