MEMOIRS
1971

Nichols, A.R. 1971 “Dry Gill Mill”
Memoirs NCMRS, Vol.2 No.1, pp.31-36.

Published by the

THE NORTHERN CAVERN & MINE RESEARCH SOCIETY
SKIPTON U.K.

NB
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DRY GILL MILL

A.R. Nichols

Introduction

This article describes the development of the mill built in 1963, by the Clay Cross Company Ltd to extract fluorspar from the old tips of the Burhill mines and later from the companies own mines, on a lease held by the company in the parish of Appletreewick in Wharfedale, Yorkshire. Most of the information Used in the compilation of this article was gathered directly from operations at Dry Gill, the writer being an employee at the mill until shortly after its closure in 1967.

Location.

The mill was situated at Dry Gill Appletreewick in the West Riding, of' Yorkshire, (NGR. SE 07876318) approximately 200 yards south of the B6265 Pateley Bridge to Grassington road. This part of the mineral lease was chosen as the mill site 'for a number of reasons, three of the more prominent being, accessibility from the public road, water supply and the fact that the site had been used for, a similar purpose by the previous lessee, Mr F.C. Walker. As the mineral lease is in the Yorkshire Dales National Park, planning permission was more readily granted using the same site, as this did not involve a change in the use of the land.

Development.

The original mill was made up of a log washer, bucket elevator, vibrating screen, crusher, hopper and a jig.

The log washer was fed by hand, the feed material being thrown, against a 3 inch inclined grizzly, positioned over the log washer. The underflow from the log washer discharged into the well of the elevator, overflow passing along a launder into three sluice boxes which were emptied periodically.

If a particularly clean material was to be fed, the log washer could be by-passed by tipping feed into a hopper through a 3 inch horizontal' grizzly. Discharge was controlled by an adjustable gate into a chute to the elevator well.

The elevator discharged into, a chute feeding a Pegson Twin Deck vibrating screen. A hall inch screen mesh was fitted to the top deck, the bottom being blanked off. Over ½ inch material passed either to [31] a stockpile or through a coke crusher and back to the elevator well. Material less than ½ inch could either be fed by chutes to the jig or into a 20 ton hopper.

The jig was built using Wilfley shafts, bearings, eccentrics and pedestals. The hutches were fabricated with sheet steel using the original Wilfley pattern, but with steel floats. The first of the four compartments was fitted with a ¼ inch screen and bedded with barytes, collecting galena and barytes, although usually with a good deal of fluorspar. Metallurgical grade fluorspar was taken from the second, third and fourth hutches, which were discharged into ¾ cub. yd. dumper, to be carried to the stockpile.

Slimes from the log washer overflow were collected in a lagoon adjacent to the mill. Water used in the mill was pumped from a small dam built in Dry Gill Beck by a 7 H.P. centrifugal pump. The dam level could be raised by discharging water from an old man dam above and south of the mill. Loading operations around the mill were carried out by a Fordson Major tractor fitted with a 'Horndrau1ic' bucket unit.

A number of difficulties were encountered with this mill.

