

MICHIGAN
STATE HIGHWAY DEPARTMENT
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AGRIFIL AS A MINERAL
FILLER FOR BITUMINOUS MIXTURES

By

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Agrifil has been used as a mineral filler on several oil aggregate projects in the state with unsatisfactory results. Because of this fact the Construction Division has requested that a study be made of Agrifil to determine if, under proper control, it can be used successfully as a mineral filler in bituminous mixtures.

This report presents the results of the study, and recommendations pertaining to the use of Agrifil. The study involved a physical and chemical analysis of the material.

General Characteristics of Agrifil

Agrifil is a residue material obtained from the stacks of the Huron Cement Plant, at Alpena, Michigan. Agrifil is sold commercially for several purposes one of which is a mineral filler for bituminous mixtures.

Agrifil is a light gray powder weighing about 40 pounds per cubic foot, with 98 percent of the material passing a 325 mesh sieve.

The chemical analysis discloses that the material consists in general of approximately 36.5 percent of burnt gypsum (plaster of paris, $\text{CaSO}_4, 1/2 \text{H}_2\text{O}$), 33.0 percent of low quality cement, 15.4 percent of unaltered clay and sand, 7.8 percent of calcium oxide containing some calcium hydroxide and calcium carbonate (equivalent to 2.52 percent combined water and CO_2) and 4.21 percent magnesium oxide (MgO), potassium oxide (K_2O) and sodium oxide (Na_2O).

The physical properties of Agrifil have been compared with those of Standard Huron cement. The results are presented in Table I. Also, the chemical properties of Agrifil have been compared with those of Standard Huron cement and presented in Table II.

Agrifil is highly soluble in water as compared with other fillers as shown in Table III.

TABLE I
COMPARISON OF HURON AGRIFIL
AND HURON STANDARD CEMENT

Physical Properties

Tests	Agrifil	Huron Std.
Specific Gravity	2.74%	3.16%
Normal Consistency	48%	23.5%
Fineness		
Passing 200 mesh	100% dry	97.4% dry
Passing 325 mesh	98.4% dry	90.7% wet
Time of Set		
Initial Set Vicat	30 min.	4 hr. 5 min.
Final Set	40 min.	5 hr. 20 min.
Tension Test - 7 day	0 lbs.	380 lbs.
Compression Test 2" cubes 7 day	680 lbs.	

TABLE II
COMPARISON OF HURON AGRIFIL
AND HURON STANDARD CEMENT

Chemical Properties

	Agrifil	Huron Std.
Silica (SiO ₂)	16.72 %	21.43 %
Calcium Oxide (CaO)	41.65	64.77
Sulfuric Anhydride (SO)	20.10	1.31
Ignition Loss	4.92	1.29
Alumina (Al ₂ O ₃)	6.08	5.96
Ferric Oxide (Fe ₂ O ₃)	3.82	3.00
Magnesium (MgO)	2.61	1.80
Potassium & Sodium Oxide (Na ₂ K ₂ O)	3.96	—
Insoluble	15.40	—

TABLE III
SOLUBILITY OF VARIOUS MINERAL
FILLERS IN WATER

Limestone Dust	0.17 %
Toledo Silica Dust	0.28
Calcium Hydroxide (Commercial)	1.95
Portland Cement	2.94
Plaster of Paris (Commercial)	2.61
Agrifil	6.84

Conclusions

Upon analysis of the above laboratory data, the following conclusions are presented:

1. Agrifil has, in general, the characteristics of a low quality Portland cement and, therefore, if it may be considered as such, could be placed under the same category as Portland cement and used in accordance with present specifications.
2. On the other hand, Agrifil has the following undesirable qualities for a mineral filler which should exclude it from all types of bituminous mixtures.
 - a. The material has not the proper gradation requirement necessary for a suitable mineral filler.
 - b. A mineral filler for bituminous mixtures should be chemically inert in order that it will be incapable of reacting with the bituminous binder or with water. The high percentage of gypsum and other chemical compounds present in Agrifil make it even more soluble in water than calcium hydroxide which is not used as a filler in Michigan. Therefore, this high solubility factor should make Agrifil undesirable for bituminous mixtures especially so for surfaces constructed with slow curing binders or for surfaces of the open mix type.

It is true that all well-made bituminous surfacings are impervious to water, but it must be remembered that the surface tension relationship of binder-aggregate-water are such that water tends to enter between the aggregate particles and the binder if it has the opportunity through bad adhesion. The employment of such a filler might lead to definite trouble in circumstances that might otherwise be only doubtful.

- c. It's unit weight, fineness and absorptive properties, as compared with other mineral fillers now in use would seem to make it a very difficult product to handle and control in the design and construction of bituminous roads.

- d. The rapid time of set, both initial and final, would make construction operations difficult if any degree of moisture was present in the aggregate.

In view of the above facts, it is recommended that Agrifil should not be used in any type of bituminous mixture as a mineral filler. However, if conditions are such that it is imperative to use Agrifil, it is suggested that its use be confined to the hot type mixtures under the same requirement as Portland cement and that the quantity necessary per batch should be the same in volume as that of other mineral fillers now in common use.