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# Production Efficency Analysis Overburden on Activities Backfilling Reclamation using Simplex Method at PT. Lamindo Inter Multikon Site Bunyu Island, North Kalimantan

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**Abstract:- Reclamation is one of the activities that must be carried out in mining operations. One of the reclamation activities is the closure of ex-mining holes (voids). Not all of these former mining holes (voids) can be closed. However, the effort that can be made by mining business actors is to close voids which can still be closed to minimize the amount of waste, namely acid mine drainage which is accommodated in the mining area. Carrying out reclamation and post-mining activities requires costs. However, this can be minimized by using the right methods and designs. One of these methods is backfilling which has the advantage of setting distances or distances that can be adjusted. Meanwhile, the calculation of the use of tools can be calculated using the simplex method with minimization. This research was conducted at PT. Lamindo Inter Multikon located on Bunyu Island, Bunyu District, Bulungan Regency, North Kalimantan. In this study the results obtained in area 1 a target of 220,000 Bcm can be achieved if using 7 tools. This is in accordance with manual calculations which obtained the number 6.82 and in the POM software through iterative calculations obtained the number 7.26. In area 2 the target of 205,000 Bcm can be achieved using 6 tools. This is in accordance with manual calculations which obtained the number 6.35 and through the POM software through iterative calculations obtained the number 6.142**

***Keywords**: Reclamation, Backfilling, Simplex Method.*

## I. INTRODUCTION

Coal is organic sedimentary fuel solid hydrocarbons formed from plants that have undergone biochemical, chemical and physical decay in oxygen free conditions that take place at certain pressures and temperatures over a very long period of time.

Coal mining activities using heavy equipment result in decrease in soil productivity, soil compaction, erosion and sedimentation. In post mining land, the pH of soil becomes very acidid due to heavy metal contamination. These extreme conditions can be overcome by improving soil conditions, namely liming or adding organic matter, improving the drainage system to prevent waterlogging and watering. As well as selecting the right tree species that can adapt to these extreme conditions. Restoration of ex-mining land by applying organic and inorganic fertiliziers can improve the chemical, physical and biological properties of the soil on land that has been disturbed ny mining activities so that it is suitable and useful for revegetation activities.

Reclamation activities are carried out aiming to restore the function of the land and manage quality environment post mines generally have acidid and nutrient poor soil, so effort are made to increase soil fertility by means of fertilization. Nutrient status in the soil is always changing, depending on the season, soil management and plant species.

The process of reclamation activities carried out mechanically causes environmental pollution in the form soil and water pollution. Soil management on post mining on provides great benefits for the growth flora and fauna disturbed by mining activities. Organic and inorganic fertilizers are expected to improve soil conditions and support plant growth in an effort to increase reclamation success. Fertilization is generally interpreted as adding plant nutrients to the soil.

Post land mining coal generally arid, vegetation is difficult to grow and becomes unproductive. When it rains, it is difficult for water to seep into the ground or most of it flows on the surface, as a result groundwater is reduced and erosion continues to increase, even though the threat of flooding and landslides continues to lurk. It is unfortunate if post coal mining land eventually becomes unproductive and actually brings disaster to humans. By therefore, post mining land should not be abandoned and serious efforts are needed to restore the conditions of the land to normal or at least close to its pre-mining state. Recovery to efforts to restore post mining land conditions are called reclamation.

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➢ *In Carrying Out Reclamation Activites, A Concept of the Stage must be made, Namely:*

- *Surveying Stage*

At this stage topography data is collected to determine the volume of overburden which will be transferred to the landfill of ex-mining pits.

- *Mine Planning Stage*

This stage is the most important stage because it is in the process mine planning will affect the level of efficiency in production, where the determination of heavy equipment used will greatly affect cost company. At this stage the creation of the concept is carried out by making design from loading point until dump area, spacing, manufacture safety plan, calculation of heavy equipment to be used and calculation of estimated loss time in production

- *Data Processing Stage*

At this stage the existing data is processed using some software. For data processing design mine use mine craft software5.7, the calculation of volume and production progress rate on a weekly basis using surpac software, and cost calculations and determination calculations matching fleet using excel.

As for this research calculate work compatibility match factor) loading and conveying equipment, calculating the optimal production resulting from the stripping activity over burden based on Linear Programming Simplex method, calculating the optimal means of conveyance in production over burden based on the Simplex method, and calculate the minimum production costs that can be generated on production overburden based on the simplex method.

## II. LITERATURE REVIEW & RESEARCH AREAS

➢ *Company Location*

The location of this research area is in the Bunyu Island coal mine, Bulungan Regency, North Kalimantan Province which can be shown at the coordinate points of WIUP PT. Lamindo Inter Multikon.

