

Larger Shovels - The Reality

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ABSTRACT: The drive for larger loading and hauling units has not slowed, with significant numbers of shovels with +100t payload loading trucks in the 240t - 400t size range. Productivity data is now available to assess the performance of the larger loading units. This paper takes a brief look at some of the available data and compares performance of the units in a number of "High Production Low Cost" operations.

1 FOREWORD

Since the authors are employees of P&H MinePro Services and P&H Mining Equipment, access to P&H equipment performance data is readily available through the kind cooperation of our customers, and that data forms the basis of this paper. Mining is an extremely competitive "environment and therefore we honor the request of our customers to keep our information sources confidential. We do not have ready access to competitor equipment performance and therefore the performance of only P&H loading equipment is covered in this paper. The numbers are real - this is not a marketing exercise to justify the purchase of specific equipment, it is dissemination of real information that will hopefully be informative to members of our Industry.

2 INTRODUCTION

For some years the term "Bigger Faster Smarter" has been heard throughout the Mining Industry. Just how are these machines performing? We have reached the stage where we have been able to gather sufficient data to demonstrate the capabilities of these shovels and their associated truck fleets. This paper is a summary to date of the performance of some of these larger loading units, highlighting some differences in applications and loading preferences.

Since 1991 the P&H 4100 series of machines has been among those setting the standards of productivity in the Mining Industry. Initially developed with a payload of 80t (short ton) to 3-pass load 240t (short ton) trucks, the equipment size has grown to payloads of up to 120t (short ton) 3-pass loading trucks with 360t (short ton) payload capability. Throughout

this period the emphasis has been focused on improving the productivity and lowering the cost per unit of product produced. And successfully, so it seems, since P&H alone has sold more than 140 units in this size range.

In the past, the performance of the larger shovels has largely been calculated and predicted through the utilization of various productivity and simulation models, and it's always handy to have some information to "back that up". Of course real information from the field is subject to a number of variances which make direct comparisons somewhat difficult, but we encounter amazing similarities when we look at mines that are truly "high production low cost" operations. Before we continue perhaps it's best that we get a little more definition on this term.

3 HIGH PRODUCTION LOW COST MINING

These are mines that truly seek to utilize their loading and hauling equipment optimally. Pushing these resources and maintaining their performance at their optimal capability ensures that the machines produce maximum tonnage at a lower cost per ton.

In order to do that, the mine has to make certain commitments from the overall mining perspective:

a) Blasting cannot be compromised - this is perhaps the key to the success of any loading operation. Unfortunately when it comes to cutting costs, the explosives are one of those items that gets high visibility, since it's usually a large check that gets sent to the explosives supplier every month. Because it's so visible and so easily measured, the explosives element is usually one of the first areas to get cut in a cost cutting exercise, which is exactly the opposite of what should be done in lowering total costs.

In fact the contribution by explosives to productivity and cost savings extends far beyond the loading unit productivity -

- Loading units are subjected to less shock loading and wear and tear when excavating well blasted ground
- Loading unit cycle times are optimized in that less time is spent digging through a poorly blasted face
- Power consumption is reduced in good digging conditions
- > Truck bodies are subjected to less impact loading from poorly blasted material
- There is less possibility of spillage in the loading area and on the haul road
- " Trucks leave the shovel both optimally loaded and with the load distributed evenly in the truck body
- In ore processing, the comminution process is optimized in that the primary crusher should be subjected to what it is planned to handle. In addition, the overall crushing process is optimized through proper fragmentation of feed material.

b) Scheduling has to be running at absolute optimum. Truck dispatch should ensure that there is no excessive queuing at the loading units. In order to maximize the production from a loading unit, a slightly over-trucked situation is ideal, this eliminates unnecessary "non-loading" time.

c) Loading method has a huge effect on productivity, and varies among applications. For high production low cost applications, the double back-up or drive by systems produce the best results.

In many applications, the double back-up is enhanced by the fact that a truck is already positioning itself ready for loading on the one side while the truck on the other side is being loaded. For some mines, this is considered a safety issue, and the preference is for the truck to be ready to back up. It does not move into position until the shovel operator gives a signal. Certainly, within the P&H range of shovels, there is sufficient geometry and truck spotting tolerance to enable backing up on the "blind side" to be conducted safely.

The modified drive-by system has been used with great success in coalmines in the Powder River Basin in the U.S.A. What makes it "modified" is the fact that the first load is dumped into the truck in the standard drive by fashion. Thereafter when the shovel turns to fill the dipper in the face for the 2nd pass, the truck operator actually backs the truck up and decreases the angle the shovel has to swing for the 2nd and 3rd passes. After the truck has the 3rd pass loaded, it drives away and the next truck pulls into the "drive by" position in time for the shovel to dump its first pass. The result is that there is no time

lost due to spotting, swing angles are reduced and the operation is virtually continuous.

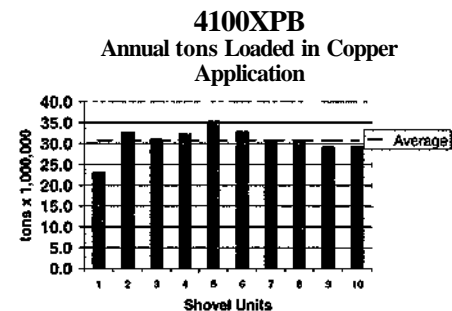
d) Maintenance has to be well planned and coordinated with the schedulers in order to ensure that equipment downtime has little or no effect on the operation.

