THE USE OF SURFACE MINER AT PARAGOMINAS BAUXITE MINE

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Abstract

The Paragominas bauxite mine is located in the north of Brazil and has about 280 millions metric tons of washed bauxite (dry). The average ore thickness is about 1.5m and after the overburden removal the ore is ripped by bulldozer (34m^3), excavated by backhoe hydraulic excavator (5m^3) and loaded to small trucks (25m^3). In order to get better selectivity and reduce the costs on the mining process, Mineração Paragominas has bought a surface miner. This equipment has replaced the operations did by the bulldozers, hydraulic excavators and the graders. Beyond this, it has almost the double of the hydraulic excavator productivity and can work with bigger trucks (60m^3) reducing the mining costs. The ore control process is better, since the terrain shape left by the surface miner is more regular. At the feasibility studies there were a lot of questions and doubts regarding the performance and costs of this machine. The first question was about the productivity working on the bauxite of Paragominas mine which is very hard, when compared with MRN for example. The second question was about the costs, since the bits consumption has a big weight on the operation costs. And the last one was about the operation on the rainy seasons since with the backhoe excavator always works on the top of the ore and with the surface miner there are three or four levels depending on the ore thickness. This paper discusses these questions and presents the previous results of the performance of this machine.

1. INTRODUCTION

The main objective to introduction of surface miner (SM2500 Wirtgen) in the Paragominas bauxite Mine is to reduce operating costs and investments, replacing the equipment of current mining system (CAT D11 dozers in scarification process and recovery the pit, CAT 365CL excavator in ore loading and CAT 160M in the square after scarification) with a differentiated system, composed mainly by SM 2500. Thus, we expect significant gains in productivity system, reduction in diesel consumption and possibility to implement new development projects.

2. PREPARE OF WORK AREA

The Surface Miner (SM 2500) areas of operation are 30m x 400m (Figure 1). The preparation is done with the D11 bulldozers, excavators of 19m^3 and trucks of 60m^3.

The dimensions of the area are directly related to two factors:

- Entry and exit of trucks - eliminating the switching operations for loading;
- Free area to move the SM - the end of the track and the beginning of a new cut has the space concerning the progress of access for this operation.

It is extremely important that during overburden operation, are complied with topographic alignments and the excavators move towards the deposit beyond the contact of the ore, as well, to minimize ore losses during the loading of trucks and related to the contact side.\

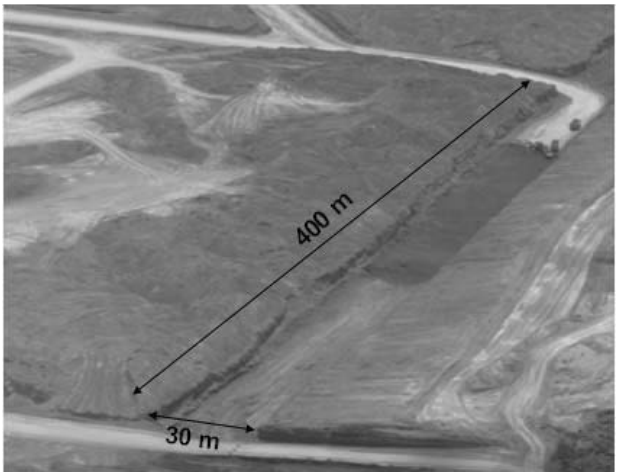

Figure 1 - The Surface Miner (SM) area of operation.

3. OPERATIONAL CHARACTERISTICS

Initial studies showed that the productivity of the SM 2500 is directly related to some characteristics of the deposit and operational constraints encountered. Among them are:

1 - hardness and irregularity of the layer of ore;
2 - maneuver of the equipment;
3 - time the machine waits for the return of trucks;
4 - position angle of the belt (spear).

In the beginning of the cut, the cycle times were recorded up to 130 seconds, as the first layers of ore (bauxite crystallized – BC). Moreover, this cycle time is directly influenced by the irregularities of the ore body. As finished the first cutting and you get a square level, the cycle times of loading between 90 and 100 seconds.

Another influence is the belt position angle and can operate with 90° or 45°. The perpendicular operation (Figure 2) gives more visibility to the operator of SM 2500, and during loading, there is less spillage of ore. The operation at 45 ° (Figure 3) is required when the equipment is near to the sides of the box. Here, there is a greater spill in the loading of ore on the backs and sides of the truck due to poor visibility of the operator.

Figure 2 - Loading at 90°

Figure 3 - Loading at 45°

One of the operational delays that also impacts on the machine productivity is the time spent with the exchange of trucks after loading. There are currently spending an average of 20 seconds.

Another relevant point is the system's operating SM 2500, running at the end of each section according to the diagram shown in Figure 4 and spending on average 7,5 minutes, counted from the completion of loading the last truck and beginning of the next section, located next to the former. In this methodology, there is no loading of trucks during the maneuver.

