GEORGIA INSTITUTE OF TECHNOLOGY
Engineering Experiment Station
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FINAL REPORT

PROJECT A-232-363

EVALUATION OF PROPERTIES OF FULLERS EARTH-TYPE CLAYS

By

MAXIMO F. MUNOZ
Senior Research Engineer
Minerals Engineering Branch

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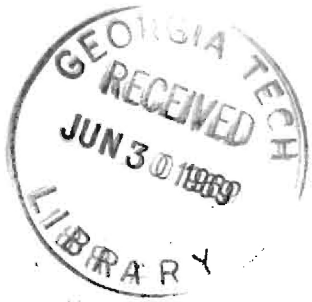


PURPOSE:

The purpose of this work was to dry, crush, screen and calcine Fullers Earth cores, and to investigate certain properties of the clay cores as well as of the calcined products to meet requirements of industry.

EXPERIMENTAL PROCEDURE:

The cores brought to the Georgia Tech laboratory were in polyethylene liners and they were identified by hole number. According to instructions of Mr. Stanley Smith, the cores were mixed into two portions, gray clay and blue clay, disregarding the hole number. Therefore, all through this report "gray" clay means the composite of grayish clays from holes 3, 4, and 5. "Blue" clay means the composite of bluish clays of holes 3, 4, and 5. The densities of the blue and gray clays were determined using a standard half-cubic foot measure. Results from this determination may be seen in Table I.

Drying: The clay composites were dried separately at 220°F until completely dry.

Crushing: The dry gray and blue clays were passed separately through a Williams hammermill. Screens produced an extremely fine product, and they were removed to produce a coarsely crushed product.

Screening: A 18 inch Sweco screening unit was used to make a primary 60-mesh separation in each product. The undersize was stored and the oversize was screened through 8, 14, 20, 30, and 50 mesh sieves, to produce the following screen cuts:

8x20, 14x30 and 20x50. The +8 fraction was passed through the hammermill and re-screended.

Calcining: The screen products were calcined at 900°F for 20 minutes in an electrical kiln.

Bulk Density: The procedure used was specified by Mr. S. Smith. It consisted of adding the 8x20 calcined product into a previously weighed 100 ml. graduate up to the 100 ml. line, tapping the graduate nine times on the counter top and adding more product to keep the level constant at the 100 ml. line. The graduate and its contents were reweighed. The bulk density was determined in grams per 100 milliliters of calcined product and the results reported as pounds per cubic foot. Results may be seen in Table II.

Oil and Water Absorption: Two procedures were used, both provided by Mr. Stanley Smith. The Westinghouse Oil or Water Absorption test was chosen to test the following samples:

Blue Clay	Gray Clay
8x20	8x20
14x30	14x30
20x50	20x50

In addition, a sample of 8x20 Blue clay (dried only), was tested for oil and water absorption and samples of commercial products such as "Kitty Pan", "M C P", "Hartz Mountain", "Cat Comfort", and "Thompson-Hayward" were tested for oil absorbency.

The procedure was as follows:

1. Dry sample for 1 hour at 110° centigrade.
2. Weigh out 20.0 gm. of sample.
3. Weigh a 400 ml. beaker, full of SAE No. 10 Motor Oil to 3/4 in. of beaker's rim.
4. Place clay product into a brass mesh cone and submerge cone for 20 (± 1) minutes in oil.
5. Take mesh cone with sample out of the oil, and let drain excess oil into beaker for 60 (± 3) minutes.
6. Reweigh beaker with oil. Note loss of weight.
7. Calculate absorption of oil in grams oil per gm. of clay.

Example:

Let x = gm. oil absorbed by clay,
y = initial weight of clay sample in gm.

$$\text{Absorption} = \frac{x}{y}$$

The procedure for water absorption was similar to the one outlined above, but using distilled water instead of oil, and using a draining time of 20 (± 1) minutes.

