The Australian Mineral Development Laboratories

Telephone: 79 1662 - 79 1625 - 79 1635
Telegrams: "AMDEL", Adelaide.
Address all communications to the Director.
Please quote this reference in your reply

CONYNGHAM STREET,
PARKSIDE,
SOUTH AUSTRALIA.

1/1/58

Your reference DM 344/62
RB 86/6

6th February, 1963

The Director of Mines,
Government Offices,
169 Rundle Street,
ADELAIDE, S.A.

Dear Sir,

We are transmitting to you ten copies of AMDL Report 234 entitled "Barytes Beneficiation", dated February, 1963.

The sample as submitted conforms to the A.P.I. Specification for drilling-fluid material if milled to the required particle size.

With regard to its use as a paint pigment, an industry classification of a beneficiated and leached sample was second-grade barytes. Therefore the final product would have a low value and treatment costs would have to be kept to a minimum.

Exploitation of the deposit will probably need to depend upon sales of drilling fluid media, with pigment product as a secondary product.

We will be pleased to receive your comments on the report in due course.

Yours faithfully,

L. Wallace Coffer

L. Wallace Coffer
Director.

1/1/58

AMDL Report 234
February, 1963

BARYTES BENEFICIATION

by

G.D. Sheridan

to

SOUTH AUSTRALIAN GOVERNMENT
DEPARTMENT OF MINES

Investigated by: Metallurgical Section
Officer in Charge: P.K. Hosking

THE AUSTRALIAN MINERAL DEVELOPMENT LABORATORIES
Adelaide South Australia

CONTENTS

1. INTRODUCTION

The South Australian Government Department of Mines requested an investigation into the commercial uses of a low grade barytes deposit from the Weekeroo district.[1]

The purpose of the project was to investigate the suitability of the material for the production of drilling mud or other commercial uses, either in raw condition or after suitable beneficiation.

2. SUMMARY

The tests showed that the sample as received conforms to the American Petroleum Institute Specification for Oil-well Drilling-Fluid materials without beneficiation. Investigation of other commercial uses of the material showed that for use as a paint extender a leaching treatment would be necessary. Beneficiation would involve magnetic separation at 20-mesh, leaching of the non-magnetics and flotation of the leached residue. It is doubtful if the value of the final product for paint use would bear the treatment costs as leached product is classed as second grade barytes because of its unsatisfactory colour.

It is recommended that the deposit be regarded primarily as a potential raw material for oil-well drilling-fluid medium.

3. MATERIAL EXAMINED

A 2-ton parcel of ore was received and the total sample was crushed to pass a ¼-inch screen. A representative sample was taken from the minus ¼-inch ore stream during crushing and one half of the sample was retained and the other half was crushed to minus 10-mesh for laboratory-scale tests and analysis.

The head sample assayed:

	Per cent
$BaSO_4$	93.9
SiO_2	2.7
Fe (acid soluble)	1.3
Cu	0.1

A mineralogical report on the raw material is given in Appendix A.

---

1. Geological Survey Bulletin No. 34, P. 129, describes the deposit.

4. EQUIPMENT USED

a. Stearns[1] laboratory pick-up type magnetic separator

b. Fagergren laboratory flotation cell (nominal 2½ litre capacity)

c. Laboratory stainless steel ball mill (500 g with ball charge of 6¼ lb of 1-inch steel balls)

d. British standard screens

e. Laboratory attriting unit (950 ml)

5. EXPERIMENTAL PROCEDURE AND RESULTS

The high grade of the head sample indicated that the raw material may be suitable for drilling mud without beneficiation. Initial tests were therefore confined to comparing the material against the specification limits set by the American Petroleum Institute Specification for Oil-well Drilling-Fluid Materials[2]. The results of these tests are shown in Table 1.

TABLE 1: COMPARISON OF WEEKEROO SAMPLE WITH API SPECIFICATION FOR OIL-WELL DRILLING-FLUID MATERIALS

Specification Data	Weekeroo	API Standard 13A
Specific gravity	4.35	4.20 minimum
Soluble alkaline earth metals as calcium	23.1 ppm	500 ppm (max.)
Water-soluble content	0.016 %	Not quoted
Wet Screen Analysis		
Residue on US sieve No. 200	(1)	3.0% (max.)
- ditto - No. 325	(1)	5.0% (max.)

