R.B 52/51
D.M. 618/60

CONFIDENTIAL

RB 52/51

AUSTRALIAN MINERAL DEVELOPMENT LABORATORIES

REPORT NO. AMDL-86

SOUTH AUSTRALIAN GOVERNMENT
DEPARTMENT OF MINES

PROJECT 1/1/27

MORGAN GYPSUM
WASHING TESTS

by

P.B. Moffitt
P.K. Hosking

MICROFILMED

Investigated by the Metallurgical Section.
Officer in Charge: D.W. Read.

Issued February 1961 L. Wallace Coffer. Director.

CONFIDENTIAL

CONTENTS

		Page
1.	INTRODUCTION	1
2.	SUMMARY	1
3.	MATERIAL EXAMINED	1
4.	EQUIPMENT	2
5.	TEST PROCEDURE AND RESULTS	2
5.1	Sample Crushing	2
5.2	Screen Analysis	3
5.3	Washing Test	4
5.4	Calcination Test	4
5.5	Colour of Plaster Casts	5
6.	CONCLUSIONS AND DISCUSSION	6

****

ABSTRACT

This report covers a preliminary appraisal of a grab sample of gypsum from the Morgan area. The material contains large amounts of low grade fines.

By crushing to minus $\frac{1}{2}$-inch and wet screening on 10 mesh a concentrate assaying 91 per cent. $CaSO_4.2H_2O$ with a recovery of 63 per cent. can be obtained. The minus 10 mesh discard material comprises 53 per cent. by weight of the original material. The recovery could be increased by taking a cut off point at a finer mesh.

1. INTRODUCTION

A request was received from the Department of Mines to examine a sample of gypsum from the Morgan area.

The following information was sought:

(a) The minimum degree of crushing necessary to liberate the bulk of the gypsum.

(b) Percentage recovery of gypsum at plus 1/8-inch (equivalent to 5 mesh B.S.S.)

(c) Percentage recovery of gypsum irrespective of size.

(d) Sodium and magnesium chloride contents of washed gypsum.

(e) Suitability of washed product for plaster manufacture with particular reference to colour.

2. SUMMARY

The gypsum material from the Morgan area when washed produced a gypsum concentrate of 91.9 per cent. $CaSO_4 . 2H_2O$ with a recovery of 89.9 per cent. To produce this concentrate, the material was crushed to pass a 1/2-inch screen and then agitated in water at 50 per cent. solids. Separation by screening at 10-mesh produced a concentrate of 91.4 per cent. $CaSO_4 . 2H_2O$ with a recovery of 63.0 per cent. Classification washing of the agitated pulp would give a similar grade but with much higher recoveries.

Reflectance spectrophotometer tests of casts made from the Plaster of Paris produced by calcination of the upgraded material indicates the material has a visual brightness of 85 per cent. compared to a standard magnesium carbonate block but visual examination showed that it contained a slight brown shade that may affect the sale of the product.

3. MATERIAL EXAMINED

A 20 lb. sample taken from a gypsum deposit in Sections Q and N, Hundred of Stuart, ten miles north-east of Morgan, S.A. was received from the South Australian Department of Mines.

The sample consisted of some large lumps, (approximately 4-inch), smaller crystals, and fine clay.

Results shown in this report refer to this sample which being a grab sample may not be representative of the deposit.

4. EQUIPMENT

Jaw Crusher 8" x 5".

Laboratory Standard B.S.S. screens.

Denver high-speed agitator

Thermostatically controlled oven.

E.E.L. Reflectance spectrophotometer.

Colour determinations were carried out using the E.E.L. reflectance spectrophotometer. Both the nine-filter spectrum wheel and the Y-filter of the tri-stimulus wheel were used in these determinations. The latter filter has the same spectral distribution as the average human eye. The percentage reflectance obtained by using this filter can be taken as a measure of the percentage of visual brightness.

The former series of filters give results that indicate the percentage reflectance at various wave lengths. Average wave length value of the filters are given below.

Filter No.	Wave Length (Å)
601	4260 - Violet
602	4700 - Blue
603	4900
604	5200 - Green
605	5500
606	5800 - Yellow
607	6000
608	6800
609	6840 - Red

The spectrophotometer was used to measure the relative reflectance between the plaster under test and a standard white block of magnesium carbonate.