The second procedure used was the Federal Specification for Sweeping Compounds, P-S-00865c (Army - GL) dated 21 January, 1965, also provided by Mr. Smith.

This procedure was used to check the results of the Westinghouse test, and two samples were processed: 8x20 Gray and "Thompson-Hayward".

Results of oil and water absorption tests may be seen in Table III.

ELECTRON MICROGRAPHS:

Samples of blue and gray clays were examined by electron microscopy, and the prints are enclosed. The interpretation of these prints by Mr. John L. Brown of Georgia Tech, is as follows:

Both samples were examined by transmission electron microscopy using standard techniques. They are similar in appearance and both contain diatomaceous earth as evidenced by particle fragments with evenly spaced holes. The hazy ill-defined material is probably montmorillonite and other poorly ordered material such as chlorite or illite.

The major constituent of both is attapulgite. Sample Gray shows a fine-grain material predominantly attached to the attapulgite spicules. Sample Blue shows virtually none of this. A similar effect has been observed in some soil clays and the fine-grain material was identified as an iron bearing mineral.

X-ray diffraction analyses were done on the gray and blue samples. The results, at no cost to the sponsor, are as follows:

Sample Blue: Mostly montmorillonite, attapulgite, quartz, and kaolinite. This sample slaked with difficulty.

Sample Gray: Montmorillonite, quartz, kaolinite, possibly attapulgite. This sample slaked easily.

The minerals identified are listed in order of relative abundance.

TABLE I

DRY DENSITY OF CRUDE CLAYS

CLAY TYPE	MOISTURE AS RECEIVED, %	DRY DENSITY, lb/cu. ft.
Blue	51.5	42.4
Gray	49.0	44.5

TABLE II

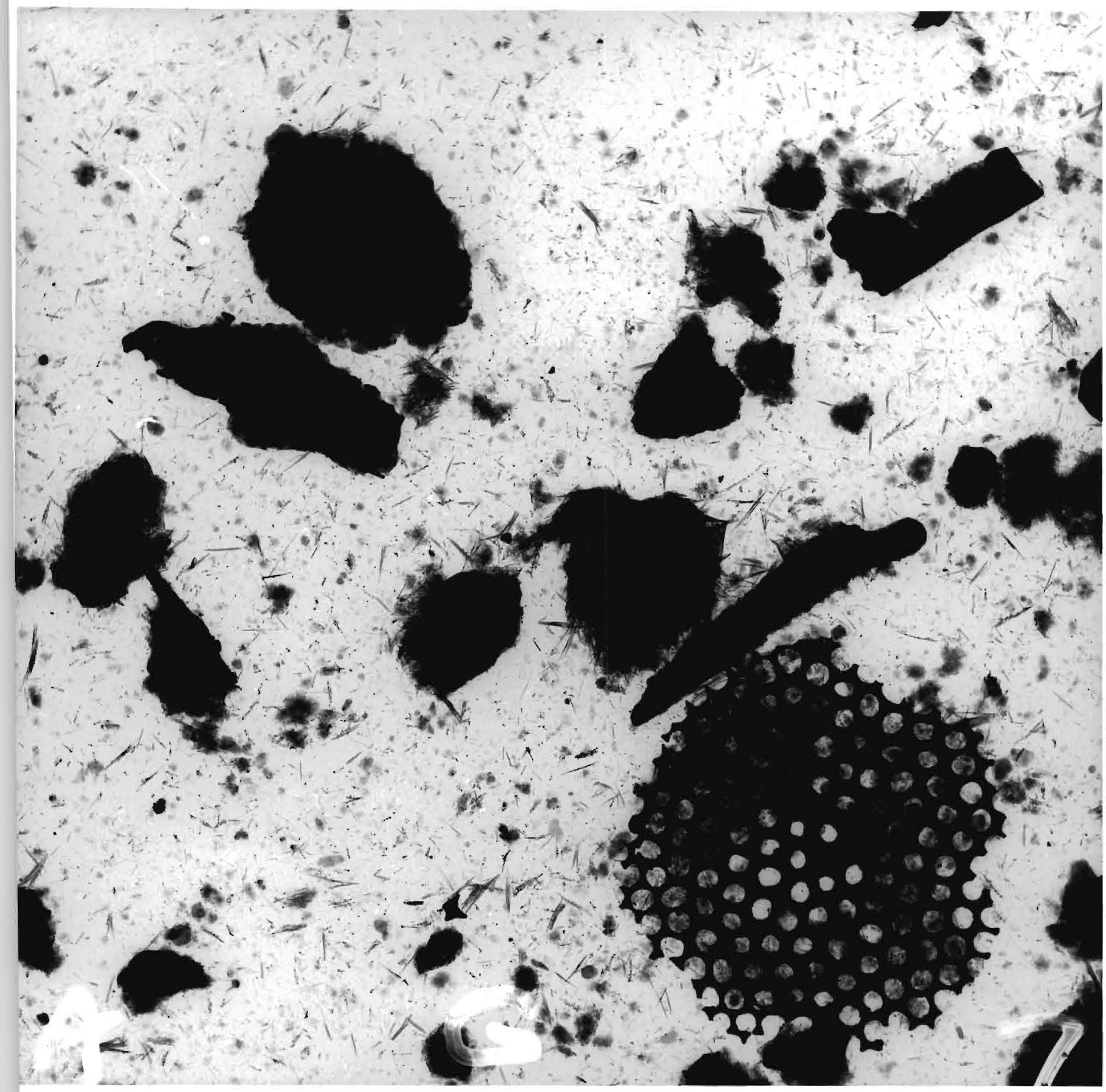
BULK DENSITY OF CALCINED 8x20 CLAY FRACTION

