August, 1965

SOUTH AUSTRALIAN GOVERNMENT DEPARTMENT OF MINES

Amdel Report

No. 431

LIGHTWEIGHT AGGREGATE TAPLEYS HILL SHALE

by

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SUMMARY

Preparation of lightweight aggregate from a sample of Tapleys Hill shale by expansion in a rotary kiln is described. Lightweight concrete test cylinders containing 7 bags of cement per cubic yard were prepared from the aggregate. At a water: cement ratio of 0.57 these had a bulk density of 88 lb per cu ft and a compressive strength of 2170 lb per square inch. The lightweight aggregate produced would be suitable for load-bearing walls and concerete masonry units such as are used in house construction, and its use would result in a weight saving of about 40%. It would not however have sufficient strength for use in structural concrete. Before commercial exploitation of the shale deposit can be recommended, further work is necessary to determine means of preventing the tendency of this material to agglomerate in the kiln during expansion, and a recommendation is made to this end.

1. INTRODUCTION

The last report on this project was AMDL Report 297, dated November, 1963. This gave the results of rotary kiln tests on Tapleys Hill shale, Halletts Cove and Sturtian slates and a Recent clay from the Hundred of Port Adelaide, and recommended further work on Tapleys Hill shale and three clay deposits. The Director of Mines indicated that no further work was to be undertaken on the clay from Section 104 Hundred of Yatala, and deferred work on the other two clay deposits in Sections 1012 and 3070, Hundred of Port Adelaide, until completion of a survey of the potential reserves of these deposits. He authorised Amdel to proceed with the work recommended on Tapleys Hill shale, namely the preparation of sufficient well-bloated material to make standard lightweight concrete cylinders for compression tests.

2. MATERIAL EXAMINED

The sample of grey laminated Tapleys Hill shale from Section 79, Hundred of Noarlunga, described in AMDL Report 297, was used.

3. EQUIPMENT

The shale was expanded in the rotary kiln described in AMDL Report 297. Several oil burners were used, of which the most successful was a simple burner made from a length of $\frac{1}{2}$-inch galvanised iron pipe, through the middle of which was inserted a $\frac{1}{4}$-inch copper tube. The burner was closed by a brass nozzle. Oil was admitted through the inner and air through the outer tube.

Diesel fuel oil from a gravity tank was metered to the burner through a Rotameter Metric 7A flowmeter. Primary air from a compressor was metered to the burner through a Rotameter Metric 14K flowmeter. Secondary air was supplied only by the natural draught of the kiln.

Temperature measurements were made with an optical pyrometer.

	% by Weight
- 3/16 inch + 16 mesh (BSS)	45
- 16 mesh + 52 "	40
- 52 " + 100 "	10
- 100 "	5

The bulk density of this final sample of fine aggregate was 44.4 lb per cu ft.

4.3 Compression Tests

The final samples of coarse and fine aggregate prepared as described in Section 4.2 were sent to the Institute of Technology for testing. The Institute was requested to prepare six standard concrete cylinders to be tested for unit weight and 28-day compressive strength, the proportions used in making the concrete to be:

	Proportions	
	by Volume	by Weight
Portland cement	1.00	1.23
Fine aggregate	1.82	1.06
Coarse aggregate	2.75	1.00

These proportions were calculated to give a concrete containing 7 bags of cement per cubic yard, with a ratio of fine to coarse aggregate of 2 to 3 by volume.

The following four-stage mixing procedure was suggested to the Institute:

1. Mix the coarse aggregate with enough water to wet the particle surfaces
2. Combine the cement and fine aggregate and mix dry
3. Mix the coarse and fine materials thoroughly
4. Add sufficient water to obtain good workability

The tests were carried out as requested under the supervision of Mr M.G. Symons, who made the following comments:

1. The suggested mixing procedure was found to be very satisfactory for producing a uniform mix; using alternative procedures, segregation of the coarse aggregate can be a problem.
2. The water-cement ratio is not as critical in a concrete mix using this lightweight aggregate as compared with a mix using ordinary aggregate.
3. The slump test has no practical application to a concrete mix containing lightweight aggregate.

TABLE 1

FIGURE 1

TABLE 1: COMPRESSIVE STRENGTH TESTS

Cylinder No.	Height in.	Diameter in.	Sectional Area sq in.	Maximum Load lb	Weight lb	Age Days	Density lb/cu ft	Water Cement Ratio	Compressive Strength lb/sq in.
1	11.9	5.96	27.9	58,500	17.13	28	89.2	0.57	2100
2	12.0	5.97	28.0	65,300	17.40	28	89.5	0.57	2330
3	12.0	5.97	28.0	52,000	16.00	28	82.3	0.57	1860
4	11.9	5.97	28.0	66,900	17.63	28	91.4	0.57	2390
5	11.8	5.97	28.0	49,400	16.68	28	87.2	0.66	1760
6	11.8	5.97	28.0	50,100	16.84	28	88.1	0.66	1790

Note: 1. Cylinders were stripped from the moulds 24 hours after casting and cured in water until tested. They were cast on 2/6/65 and tested on 30/6/65.