5. TEST PROCEDURE AND RESULTS

5.1 Sample Crushing

The sample was stage crushed to pass a 1-inch screen. This size was estimated to be the maximum commensurate with the liberation of significant amounts of impurities.

5.2 Screen Analysis

A sample of the minus 1-inch material was wet screened as follows to produce the fractions set out in Table 1. The sample was first dry screened and then each fraction was soaked in water. The wetted fractions were then returned to the respective screen in turn and washed. Each undersize portion was added to the next screen before that fraction was washed. In this manner a series of very clean sized-fractions was obtained.

Table 1 shows the screen analysis of the minus 1-inch material, together with the gypsum content and distribution, and water soluble chlorine and magnesia.

Recoveries of gypsum at various size levels are shown in Table 2. The figures listed opposite each mesh of separation would be the values of the total oversize material produced if the feed had been screened at that particular mesh.

TABLE 1: ANALYSIS OF THE MINUS 1-INCH MATERIAL

Fraction	Wt.	Gypsum		Water Soluble	
		$CaSO_4 . 2H_2O$	Dist.	Cl	MgO
	%	%	%	%	%
+ ½ inch	21.2	88.5	34.1	0.01	0.012
-½ + ¼ "	10.5	90.1	17.2	0.01	0.012
-¼ + 5 mesh	8.8	90.6	14.4	0.01	0.012
-5 + 10 "	6.8	87.1	10.7	0.01	0.016
-10 + 18 "	5.6	84.1	8.5	0.01	0.024
-18 + 36 "	3.6	76.9	5.0	0.01	0.017
-36 + 72 "	2.6	69.8	3.3	0.015	0.017
-72 + 100 "	0.6	53.9	0.6	0.015	0.017
-100 + 200 "	2.2	24.2	1.0	0.01	0.024
-200 +	38.1	7.8	5.2	0.01	0.024
	100.0	55.2	100.0	0.01	0.018

TABLE 2: CUMULATIVE RECOVERY OF GYPSUM

Separation at.	Weight %	$CaSO_4 \cdot 2H_2O$ %	Distribution %
½ inch	21.2	88.5	34.1
¼ "	31.7	89.1	51.3
5 mesh	40.5	89.5	65.7
10 "	47.3	89.1	76.4
18 "	52.9	88.6	84.9
36 "	56.5	87.7	89.9
72 "	59.1	87.0	89.9
100 "	59.7	86.7	93.8
200 "	61.9	84.5	94.8

5.3 Washing Test

Examination of the results set out in Table 1 indicated that further crushing would be required to increase the grade of the washed gypsum. The plus ½-inch material was therefore screened out and recrushed to pass this screen.

The material was agitated with water at 50 per cent. solids, for five minutes in a high speed Denver glass-bowl conditioner, and then screened through a 10-mesh and a 100-mesh screen. The results of this test are set out in Table 3.

Because of the low values of soluble chlorine and magnesia in the various screen fractions shown in Table 1, the products were not assayed for these components.

TABLE 3: RESULTS OF WASHING TEST

Fraction	Weight %	$CaSO_4 \cdot 2H_2O$ %	Distribution %
+ 10 mesh	37.4	91.4	63.0
-10 + 100 "	15.7	93.1	26.9
- 100 "	46.9	11.8	10.1
Feed	100.0	54.3	100.0
+ 100 mesh material (calculated)	53.1	91.9	89.9

5.4 Calcination Tests

Three fractions obtained from the washing test were calcined to produce Plaster of Paris. These fractions were the + 10 mesh, - 10 + 100 mesh and the total + 100 mesh fraction obtained by combining the first two fractions. The plus 10 mesh fraction was crushed to pass 10 mesh before calcination.

Time of calcination at 170°C, and weight loss for each sample are shown in Table 4.

It is to be noted that the times of calcination and weight losses refer to these samples only and should not be used to indicate probable operating conditions in the actual manufacture of Plaster of Paris from this material.

