BARITE

Barite, $BaSO_4$, is the principal economic barium mineral. It usually occurs as vein material with lead and zinc ores and also as replacement and cavity fillings in limestone. It is often associated with flint and calcite and with intergrown hematite, fluorite and celestite.

Barium ores usually contain silica, iron oxide and also alumina as the chief impurities.

Properties:

Colour: White when pure, but may be grey, yellow, blue, red brown or black.

Lustre: Vitreous to resinous or pearly.

S.G.: 4,3 - 4,6.

Hardness: 2,5 - 3,5 on Mohs scale.
Soft or granular barite is usually preferred to hard, crystalline material in view of the grinding requirements during treatment.

Grindability: 116 Hardgrove index, which is easy grinding compared to silica.

Barite is insoluble in water or acids, it fuses with difficulty and usually decrepitates losing SO_3. It is usually platy or granular consisting of diamond-shaped or rectangular crystals.

Uses:

1) Paint Industry
in lithopone production - a white pigment containing typically 70% precipitated $BaSO_4$ and 30% ZnS. Typical barite specifications are:
95 - 97% $BaSO_4$ (minimum)
1% Fe_2O_3 (maximum)
traces only of Mn and CaF_2.

First grade barite is also used in competition with pigment rutile, barite showing superior spreading power and having special application in undercoating and for outdoors.

2) It is used as a filler in the rubber, textile and paper industry.

3) The drilling mud used with deep rotary drills for oil and gas exploration is a water suspension of clay and barite, the latter providing density to the fluid.

Specifications/

Specifications usually only stipulate 95% - 325 mesh of grind and S,G, greater than 4,2. Iron content is not specified; $BaSO_4$ content can be as low as 90% as long as S.G. is > 4,2.

4) Chemical grade must contain a min. of 96% $BaSO_4$, a max. of 0,4% Fe_2O_3 and no Mn.

Most of the barite produced today is consumed for drilling mud and in the paint industry.

Market Prices: (July, 1973)

	£ Sterling/Ton
Ground, White paint grade	
(96 - 98% $BaSO_4$, 99% - 325 mesh)	45 - 50
unground, bulk (minimum 92% $BaSO_4$)	9 - 11
drilling mud grade (ground; SG > 4,2)	16 - 19

Treatment Methods

These vary with the character of the ore and with the scale of mining.

Typically

1. Coarse crushing; washing and screening; handpicking on screen oversize. Screen undersize and rejected coarse material to waste dump.

2. As above, with jigging of the screen undersize.

3. Wastepicking on washed, coarse feed followed by crushing and jigging of upgraded ore.

4. Combinations of the above with tabling after size classification, classifier overflow being fed to the tables.

5. Scrubbing followed by differential grinding and subsequent size separation.

6. Combinations of the above with froth flotation.

7. Heavy Media Separation with or without subsequent flotation treatment of the minus 0,5 min. fines.

8. Before

8. Before being finely ground to chemical purity most barites need bleaching with hot, dilute H_2SO_4 and reducing agents.

9. For drilling mud barite, heat treatment is usually required to remove the anionic flotation reagents, if used, since these result in a non-wettable product, unsatisfactory for drilling muds.

Notes on the Treatment Methods

1. Handsorting

Still used where manual labour labour is cheap. Effective only above about 30 mm. Picking rates low at ½ - 2 Ton per man per hour depending on size and S.G. Efficiencies (throughput and product recovery) are usually poor due to variable workloads.

2. Jigging.

Since handpicking is usually effective only above 30 mm, the screen undersize needs to be treated by other methods, a common means being jigging.

Jigging is very effective on separations of clean barite from gangue down to fines sizes.

It is common practise to crush the above screen undersize down to about 15 mm. and then jig down to 65 or even 100 mesh.

3. Tabling can be resorted to for material below about 20 mesh. It is an effective gravity separation method, but occupies large floor space since tables are low tonnage units.

4. Differential Grinding is often attractive when the contaminants are dispersed in the barite. This can be done dry, and large throughputs can be achieved with small installations.
It is usually carried out on part beneficated coarse barite (after coarse crushing, scrubbing, screening and handpicking).