CLAY	BULK DENSITY, lb/cu. ft.
Blue	28.09
Gray	29.97

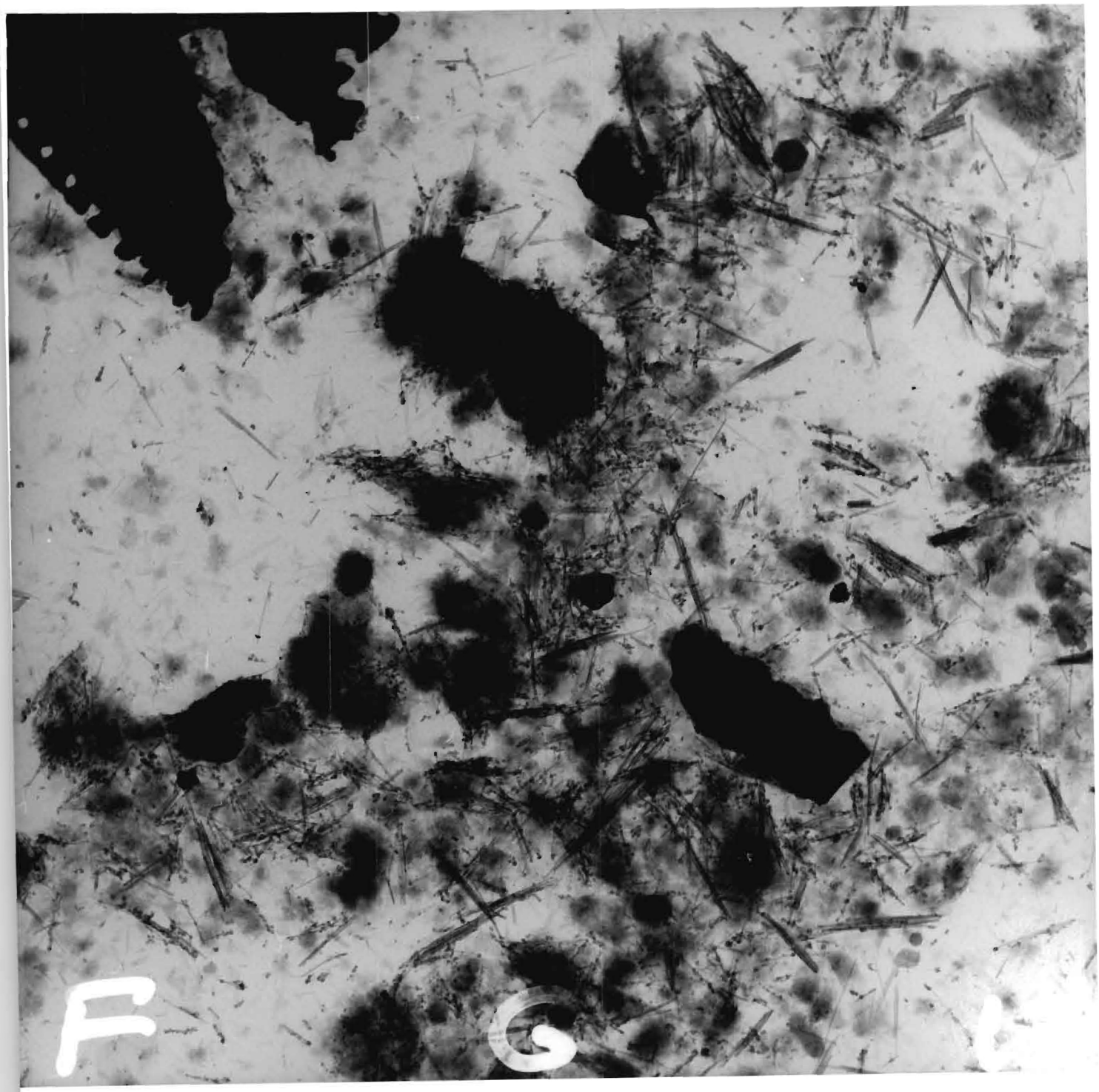
TABLE III

WATER AND OIL ABSORPTION OF
CLAY FRACTIONS

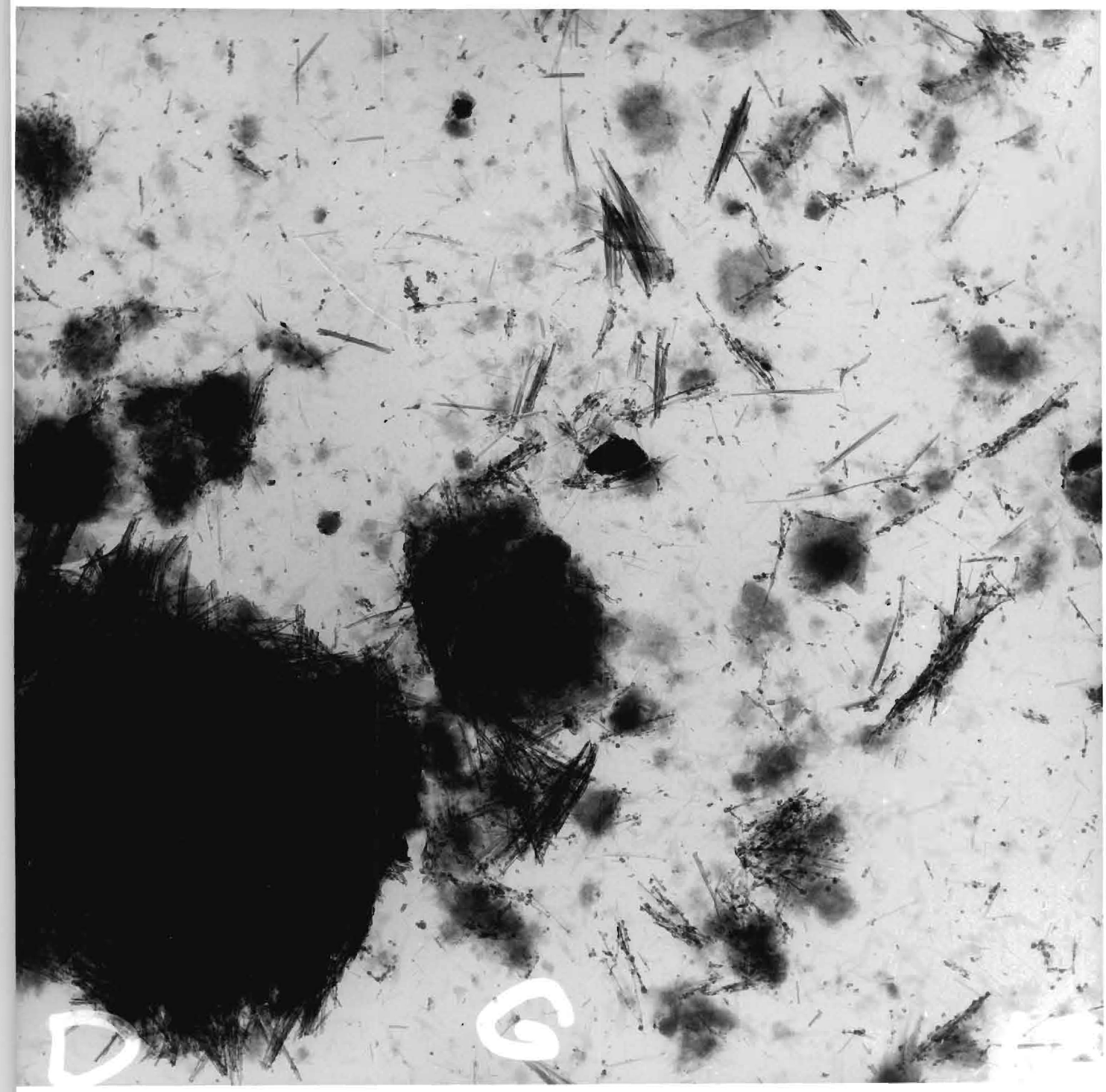
SAMPLE	TEST	OIL ABSORPTION gm. Oil / gm. Clay	OIL ABSORPTION ml. Oil / gm. Clay	WATER ABSORPTION gm. Water / gm. Clay	WATER ABSORPTION ml. Water / gm. Clay
BLUE CLAY					
cal.	Westinghouse	0.9	1.0	1.2	1.2
cal.	Westinghouse	1.0	1.2	1.5	1.5
cal.	Westinghouse	1.4	1.6	1.6	1.6
dried	Westinghouse	0.8	1.0	1.3	1.3
GREY CLAY					
cal.	Westinghouse	0.8	0.9	1.3	1.3
cal.	Westinghouse	1.1	1.2	1.5	1.5
cal.	Westinghouse	1.4	1.6	1.8	1.8
cal.	Federal Spec.	-	0.9	-	1.0
COMMERCIAL PRODUCTS					
Pan	Westinghouse	0.8	0.9	-	-
	Westinghouse	0.7	0.8	-	-
Mountain	Westinghouse	0.7	0.8	-	-
omfort	Westinghouse	0.5	0.6	-	-
Thompson-Hayward	Westinghouse	0.6	0.7	0.7	0.7
Thompson-Hayward	Westinghouse	0.8	0.9	1.0	1.0
Thompson-Hayward	Federal Spec.	0.6	0.7	0.8	0.8
Thompson-Hayward	Federal Spec.	0.8	0.9	1.2	1.2