2. Cylinders were capped at one end with sulphur compound for standard testing.

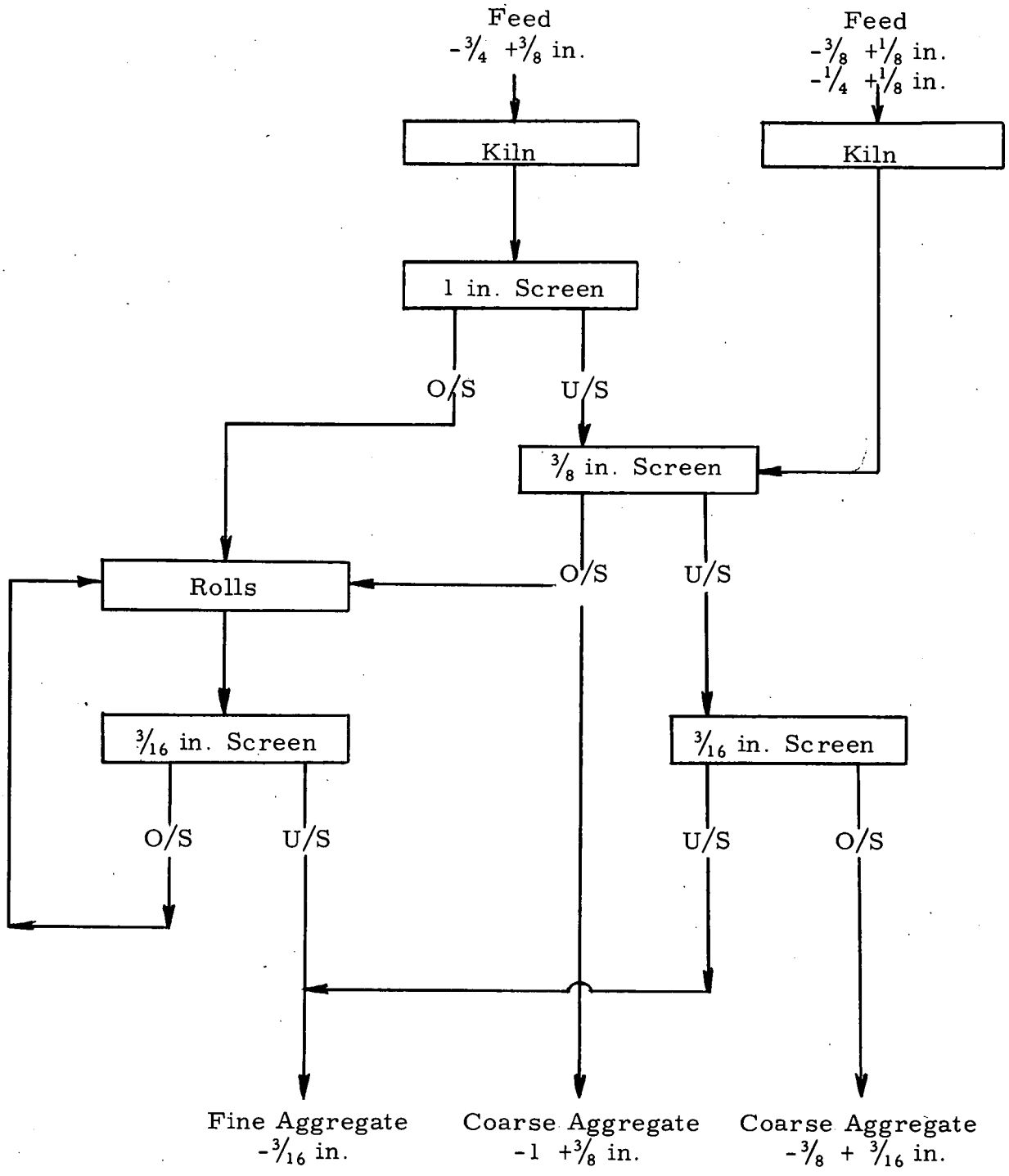

FIG. 1: FLOWSHEET SHOWING PREPARATION OF GRADED LIGHTWEIGHT AGGREGATE