4 FIELD PRODUCTION PERFORMANCE

Loading performance data has been collected from 53 shovels operating at 26 mine sites, the following is a summary of that data.

4.1 Hard rock applications such as Copper ore and waste.

The 4100XPB's with a nominal pay load of 100st to 120st have consistently passed benchmark test requirements of 7200t/hr, and achieved peak produc-



tivities of 8000t/hr. Typically we are seeing fleet averages of 5280t/hr in these applications.

Figure 1: Annual Production of 4100XPB's in Copper Applications

Referring to Fig. 1, the annual tonnage of the fleet of 10 shovels in this group from which data was collected averaged 30.7 million tons per shovel, and average production time per shovel is 25 months, i.e. an average of 2 years operating per shovel.

As can be seen on the graph, one shovel actually exceeded 35 million tons loaded per annum. This particular shovel has already been in operation for 39 months, so it is well established at the mine as the top producer. These are the tonnage that we expect to see from High Production Low Cost applications.

The 4100 and 4100A models of equipment, with their nominal payloads of 80st to 90st have also demonstrated the high tonnage that we expect in the High Production Low Cost environment.

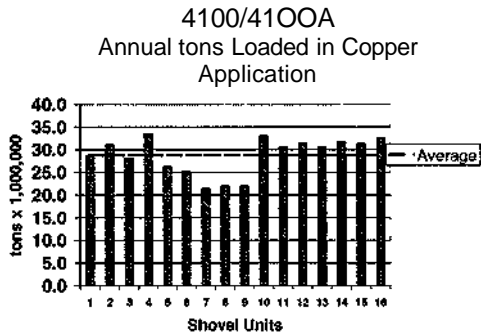


Figure 2: Annual Production of 4100's and 4100A's m Copper Applications

Fig. 2 shows the annual production of 16 shovels with an average of 29 months average production time per shovel. That's nearly 2.5 years of loading data average per shovel, one of these units has been in operation for 57 months. The top producers in this group are in the 30-million plus tons per annum, with two units actually achieving an average annual tonnage of over 33 million tons.

4.2 Coal Overburden Applications

Unfortunately the Industry views coal overburden as a "softer" loading application. Maybe in some areas of the world this does apply, but in most cases the overburden has hardness in the region of 100Mpa, is highly abrasive and has to be drilled and blasted in order to be loaded. As such we tend to view this application as still being tough. Add to that the environmental extremes of these applications and the machines take a beating. They are pushed in many cases beyond optimum in an effort to keep down the cost of the coal being exposed.

The 4100XPB's that we have been monitoring have been in coal overburden applications for an average of 22 months, with our longest serving "member" at the 40-month mark.

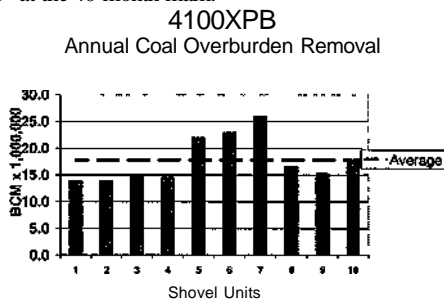


Figure 3: Annual Production of 4100XPB's in Coal Overburden Applications

The 10 units shown in Fig. 3 have been averaging a little under 18 million BCM's per annum, with the top producer exceeding 25 million BCM's per annum. This machine has been in operation for over 30 months, with another top producer averaging 23 million BCM's per annum over its 40-month life. One may debate that the 3 top producers skew the graph, which indeed they do, but the production they are achieving is real, utilizing the modified drive by method of loading, and therefore their production has to be taken into account.

The 4100 and 4100A's are again a larger group - (see Fig. 4). The 17 shovels we have in the group have averaged a little fewer than 16 million BCM's per shovel in annual production.

4100/4100A Annual Coal Overburden Removal

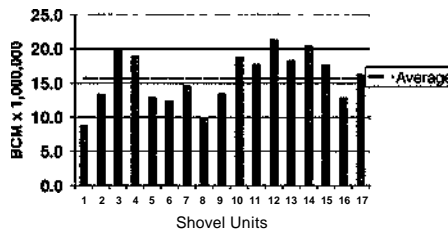


Figure 4: Annual Production of 4100XPB's in Coal Overburden Applications

Again the top producers are utilizing the modified drive-by method of loading, with 2 machines exceeding the average annual production of 20 million BCM's, and a host of machines starting to reach up toward that mark.

5 CONCLUSION

As previously mentioned, the performance of these loading units is affected by the truck allocation and loading methods. We think that the results certainly do speak for themselves. We have not shared any cost data in this exercise, as there are huge factors that affect costs and therefore they cannot truly be compared. We have clarified that this is not a marketing exercise, but an attempt to demonstrate that the new generation of shovels and trucks actually do "produce the goods". The users of this equipment continue to procure more and more units to satisfy

their production requirements, which in itself is testament to the success already being experienced

Acknowledgements

The authors would like to thank those 26 mines operating the 53 loading units referenced in this paper for sharing their production information

Thank you also to the personnel of P&H Mining Equipment and P&H MinePro Services whose passion for lowering our customer's costs is a significant contributor to the success of these "Bigger Faster Smarter" shovels.

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