1. It was found that by hand feeding the log washer sufficient feed to the jig could not be maintained.

2. The crusher would not deal with limestone or chert.

3. A good deal of fluorspar was being made unsuitable for sale because of galena contamination.

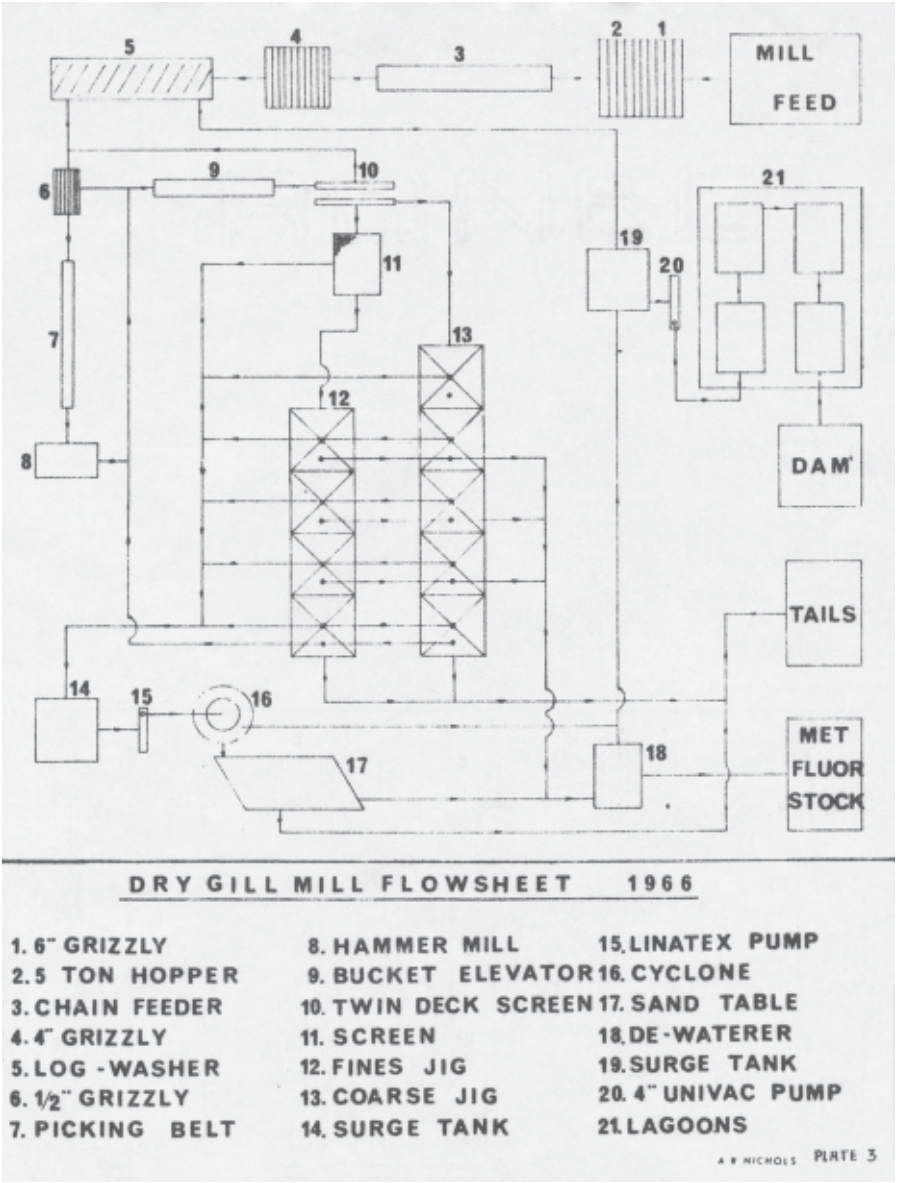
4. The slimes lagoon, which had been excavated in old man tips never filled, as effluent percolated through the tips into Dry Gill Beck.

To overcome the feed problem, a hopper fed scraper. conveyor was installed. This was fed by a tipping lorry from a specially built ramp to the hopper. The conveyor feeding onto the log washer grizzly.

After tests by crusher manufacturers a small Lightening Hammer Mill replaced the coke crusher.

The hammer mill was fitted with ½ inch grates to ensure a ½ inch product. However it was soon apparent that the crusher quickly choked due to sticky clay blocking the grates. This was overcome by removing the grates and re-circulating the crushed material until it passed through the ½ inch vibrating screen.