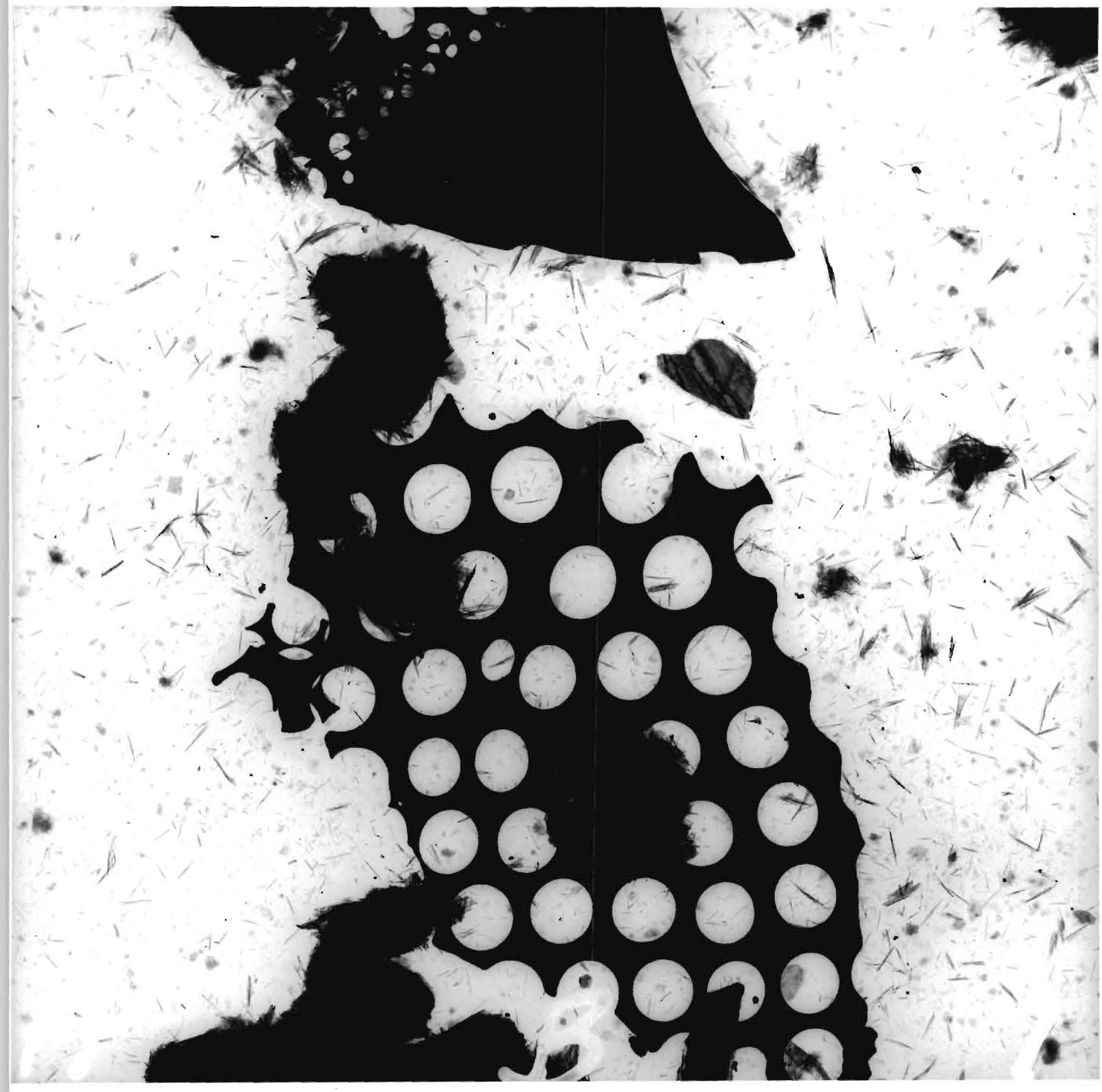
GRAY CLAY 5600X



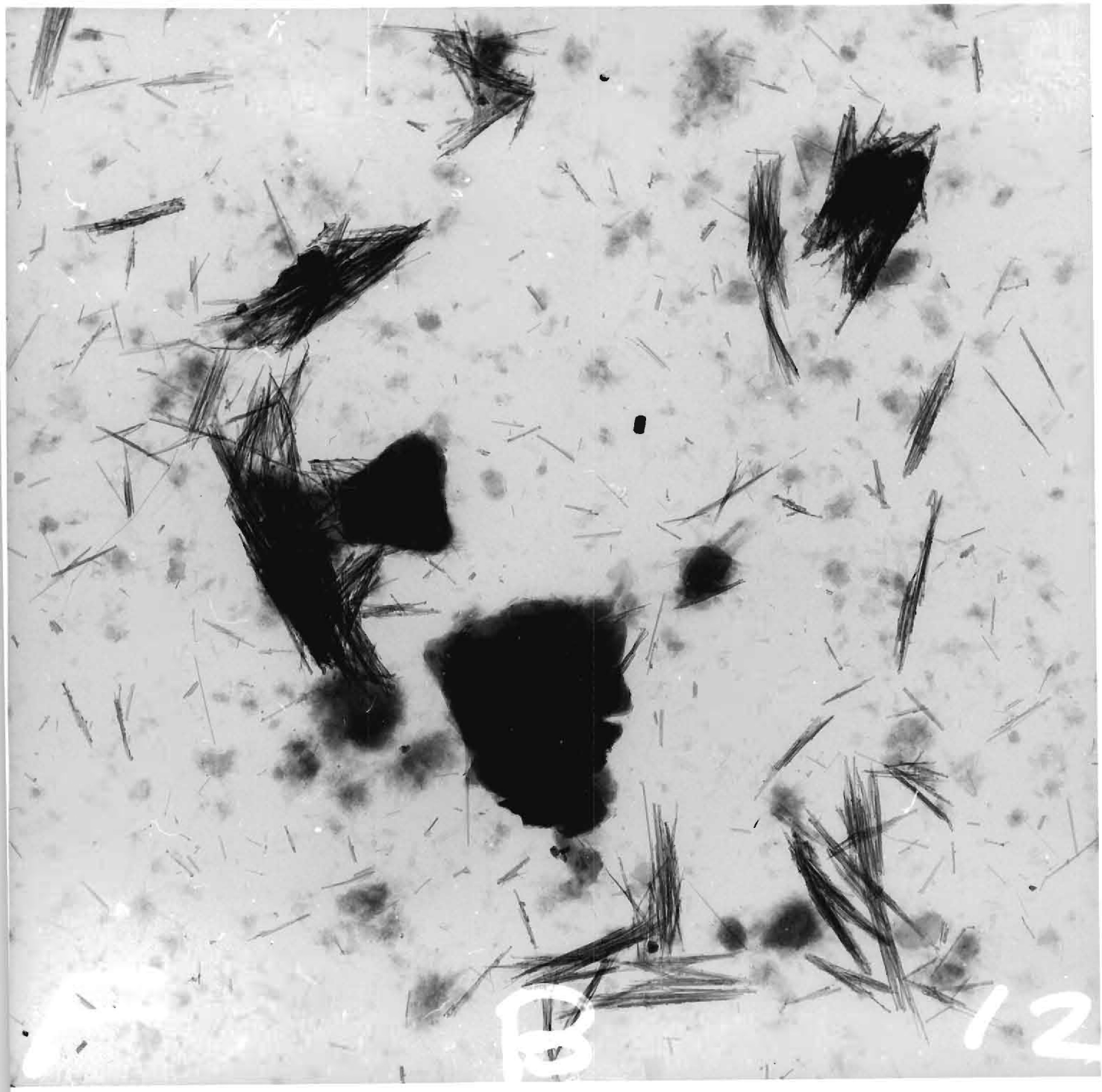