TABLE 4: CALCINATION CONDITIONS AND RESULTS

Fraction	Temperature °C	Time (min.)	Loss of Weight %
+ 10 Mesh	170	50	18.7
-10 + 100 "	170	30	18.4
-100 "	170	30	18.2

5.5 Colour of Plaster Casts

Plaster casts were made from the three plasters produced. These were produced by mixing 100 grams of plaster with 70 grams of distilled water and casting the mixture on a glass slab. The casts were then allowed to stand for 60 hours under atmospheric conditions, followed by 24 hours drying at 40°C.

Colour determinations were carried out using the "E.E.L." reflectance spectrophotometer.

Results of these measurements are shown in Table 5.

TABLE 5: RESULTS OF THE COLOUR EXAMINATION OF THE PLASTER CASTS

Fraction	Visual Brightness %	Reflectance with Filter No. 601	602	603	604	605	606	607	608	609
+10 mesh	84	70	72.5	75	79	84	87	89	90	91
-10 +100 "	85.5	72.5	75	77	80.5	85	88	89	90	91
+100 "	85	70	72.5	75	78	84	87	88	89.5	91

This shows marked absorption in the violet-green portion of the spectrum and would account for the brownish-yellow color of the plaster.

6. CONCLUSIONS AND DISCUSSION

The screen analysis of the original sample crushed to minus 1-inch showed that this material could be treated to produce relatively high grade gypsum concentrates. Visual examination of the plus $\frac{1}{2}$-inch fraction indicated that further crushing of this fraction would be beneficial in producing concentrates of higher grade.

The washing test on this material crushed to minus $\frac{1}{2}$-inch was used to simulate conditions under which the material could be concentrated. These conditions were:-

(a) Washing on a 10-mesh screen. This screen size was taken as the smallest practical size for use in this service.

(b) Washing on a 100-mesh screen. This screen was used to represent the largest partical size cut-off point possible in a classifier-washer circuit.

A grade of 91.4 per cent. $CaSO_4 2H_2O$ and a recovery of 63.0 per cent. were obtained by the first method of concentration. The second method resulted in a grade of 91.9 per cent. $CaSO_4 2H_2O$ and a recovery of 89.9 per cent. These concentrates contained low amounts of soluble magnesia and chlorine, in the order of 0.017 and 0.01 per cent. respectively. The lower cut-off point will be investigated when a bulk sample is tested.

Calcination of the fractions from the washing test indicate that Plaster of Paris could be manufactured from this material.

TABLE 5: RESULTS OF THE COLOUR EXAMINATION OF THE PLASTER CASTS

Fraction	Visual Brightness %	Reflectance with Filter No. 601	602	603	604	605	606	607	608	609
+10 mesh	84	70	72.5	75	79	84	87	89	90	91
-10 +100 "	85.5	72.5	75	77	80.5	85	88	89	90	91
+100 "	85	70	72.5	75	78	84	87	88	89.5	91

This shows marked absorption in the violet-green portion of the spectrum and would account for the brownish-yellow color of the plaster.

6. CONCLUSIONS AND DISCUSSION

The screen analysis of the original sample crushed to minus 1-inch showed that this material could be treated to produce relatively high grade gypsum concentrates. Visual examination of the plus $\frac{1}{2}$-inch fraction indicated that further crushing of this fraction would be beneficial in producing concentrates of higher grade.

The washing test on this material crushed to minus $\frac{1}{2}$-inch was used to simulate conditions under which the material could be concentrated. These conditions were:-

(a) Washing on a 10-mesh screen. This screen size was taken as the smallest practical size for use in this service.

(b) Washing on a 100-mesh screen. This screen was used to represent the largest partical size cut-off point possible in a classifier-washer circuit.

A grade of 91.4 per cent. $CaSO_4 2H_2O$ and a recovery of 63.0 per cent. were obtained by the first method of concentration. The second method resulted in a grade of 91.9 per cent. $CaSO_4 2H_2O$ and a recovery of 89.9 per cent. These concentrates contained low amounts of soluble magnesia and chlorine, in the order of 0.017 and 0.01 per cent. respectively. The lower cut-off point will be investigated when a bulk sample is tested.

Calcination of the fractions from the washing test indicate that Plaster of Paris could be manufactured from this material.

Colour determinations carried out on the cast plaster using the reflectance spectrophotometer indicated a visual brightness of 85 per cent. when compared with a standard magnesium carbonate block. Visual examination showed a slight brown shade that may affect the sale of this plaster.