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DEPARTMENT OF MINES

SOUTH AUSTRALIA

Report on

QUARRYING AND CRUSHING OPERATIONS

D. K. McDONALD & SON LTD.

PORT LINCOLN

by

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MINING BRANCH

CONTENTS

Rept. Bk. 54/140

MN. 98/176

D.M. 350/62

16th April, 1962

Dept. Mk. 54/140
R.N. 96/176
D.M. 388/62

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ABSTRACT

The quarrying and crushing operations of D. K. McDonald and Son Ltd. of Port Lincoln have been operating at a loss. This is primarily due to the small local demand for stone, although factors appertaining to practice are secondary contributors. Recommendations have been made to improve the present condition.

INTRODUCTION

Following a direction by the Deputy Director to treat an investigation of the above operations as urgent, I visited Port Lincoln on the 26th February, 1962.

The day was spent in inspecting the quarrying operation and in discussing the difficulties associated with the supply of crushed rock in the Port Lincoln area.

McDonalds are supplying ¾" crusher run in Port Lincoln for 9d/- per yard and claim they are running at a loss at this figure, but do not feel that they can reasonably charge more. They state that the earth-moving side of their general contracting business is carrying the quarrying at present despite the efforts they have made over the years to make the crushed rock business profitable.

REPORT

Before delving deeper into the reasons for the conditions which prompted this request for assistance, the following facts relating to the crushed rock business obtaining in Port Lincoln today should be stated:

1. The only quarry operator is D. K. McDonald & Son Ltd.
2. The quarrying and crushing was commenced by McDonalds as a necessary adjunct of their road making activities - there being no other suppliers.

3. Average sales are 400 tons per month.
4. Plant Capacity is 150 tons per day.
5. Size of primary crusher is 20" x 12".
6. Value of Crushing Plant is about £17,000.
7. Current quarry is 12 miles from Crushing Plant.
8. Crushing Plant is 7 miles from Port Lincoln.
9. Loading in quarry is done with Caterpillar 933 Trunsevator.

Cost of Production

There is virtually no cost control over the operations. No permanent clerk is employed as such and all figures supplied are estimated costs. Mr. J. McDonald supplied me with an estimated operating cost of 46/6 per ton, which, on checking, combined with my own observations, appears to be reasonable. This is made up as follows:-

	s.	d.	
Drilling and Blasting	10.	8.	
Loading (Transevation) Cost	7.	3.	
Labour	3.	8.	
Quarry Sundries	1.	0.	
Transport to Crusher	11.	7.	(includes 20% allowance for scalps)
Crushing	8.	0.	
Transport for Stockpiling	4.	0.	
Royalty		4.	
	46s.	6d.	

In view of the selling price of 50/- per yard it is worth noting that the figures supplied make no allowances for sinking fund, interest on capital or maintenance. Allowing investment rates of 5%, a 10 year life, and a maintenance rate of 10%, a further charge of 16/- per ton should be imposed for fixed costs, making the cost of production 62/6. If a 10% profit were superimposed on this the selling price should be 68/9 which is far in excess of the 50/- being charged by McDonalds.

From these figures it would appear that McDonalds request for urgent assistance is thoroughly justified.

Working Costs

Drilling and Blasting Costs are excessive. This is due to several factors. Firstly, the small size of the primary crusher 30" x 12" makes it necessary for run of quarry rock to be broken very small. Secondly, the only acceptable available rock is either granite or granitoid gneiss. To blast this tough rock to a size which will reduce secondary blasting to a minimum requires close spacing of holes and an explosive factor of approximately 1 ton per lb. of explosive. Even so an absolute minimum of approximately 20% of stone produced requires secondary breaking, usually by hand since its size is such that it does not warrant popping but is just too large for the small primary crusher.

The close spacing of the holes requires a lot of drilling. This is currently done with a Silver Bullet using 1" hexagon T.C. tipped drill steels up to 18 feet in length. The time taken to drill an 18 feet hole with this equipment is approximately 2 hours.