To remove the galena a Denver Duplex jig was installed, dealing with $-^1/_8$ inch material passing through the second deck of the Pegson [32] screen, now fitted with $^1/_8$ inch woven wire mesh. The jig was bedded up with galena, which very quickly broke down to $-^1/_8$ inch, $^1/_8$ inch wedge wire being fitted in the jig and the bed was soon lost into the hutches. The $-^1/_8$ inch feed to the mill was reputed to consist of material carrying 80% fluorspar, enabling the tailings from the Denver jig to be collected in a tank, emptying along with the Wilfley jig product into the dumper. Unfortunately the $-^1/_8$ inch material contained silica in various forms Which lowered the grade of the product accordingly. Another small alteration was needed because of continual choking of the log washer grizzly, after the installation of the scraper conveyor. The grizzly aperture was altered to 5 inch and a 3 inch grizzly installed between the log washer head and the bucket elevator well. Oversize from this grizzly was hand sorted, lump fluorspar being shovelled into the elevator, stone being piled separately. Blockages were frequent in the scraper conveyor mouth, necessitating the fitting of a 6 inch horizontal grizzly on the hopper top to enable hand sorting of large stones.



The mill was run for a number of months but it became apparent that the 'old man' . dumps, which as mentioned earlier were reputed to contain a high percentage of fluorspar, were rapidly diminishing. Mill feed was upgraded by adding high grade material from the Burhill Mine when available.

It was obvious that a major change in the mill was necessary to enable low grade dump material to be dressed. In l964 it was decided to split the feed into three sizes, treating each size separately. Two jigs and a table were purchased from Derbyshire Stone Ltd, these being surplus to their requirements. The original Wilfley type and Denver jigs were removed. The new jigs were fitted with $^{1}/_{8}$ inch wedge wire screens and a product taken from the beds by 'Pen-taps'. The larger of the two jigs, having five compartments, treated the coarser sizes +¼ inch to -½ inch. The smaller four compartment jig, treating -¼ inch. On both jigs, the last compartment pen tap took a low grade product for recirculation, helping to prevent loss of fluorspar in the tailings. The -$^{1}/_{8}$ inch hutch product from both jigs emptied into a surge tank feeding a 1½ inch Linatex pump which discharged into a cyclone. Sand from the cyclone fed the Holman sand table.

Satisfactory results from the table were rare, as the coarser material in the cone settled through the slimes every time the jig hutches were emptied, constant1y changing the feed characteristics.

When material from the mine, containing many fines, was being fed into the mill, the fine jig hutches required constant emptying, causing a great deal or work for the jig man, and upsetting the table feed more often. To help overcome this problem a small $^{1}/_{8}$ inch vibrating screen was installed between the Pegson screen and the fines jig, in an attempt [33] to remove the -$^{1}/_{8}$ inch fines from the jig feed. Screening at this size with such a simple screen was not very efficient, although the trouble was eased somewhat.

Much of the mill feed at this time was coming from the Gill Heads Mine dumps, which contained large stones and lump spar. With the then existing plant layout, 3 inch and 4 inch material was being passed up the bucket elevator and over the ½ inch wire mesh screen before reaching the crusher. This caused excessive wear on the machines and constant blockages of the crusher feed chute.

During the 1965 summer shut down, the, crusher was moved to a new position and was preceded in the flow line by a 12 inch wide picking belt, to enable large stones to be removed before the feed reached the crusher. Most of the -½ inch, material by-passed the picking belt and crusher through a ½ inch grizzly at the log washer head.

Stone picked off the belt was thrown down a chute to a small stockpile, to be removed by a Weatherill L62 loading shovel, which replaced the original Fordson tractor loader, after trials with a Weatherhill 12H shovel. A Weatherill L61 later replaced the L62 after many failures.

The sluice-boxes, used to collect sand from the log washer overflow, needed to much attention to justify their use. An attempt to collect sand mechanically using a paddle classifier, placed so as to enable its underflow to be discharged either onto the fluorspar stock pile or to an alternative stock pile. The attempt was not successful, however, the classifier was left in place and put to good use. Until this time, mill fluor spar product was discharged by launders into the stock yard, along with the flushing

water, which unfortunately washed fine fluorspar down the drains. The launders were made to discharge into the classifier, which now served as a dewaterer, for which use it was originally designed.