GRAY CLAY 20500X



GRAY CLAY 20500X



BLUE CLAY 5600X



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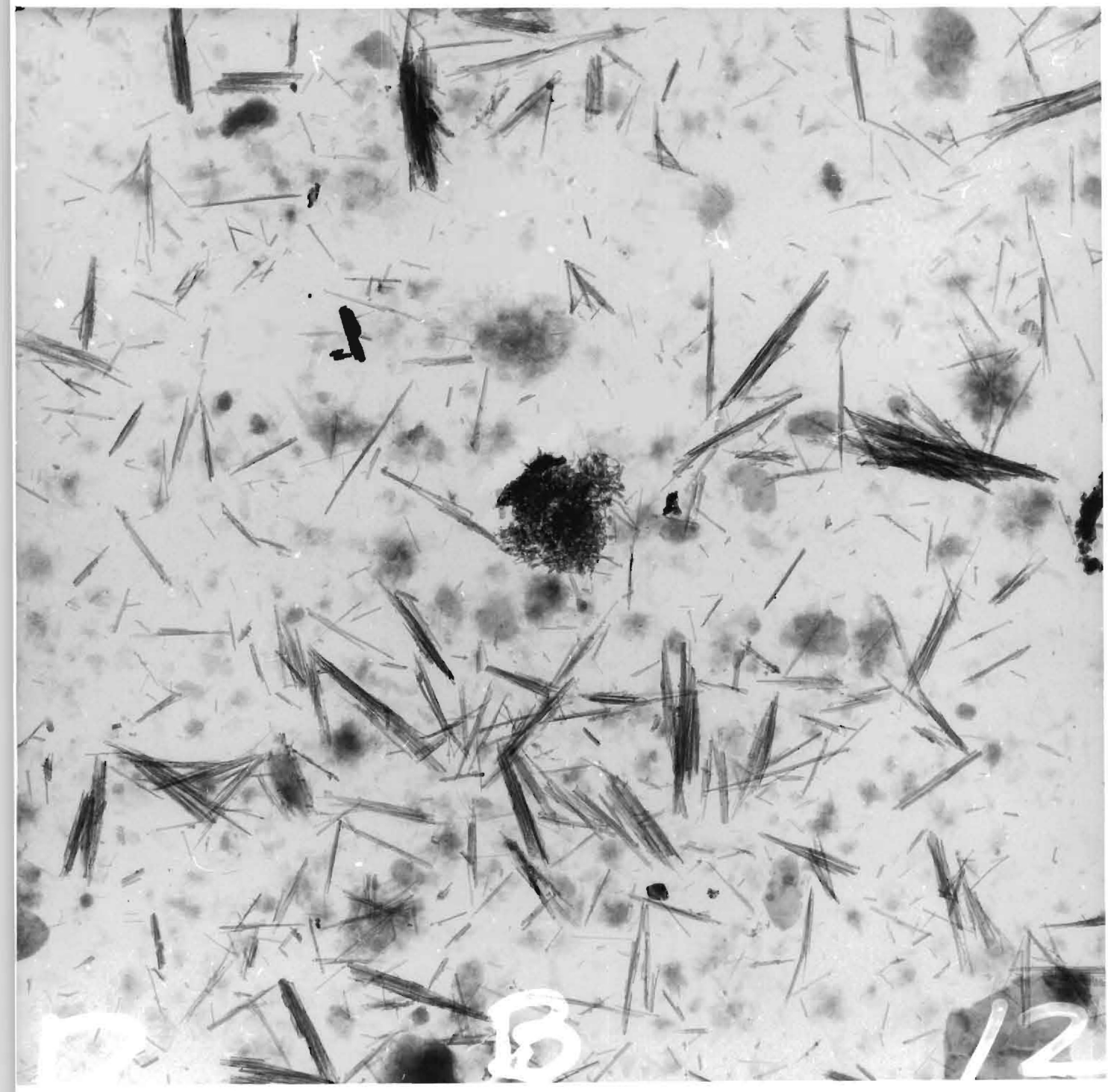

BLUE CLAY 20500X