The cost of transport to the crusher is high at 11/7. However, this is based on the standard transport charge of 9d. per ton mile for on-highway hauling and allowing for a 20% loss for material hauled from quarry to crusher which is of no commercial value. The McDonalds feel that this quarry, even though 12 miles from the crusher, has better potential from the viewpoint of topography, blasting characteristics etc. than any quarry they have previously worked.

Plant Throughput

With a steady demand to the capacity of the plant, the monthly output would be in the vicinity of 3000 tons. Instead of this, the average sales are only 400 tons per month which must have a marked effect on the cost of production. In effect, the quarry and crusher only work about 3 days per month.

Admittedly, the working costs are excessively high, and the means of reducing this will be discussed later, but with such spasmodic operations and the consequent reshuffling of men and plant an efficient operation can hardly be expected. McDonalds state that if they could produce 20/- per ton cheaper the consumption would rise by 25% - but this would make the monthly output only 500 tons per month, still far short of the maximum figure obtainable.

It would thus appear that a large part of the problem is the limited demand for crushed rock in this area.

Reduction of Costs

The first step which must be taken by McDonalds in this regard is to institute a costing system which will give them a complete breakdown of their current quarrying and crushing costs. The importance of this step was stressed during our discussion and I am forwarding to them a list of headings under which their various costs should be grouped.

There are complimentary bottlenecks in the current operation and the critical observer could say that the existing crusher is too small. He could also say with equal certainty that the run of quarry stone produced is too big. Which statement should be acted upon is easily ascertained. The existing crusher can handle at least six times the current demand for stone, so the installation of a larger crusher is not warranted from this angle. A larger crusher is certainly warranted from the viewpoint of stone size it will receive, but when the plant capitalisation is already so high when compared with demand, further capitalisation in the form of a larger crusher cannot be reasonably justified. This then makes the second statement the nub of the problem, i.e. the run of quarry stone produced is too big.

The first step in the solution of this problem was taken during my visit. The firing method to date has been by the instantaneous firing, with the use of cordtex, of holes on 4' spacing and 4' burden column loaded with 1½" AN 60 Geligmite. I suggested that we fire a number of holes which had already been drilled using short delay detonators directly in the primers and dispensing altogether with cordtex. The effect of dispensing with the cordtex is to increase the velocity of detonation of the explosive and so increase the fragmentation. The effect of the short delay detonators is to further increase the fragmentation by prestressing the rock with one delay before firing the succeeding delay period. The blast produced was quite satisfactory in one regard but did not improve the other. The average size of stone produced was much improved but the overall proportion of large rock produced remained the same - this was to be expected since the four feet of stemming in the top of each hole means that over 20% of the stone in the face is not acted upon by the explosive. I suggested that the next series of holes to be drilled be put in at an angle of 15 -20° to the vertical, inclined towards the toe -

this will result in a further decrease of average size by reducing the 20% of large stone to about 10%. This 10% can be further reduced by the use of a secondary row of leading holes of 2' burden bored 2' deep in front of the main holes.

The secondmjor cost reduction can be effected by the use of more balanced drilling equipment. The Silver Bullet at present in use, although a good machine within its limitations, is not heavy enough for drilling holes up to 18' in depth using 1" hexagon steel. A much heavier machine on a mobile mount, such as a wagon drill is called for. I have suggested a machine about the size of Holman SL 250 or 300 Drifter and, since the Rockdrills at present in use are Holman, have requested A. Noble and Son to contact McDonalds in this regard. With the larger machine and the consequent faster drilling rate one man could be dispensed with in the quarry so lowering these costs.

One more practical point to be considered at this stage is that no toe should be allowed to build up between shots. At the time of inspection toe had built up to about 3 feet high, so reducing the efficiency of the trial shots fired on my suggestion.