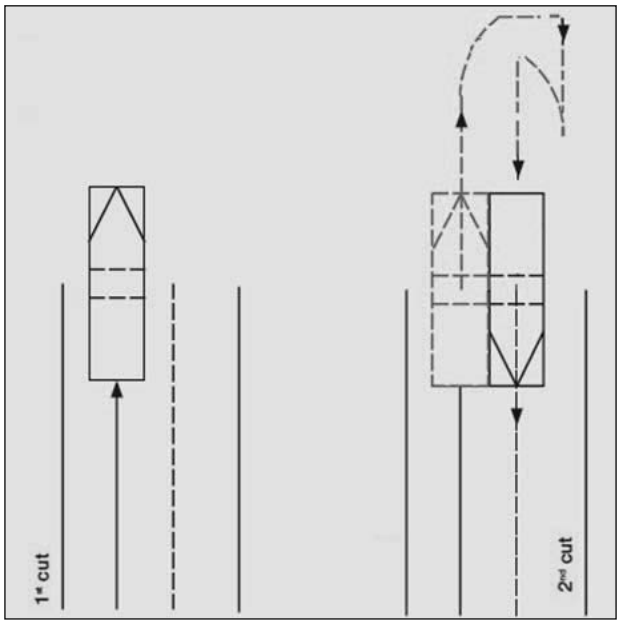

Figure 4 - Maneuver methodology 1

It is worth noting that the use of this system is directly related to the size of the current area of SM operation (400m x 30m), where the two ends of the range are reserved 15m x 30m for maneuver.

The system of Figure 5 presents different characteristics and, using this method, it is expected initially, a 25% reduction in time to maneuver the equipment. In addition, depending on the resistance of the ore, there is the possibility of performing the maneuver and at the same time, loads the truck. However, for application of this methodology, it is necessary that the SM 2500 to operate in areas wider than the current (≥ 50m).

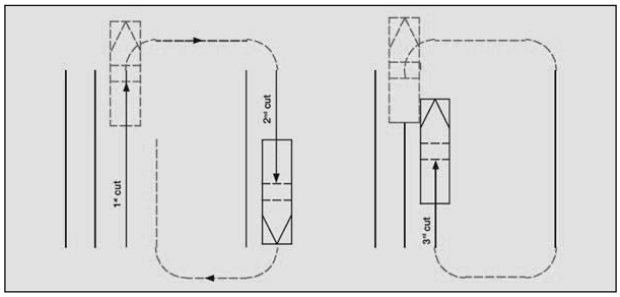

Figure 5 - Maneuver methodology 2

So much for the conventional method and for the system with the use of surface mining, the transport of bauxite ore is the same. The main differences between the methods are the elimination of steps ripping / removal and leveling with the method of SM 2500, however, it is still necessary to perform rake / re-foot more often than in bands than the conventional method.

4. OPERATION IN RAINY PERIODS

The surface mining operation in periods of high rainfall (January-May) drainage conditions requires more specific than those used in other fronts the mining, due to restrictions of the equipment to work in flooded areas (water level inside the range can not reach the box drum straps cut). Thus, the areas available for the SM, it is extremely important to carry out the leveling layer of ore, action is being done during the initial cut and the end of the stripping. In addition, one must fabricate contour points in the second floor; piles contain deposits of water and direction of access sumps to capture, thus minimizing the entry of water to dig ore.

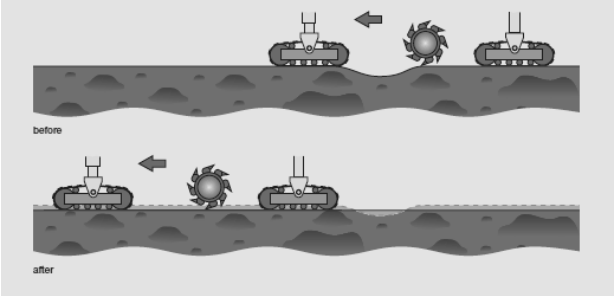

Figure 06 – Leveling in the first cut

5. OPERATIONS TIME

The figure 07 shows the relation between the loading time with EH CAT 365 CL and SM 2500.

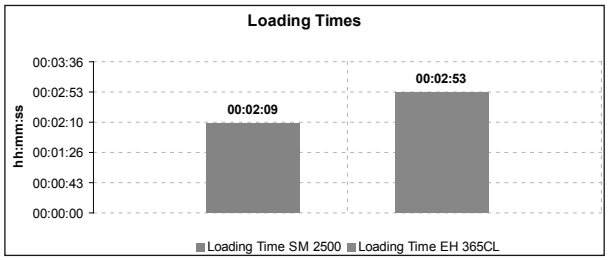

Figure 07 – Comparison of loading times

The first studies show that the SM 2500 productivity (t/h) is 74% higher than those CAT 365 CL (these numbers, shown in figure 08, refer only to the truck loading).

