Low Energy Intensity Structural Materials

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Short Papers on Research

Low Energy Intensity Structural Materials

Without a doubt, materials for construction requiring low energy inputs to produce will become increasingly important. One such product was developed in Sweden during the early 20's. Essentially, it is composed of a mixture of limestone and a shale high in bituminous content whereby the fuel is the bituminous materials in the shale. When ignited and caused to burn with the limestone a type of hydraulic lime is produced.

Inasmuch as there are several shale deposits in Kansas that can support combustion on being ignited and having air blown through them; the possibility exists for fabricating a structural material of low energy requirements. Basically, such a material could consist of an oil shale--limestone mixtures, self calcining; formed into suitable brick, block or panels. By treating the blocks with high pressure steam, adequate strength is obtained. Thus, there exists a possibility to use a mixture of Kansas oil shale and limestone--self firing--and fabricating inorganic structural shapes.

A series of tests based on this premise were undertaken as described in the following:

(A) Compositions tested for a suitable mix

Number	Materials Percent		
	Limestone	Flint	Shale
1	80	20	
2	60	40	
3	40	69	

4	80		20
5	60		40
6	40		60
7	20		80
8	30	40	30
9	70		30
10	70	10	20
11	70	20	10
12	60	10	30
13	60	20	20
14	60	30	10
15	30		60
16	30	10	60

Material: Shale: Little Osage--20 mesh

Limestone--Higgensville--20 mesh

Flint--Ottawa, Illinois--200 mesh

Mixtures calcined 24 less @ 1,500°F, made into a slurry and allowed to set 24 hours. All were autoclaved @ 100 psi for 6 hours.

(B) Compositions tested for a suitable mix

Number	Limestone	Coal	Shale
17	20	10	70
18	10	20	70
19	30	10	60
20	20	20	60
21	10	30	60
22	40	10	50
23	30	20	50
24	20	30	50
25	10	40	50

Material: same as above except--20 mesh

Mineral Coal used.

Mixture calcined 24 hours @ 1,500°F, made into a slurry and allowed to set 24 hours all were autoclaved @ 100 psi for 6 hours.

Mixtures 5, 16, and 22 were the best of each series with 5 and 22 the best of all series.

Using the bench scale, down-draft, furnace, a mixture of 40% Higginsville limestone, 50% Little Osage Shale and 105 Mineral Coal was ignited and fired off under the following schedule:

Time	Temp off	Air Flow CFM
2:00	Lighted	
2:15	100	26
2:30	1200	24
2:45	1640	18
3:00	1540	22
3:15	1600	20
3:30	1550	20
4:00	1230	20
4:30	1000	24

After cooling the fired mix was removed from the furnace, ball milled to minus 20 mesh, made into a slurry and poured into a 3 1/2 W x 3" DX 10"L mold. After a 24 hour set the shape was autoclaved @ 150 psi for 4 hours.

The resulting product was a moderately dense product that could be used as a structural unit.

Using the classic reaction of an aluminum powder with an alkali further mixes were contructed using this as a means of producing a light weight unit.

The compositions tested were as follows:

Number	Blackjack Limestone	Excello Shale
31	20%	80%

Calcine at 1500°F

Batch

Calcine--800 gms

Water--800 cc

Al powder--2 gms

Mix 5 minutes and run into mold. Set 24 hours and autoclaved at 150 psi for 4 hours.

Good, moderately dense block; little weight reduction.

Number	Little Osage Shale	Higginsville Limestone
32	80	20

Calcine at 1500°F

Batch

Calcine--800 gms

Water--800 cc

Aluminum powder--2 gms

Mix 5 minutes and run into molds

Set 24 hours and autoclave at 150 psi for 4 hours

Mix OK but block is dense.

33 Repeat above mix but add 4 gms aluminum powder: Good light weight unit

34 Repeat above mix but add 6 gm aluminum powder: Too much swelling of mix.