The last point which can be considered as an immediate aid to cost reduction would be the use of a quarry site closer to the plant than the 12 miles obtaining. McDonalds have tried three other sites to my knowledge but for good and sufficient reason have discarded each. Discussion with Mr. K. Johns has elicited that there is a possibility of suitable stone in an area containing banded gneisses situated at approx. Lat. 34°38'S Long. 135°49'E on the Lincoln Sheet. This could be inspected by McDonalds in company with Mr. R. Shepherd, resident Geologist on the West Coast. If suitable stone were found here the haul from quarry to crusher could be halved.

SUMMARY AND CONCLUSIONS

1. A comprehensive costing system must be introduced immediately.
2. Attention must be focussed on better fragmentation in quarry.
3. Heavier rock drills are required to cope with tough drilling conditions.
4. Enquiries should be made into the possibility of finding a quarry site considerably closer to the crushing plant.

5. The effect of all suggestions made here would be to turn an operation which is currently losing money to a considerable degree into one which is less unprofitable.

6. If allowances for sinking fund and interest charges on capital are disregarded, they could even have the effect of turning a small profit.

7. Unless the demand for stone in the area increases, it will be nearly impossible to turn this operation into a really profitable proposition whilst charging a reasonable price for the product.

8. Aid could be given by this Branch in the form of more frequent visits with the prime aim of providing closer technical supervision.

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APPENDIX

SUGGESTED BREAKDOWN OF OPERATING COSTS

DRILLING COSTS

Gross Tonnage	X
Scalps	X
Nett Quarried Stone	X

X Where this appears the actual figure in tons or the total expenditure in pounds is inserted as applicable.

Y This is the cost per ton obtained by dividing total cost for any one item by nett quarried stone tonnage.

Job. No.	Labour	X	Cost/ton Y	Remarks
A1	Supervision (a)	X		(a)Supervision should include proportion of time of J. McDonald.
A2	Mechanical	X		
		X	Y	

Operating Materials

A3	Steel (b)	X		(b)Steel should be charged for at a regular rate/ton and a suspense account established.
A4	General Stores (c)	X		(c)Comprises such consumable items as oils, grinding wheels etc. - on a similar system as for Steel
		X	Y	

Repairs and Maintenance

A5	Labour	X		
A6	Materials (d)	X		(d)This should also operate on a suspense a/c - a fixed rate/ton established which may be varied depending on the condition of the a/c.
		X	Y	

Services

A7	Air Compressor (e)	X		(e)A rate/hour should be fixed for the compressor and a suspense a/c established as outlined above.
A8	Sundries	X		
		X	Y	

Cost per ton

Current Month	Y
Average Half year to Date	Y
Average Previous Half Year	Y

BLASTING COSTS

Job No.	Labour	Cost/ton	
B1	Supervision	X	
B2	Loading	X	
B3	Hand Breaking	X	
		X	Y
	Operating Materials		
B4	General Stores (a)	X	(a) Bell wire, firing lines, tamping sticks, hammers etc.
B5	Explosives	X	
		X	Y
	Repairs & Maintenance		
B6	Labour	X	
B7	Materials (b)	X	(b) Maintenance of firing gear, magazines etc.
		X	Y

Cost/Ton

Current Month		Y
Average Half Year to Date		Y
Previous Half Yearly Average		Y
Gross Breaking Rate (c)		(c) Includes scalps and is the amount of rock (in tons) broken per lb. of explosive.
Current Month		-
Average Half Year to Date		-
Previous Half Yearly Average		-

Without going into further detail, similar breakdown sheets could be prepared to cover

(1) Loading

(2) Transport, and

(3) Crushing and Screening.

For this scheme to operate effectively, each man employed must fill in a daily time sheet stating what duties were performed each day and how much time was spent on each. An hourly rate (including overheads) per man then allows the appropriate costs to be duly allocated.

All stores etc. should be requisitioned against the particular job for which they are required. The usual practice is to allocate job numbers for each phase of the operation - these have been shown on the suggested breakdown sheets. The extensions for Loading, Transport, and Crushing and Screening could use the prefixes C, D and E respectively.