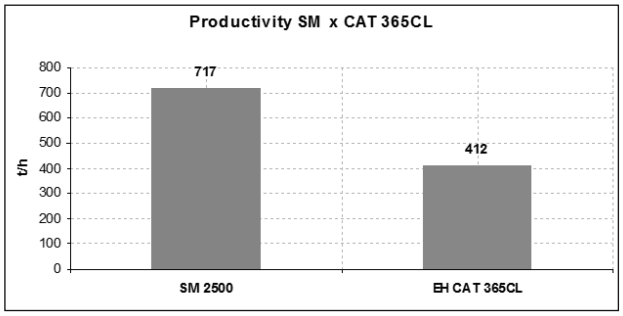

Figure 08 – Productivity numbers

The total time of extraction of the SM 2500 eliminates scraping / leveling and removal phase and strip mining has greater width 10m. Figure 09 presents the time of shipment of ore to the system's method of extraction with SM 2500 (the operation area is 400m x 30m).

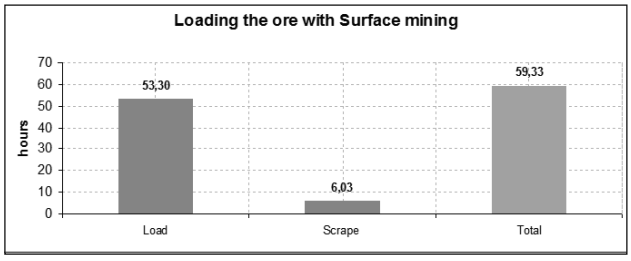

Figure 09 – Average time of mining with SM 2500

With the convectional methodology (CAT D11R and 365CL) are spent more time to mining the bauxite, because before of the loading, it's necessary to rip the ore. The times are shown on the Figure 10.

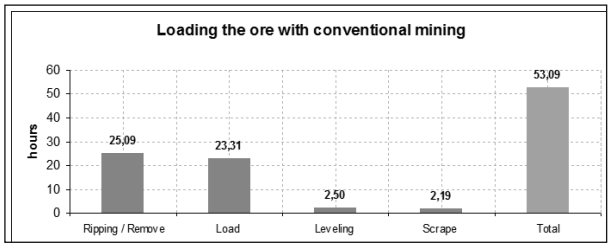

Figure 10 – Average time of mining with convectional methodology

The local of the conventional method is 20m x 200m and the areas where mining with SM 2500 are three times higher.

6. DIESEL CONSUMPTION

Considering the geometry of the different operating ranges of the conventional method (200m x 20m) and the SM2500 (400m x 30m), allowing generating the ratio l / t, shown in Figure 11 (the thickness of ore was 1.55 m for two systems).

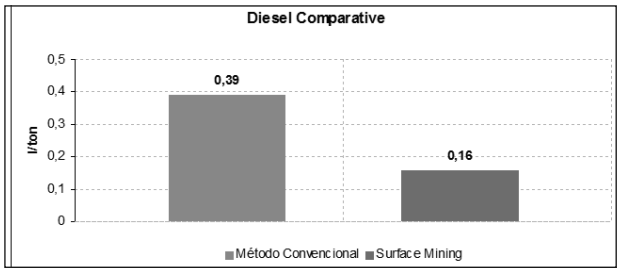

Figure 11 – Diesel consumption

Table 1 – Diesel consumption with convectional methodology

Equipments with Conventional Mining	Consumo l/h	Liters
Dozer CAT D11R	122,23	3.334,66
Excavator CAT 365CL	44,19	1.030,02
Grader CAT 16H	21,82	54,55
Total		4.419,23
Consumo Específico l/t - Método Convencional		0,39

Table 2 – Diesel consumption with SM 2500 system

Equipments with Surface Mining	Consumo l/h	Liters
Surface Mining 2500	100,00	5.330,00
Dozer CAT D11R	122,23	738,72
Total		6.068,72
Consumo Específico l/t - Surface Mining		0,16

7. BIT'S CONSUMPTION

During the tests, the bits used by the SM 2500 showed a rate of consumption three times lower than expected (based on design features: 0,008 bits / ton).

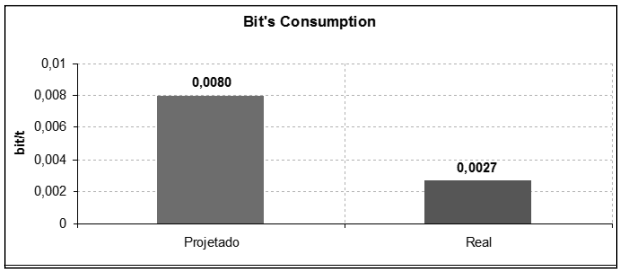

Figure 12 – Bit's Consumption

8. FINAL CONSIDERATIONS

The use of surface mining system in the Paragominas bauxite mining, despite being in operational training period, shows noticeable gains in the process of loading the ore. In addition to higher productivity rates than the conventional method of charging with CAT 365CL excavator, the SM has a lower specific consumption of diesel compared with the current system of mining. Moreover, the consumption of bit rates below what had been expected in early design studies. However, it is noted as the turning point, the constant maintenance of the drainage pit.

It should be noted that the adoption of SM across mine allows charging in larger trucks, conveyor belt, bucket wheel excavator and disposal of primary crusher.

References

Surface Mining - Wirtgen Surface Mining Manual. Edition 2008.