During the time taken to modify, test and re-modify the mill, the dump material was practically exhausted and mine production, both stope and opencast increased. This changed the character of the mill feed dramatically. The ore from the mine was usually very friable, causing many fines in the mill feed. The table, which produced the lowest grade, was by this time usually working heavily overloaded, making matters even worse. In an attempt to reach the production required to run at a profit (which had gradually reached an impossible figure, due to modifications to plant etc.) the material which should have been fed to the table, was usually fed direct to the stock, lowering the grade of the product accordingly.

At this stage Messrs. Davison and Co. Ltd. of Hexham were asked to [34] assist in improving the mill further. They suggested that the mill was overloaded with fines and production would have to be cut drastically in order to produce the necessary quality. The alternative was to add more plant to the mill. The plant required was another jig, to ease the load put on the table, by jigging the $-^{1}/_{8}$ to $+^{1}/_{32}$ inch material on a jig of their own design and manufacture, leaving the $-^{1}/_{32}$ inch for the table. The $-^{1}/_{8}$ material would be split by two or three Richards classifiers.

To enable this to be done, it would be necessary to reduce all material to -½ inch before passing to the existing twin deck screen. The screen could then produce the -½" to +¼", -¼ to $+^{1}/_{8}$" and $-^{1}/_{8}$" material required. This would also rid the crushing, elevating and screening equipment of recirculating material. They also pointed out that although the existing hammer mill was cheap and quick it did produce unwanted fines. This should be removed and replaced by a jaw crusher and high speed rolls with washing and screening at each stage. The crusher would be fed from a 1" trommel placed at the head of the scraper conveyor, and the rolls fed from a ½" vibrating screen at the head of the log washer. Hand picking would not be necessary. This scheme was considered and rejected because of the expense involved. The modifications would certainly have increased the grade of the mill product, but only marginally increased overall production. Each change to the mill had increased the tonnage required to show a monthly profit, which was already practically beyond reach. Further capital outlay was therefore impossible. Because of this and a similar situation with mining costs, the mill was finally closed early in 1967.

Effluent Control

The original settling pond for mill effluent was allowed to fill with slimes and fine sand, and a new lagoon was made by building up the sides of a shakehole situated a few hundred yards from the mill. A 4 inch pipe line was laid across the moor being fed by a 4 inch Sykes Univac pump, pumping from an 8 ft. deep sump. When this new pond was put into use, effluent appeared in the stream a few yards from the collecting tank. The pond appeared to be leaking into an underground channel from a number of points around the pond sides. Sheet polythene was placed around the pond, easing the situation to some degree, but not enough to allow the pond to fill.

It was decided to excavate four lagoons on a site above the fresh water dam. serving the mill in dry weather. The effluent flowed round the four lagoons in turn, overflowing from the fourth along a channel cut to the fresh water dam. To improve flocculation of slimes in the lagoons, a lime feeder was installed to feed four or five hundred weight per day of lime into the collecting tank at. the mill. As the change over to the new lagoons involved an increase in pumping head, a new 40 h.p. Sykes Univac 4 inch pump was used.

[35]

CONCLUSIONS

The writer does not consider himself sufficiently qualified in the field of mineral dressing to criticize actual mill design. However close association with the mill does he feels give him the right to pass some judgment.

It is a pity that the owners did not engage specialists to design and build a mill suited to the ore reserves on the lease. No attempt was made to sample the ‘old man’ tips. available, in an efficient manner, and overall estimates of tip material available were much higher than later excavation proved them to be. Because of this, mined ore became the primary mill feed, for which the mill was not best suited. Mining was always ‘hand to mouth’, there being no planned development work in the mine, therefore it was not know what type of feed could be expected at the mill. Stockpiles, were not assayed regularly to enable a planned and regular mill feed, which did not help product quality. Mill efficiency could not be calculated as there was not a weigh bridge at the mill.

[36]