(1) Not applicable to sample; this is a function of grinding procedure.

1. Reference to specific equipment is made to facilitate understanding and does not imply endorsement of such equipment by The Australian Mineral Development Laboratories.

2. Tentative standard - API std. 13A 1st Edition March, 1962.

The data given in Table 1 indicated that the material was suitable for oil-well drilling purposes, if milled to the particle size quoted by the API Standard.

Apart from its use in oil-well drilling-fluids, about the second most important commercial use for barytes is as an extender in paints. The investigation therefore was directed towards producing from the raw material a barytes concentrate, which might fulfill the requirements of the Australian Standard Specification for barytes for paints (No. K.21-1927T). This specification calls for a $BaSO_4$ content of not less than 97 per cent in addition to limits for sizing, colour and volatile matter.

5.1 Magnetic Separation

The mineralogical report (Appendix A) indicated that the bulk of opaque impurities could be removed by magnetic separation.

Test 1. The ore was stage pulverised to minus 20-mesh. Magnetic separation was carried out in a Stearns pick-up type magnetic separator under the following conditions:

Feed rate	5 lb/in./hr
Coil current	1.25 amp
Belt speed	7.5 rpm
Pole gap	$\frac{3}{32}$ in. and $\frac{1}{16}$ in.

The separation of the dark minerals from the barytes appeared quite good, however the barytes-rich fraction still maintained the distinctive pink colour caused mainly by iron staining, as stated in the mineralogical report.

In an effort to remove the iron-staining the non-magnetic fraction was attrited in a Fagergren flotation cell at 75 per cent solids for 15 minutes. Calgon and soda ash, 33g and 7 g per litre respectively, were added as dispersants. Slime was removed by three decantations. The results of the test are shown in Table 2.

TABLE 2: MAGNETIC SEPARATION AND ATTRITION SCRUBBING OF MINUS 20-MESH FEED
Test 1 Results

Product	Weight	Assay		Distribution	
	%	Fe %	$BaSO_4$ %	Fe %	$BaSO_4$ %
Magnetics	2.1	44.5	26.4	73.4	0.6
Attrited non-magnetics					
Slime	15.6	0.85	97.2	10.4	16.2
Sand	82.3	0.25	94.4	16.2	83.2
Feed (calc.)	100.0	1.27	93.4	100.0	100.0
" (assay)		1.30	93.9		

Although some of the iron-staining was removed by attriting the pink colour of the barytes still remained after this treatment. Intensive attriting of the material may possibly remove more of the pink colouration.

Consideration was given to selecting the best method of upgrading the material to at least 97 per cent $BaSO_4$ minimum. Flotation was selected as the barytes tends to grind preferentially, as indicated by the grade of slime fraction in Table 2, and also fine crushing is required to effect good liberation of gangue and opaque impurities.

The tendency for preferential grinding of the barytes indicated that flotation of the barytes from the siliceous impurity would be preferable to the alternative of floating the silica from the barytes as in the latter process the fine barytes would float with the silica.

Gravity concentration would give heavy barytes losses because of the preferential grinding effect.

5.2 Flotation Tests

A preliminary test on a portion of the feed from which the magnetic impurities had been removed showed that good flotation of barytes could be obtained by first removing the sulphide impurity with a xanthate float and then conditioning the ground pulp with a fatty acid emulsion. The following test (Test 3) was carried out.

Test 3. A 4000 g sample of the feed was stage pulverised to pass a 20-mesh screen and treated on the Stearns magnetic separator under similar conditions to Test 1. The non-magnetic (minus 20-mesh) fraction was attrited at 75 per cent solids for 10 minutes with 1 lb of Calgon per ton added to the pulp as a dispersant. The attrited pulp was then diluted with

water and the pink-coloured slime decanted as completely as possible.

The deslimed sands were ground in the laboratory b' ll mill for 5 minutes and the ground pulp was transferred to a Fagergrer lotation cell. A sulphide fraction was removed after 1 minute conditioning with 0.1 lb per ton potassium amyl xanthate and 0.05 lb per ton Aerofroth 65. The pulp was then conditioned for 5 minutes with 4 lb per ton of a fatty acid emulsion consisting of:

	Parts
Sulphonated whale oil	0.6
Linseed fatty acid	0.8
Fuel oil	3.5
Napthenic acid	0.5
Sorbitan mono-oleate	0.09
Nonion P 100	0.23

A rougher concentrate was floated and cleaned once. This concentrate assayed 98.5 per cent $BaSO_4$ but was still pink in colour. Acid-leaching was quite effective in removing the pink colour proving that the colour was a surface staining only.