The crudely cleaned barite is either milled dry in roller mills e.g. Raymond Mill, ringroll Mills e.g. Sturtevant; hammer mills e.g. Asbestos Grading Classic Mill; or ball, pebble or rod mills or wet in ball, pebble or rod mills where a light grind and high pulp density are maintained. Separation is effected by fine screening.

Feed is usually not coarser than 15 or 20 mm. and product is often reduced to 65 or 100 mesh.

Due to /

Due to barite being relatively soft compared to silica considerable benefication with good recoveries can be achieved particularly when the natural grain size of the gangue (silica) is larger than that of the barite. Whereas the dry roller and hammer mills require very little floorspace and consume little power, the mills require considerable maintenance and efficiency decreases with operating time. On the other hand the ball, rod and pebble mills require large floor space, consume a lot of power and are high in initial cost but require little maintenance and attention and are easy to control.

5. Flotation

This is usually employed as a supplement with the above coarse size separating method or in those instances where the contaminants are so finely dispersed in the barite, that fine grinding is required. It is a relatively expensive benefication method but very effective, yielding good grades and recoveries. Because of the flotation costs as much upgrading as possible is carried out prior to flotation.

Barite floats readily with fatty acid collectors and with the sulphate and sulphonate salts of the corresponding alcohols. Since the feed to flotation is usually high grade ($>50\%$ $BaSO_4$) stage addition of collector is required.

When producing drilling mud barite anionic flotation reagents are usually not used since they yield a non-wettable barite concentrate, which must be heat-treated to remove the reagents and make it wettable. Shell 795 reagent is an effective barite collector yielding a wettable concentrate.

Typically concentrates assaying 90 - 95% $BaSO_4$ at an S.G. of 4,2 - 4,35 and at recoveries of 80/85% are reported from feeds containing 80 - 85% $BaSO_4$ and 10 - 15% SiO_2 at S.G. of 4,0 - 4,15.

Heavy Media Separation (H.M.S.)

In the past adequate supplies of clean barite easily separable from the gangue were readily available to satisfy the increasing demand for this material.

Hence many of the "plants", some still operating today, were relatively crude, using the simplest methods to extract the barite. Metallurgically speaking losses were high (low plant efficiencies; fines often discarded) and contaminated barite was not mined, which was then economically justifiable.

However, as reserves are being depleted and the demand continues to increase, so are the more efficient treatment methods employed more widely.

HMS is one of the of the most efficient commercial methods of gravity concentration and is being considered as a means of beneficiating barites,

particularly when/

particularly when these are contaminated with undesirables dispersed in the barite.

The development of the various grades of atomised, spherical ferrosilicon allows accurate separation at 3,80 S.G. in "static" vessels and even higher cutpoints in the heavy media cyclone. Due to the many improvements in overall plant design, separatory vessels, types of medium, medium recovery, density control etc., it is today possible to achieve quite spectacular separations e.g. S.G. difference of 0,01 S.G. are being exploited to economically achieve H.M. separation of valuable product from waste, and separations down to 0,5mm are now common.

"Coarse" material is usually separated in "static" vessels, while "fine" material is separated in vessels which make use of centrifugal force to effect a tight separation.

"Coarse" H.M.S.

Some "static" vessels used are H.M. Cones; Wemco and Linkbelt drum-type vessels; Akins, Hardinge and Wilmot-Daniels classifier-type vessels, the Norwalt separator and other, all employing the force of gravity to separate waste from product.

Typically in the Wemco developed drum separator large, tonnages of -100 + 6mm product particles can be accurately separated from barren gangue in plants requiring relatively little floor space.
S.G. separations at up to 3,8 S.G. can be effectively carried out separating products as little as 0,02 S.G. apart.

"Fine" H.M.S.

Ore below 30 mm is usually separated in vessels employing centrifugal force e.g. Dynawhirlpool, Bretby Vorsyl separator, Dutch State Mine Heavy Media Cyclone etc. Typically in the D.S.M. H.M. Cyclones, densities in excess of S.G. 4 can be achieved and separations closer than 0,01 S.G. have been performed.

The bottom size in the cyclones is usually 0,5 mm.

General

The many improvements in barite benefication in recent years demand that initial investigations be carried out by personnel thoroughly familiar with all aspects of the benefication processes as they require careful laboratory and often pilot plant testwork to establish the optimum operating conditions most economically suitable for each particular ore to be concentrated.