5.2.1 Leaching and Flotation

Preliminary tests showed that leaching with hot hydrochloric acid was effective in removing the pink staining on the barytes but as this would be expensive, leaching with a mixture of salt (sodium chloride) and sulphuric acid was considered as an alternative.

Test 4. A further portion of the minus 20-mesh non-magnetic fraction of feed was leached with sulphuric acid and salt as follows. A mixture of 60 g of NaCl and 100 g of H_2SO_4 (1.84 SG) was diluted to 250 ml with water. Complete solution of the salt was not obtained, but a fine suspension was prepared, 100 ml of which were added to 500 g of the barytes sample in a large beaker. The mixture was heated on a steam bath with occasional stirring for 3 hours, then filtered and washed. A flotation concentrate was produced from the leached material under similar conditions to Test 3. The final concentrate assayed 99.3 per cent $BaSO_4$ and appeared to be of a good white colour.

The Australian Standard Specification (K.21) for barytes for paints refers to 'Colour' as follows:

> "The colour of the material when mixed with Refined Linseed Oil shall match that of a sample agreed upon between purchaser and vendor. The comparison of colour shall be made in the manner described under Standard Methods of Testing."

It was decided that a sample of the product from Test 4 should be sent to a paint manufacturer for an evaluation as to its suitability. Balm Paints Pty. Ltd., was selected and a sample was forwarded to this Company in September, 1962.

In January, 1963 the Company reported that the sample was a typical 200-mesh barytes with the colour being similar to their second-grade material.

6. CONCLUSIONS AND RECOMMENDATIONS

The barytes sample as submitted is suitable without beneficiation for oil-well drilling purposes.

In order to produce a product which may be suitable as an extender in paints, the following treatment stages would be necessary:

a. Crushing to approximately 20-mesh

b. Magnetic separation

c. Acid-leaching of the non-magnetics

d. Grinding all to minus 52-mesh for flotation

e. Two-stage flotation to include flotation of sulphide impurity.

f. Milling of the final concentrate to a specified size for the purchaser

In view of the appraisal of the sample of leached concentrate by Balm Paints Pty. Ltd., and their classification of the product as a second-grade barytes, exploitation of the barytes for paint use would be a doubtful proposition. The value of second-grade barytes would probably not allow economic beneficiation and leaching of the final product. It is recommended therefore, that the deposit be considered primarily as a potential raw material for oil-well drilling media.

APPENDIX A

REPORT OF INVESTIGATION

MATERIAL:	Random 1-inch lumps of Weekeroo barite deposit
LOCALITY:	Weekeroo
INFORMATION REQUIRED:	Mineralogical examination to determine: 1. Minerals present 2. Approximate liberation size of gangue from barite

RESULTS

Thin section examination showed the sample to be principally coarsely-crystalline barite with finer-grained silica, muscovite and opaques as impurities. These granular impurities, some of which are surrounded by fine-grained limonite, vary in size between 80 and 1300 microns, while the coarser inclusions are 50 microns in diameter, but generally much smaller. Material producing discolouration of the barite appears to be mainly iron staining around the grain boundaries with inclusions of opaques having an added effect. Patches of limonite, presumably from the complete alteration of opaques, occur occasionally.

A sample of the material was crushed and wet screened to a minus 36- plus 100-mesh (BSS) fraction. It was noted here that the material was fairly clean, indicating that much of the staining could be removed by washing. Magnetic impurities were removed using a Franz Isodynamic separator at a slope of 20°, tilt 15° and at successive amperages of 0.2, 0.4 and 0.6. This was sufficient to remove the bulk of the opaques, which were shown by mineragraphic examination to be magnetite, hematite, goethite and chalcopyrite. In the size fraction stated above liberation of barite from gangue is good since few composites were observed.

Investigated by: P. J. Sweeney

Officer in Charge, Mineralogy Section: H. W. Falder