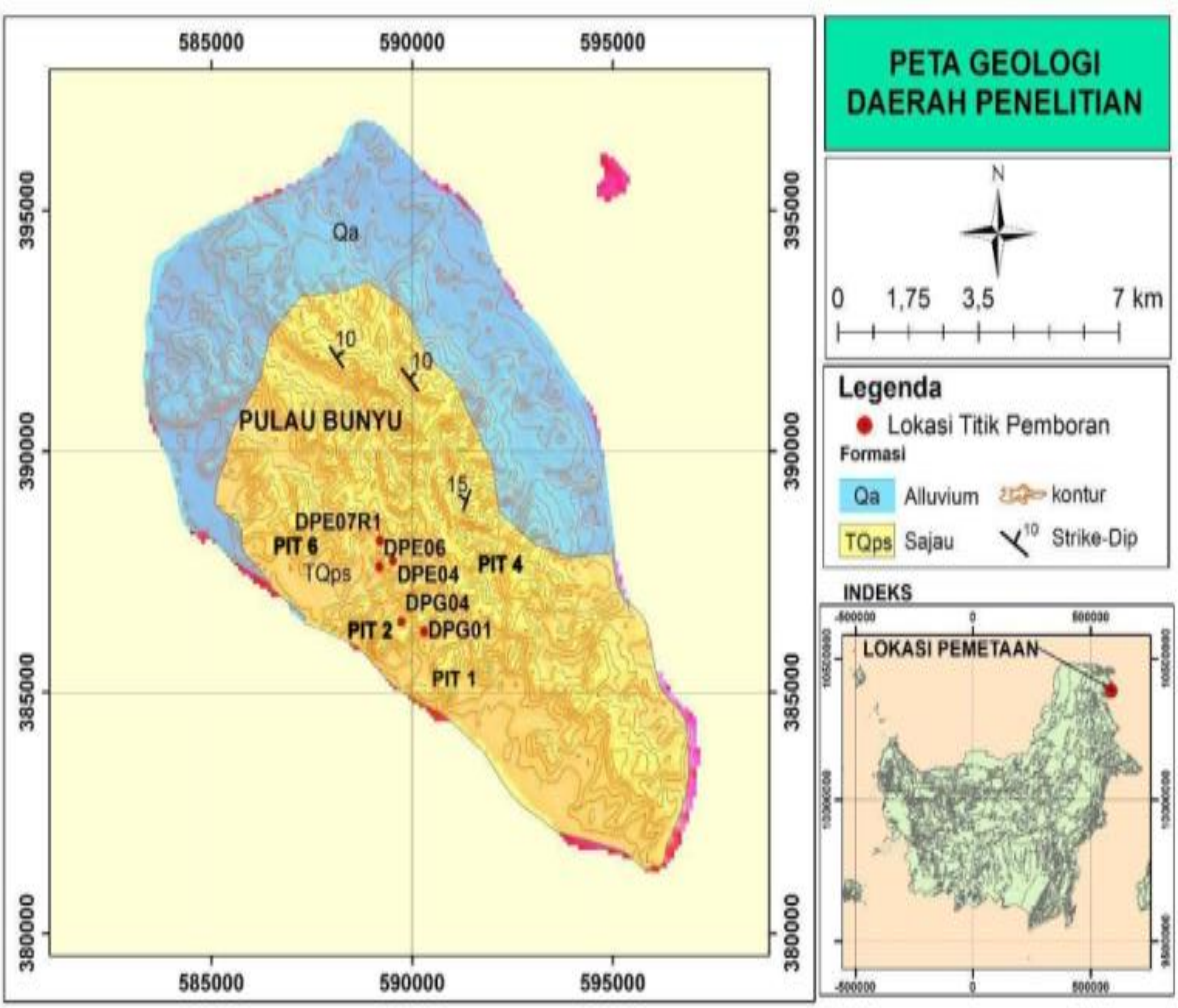


Fig 1 Location Map PT. LIM

➢ *Reseacrch Area Statigraphy*

The rock formations that make up the area research which consists of sandy clay,sandstone with coal inserts. The constituent sandstones are quartz sandstone, sandstone containing coal chips and sandstone with a layered layer structure from the distribution of rock types, it can be shown that the depositional process was in the delta and shallow sea areas. The rock formations that make up the study area consist of sandy claystone, sandstone with coal inserts. The constituent sandstones are quartz sandstone, sandstone containing coal chips and sandstone with a layered layer structure from the distribution of rock types, it can be shown that the depositional process was in the delta and shallow sea areas.

Table 1 Regional Statistics WIUP PT. LIM

<table>
<tr><th>TIME</th><th>ERA PERIOD</th><th colspan="2">EPOCH</th><th colspan="2">FORMATION</th></tr>
<tr><td rowspan="13">KENOZOIKUM</td><td rowspan="4">Kuarter</td><td colspan="2">Holosen</td><td>Aluvium</td><td></td></tr>
<tr><td></td><td>End</td><td rowspan="4">Sajau</td><td rowspan="2"></td></tr>
<tr><td>Pleitosen</td><td>Mid</td></tr>
<tr><td></td><td>Begining</td><td rowspan="2">Sinjin</td></tr>
<tr><td rowspan="7">Tertiery</td><td colspan="2">Pleitosen</td></tr>
<tr><td rowspan="3">Miosen</td><td>End</td><td>Tabul</td><td rowspan="2"></td></tr>
<tr><td>Mid</td><td>Meliat</td></tr>
<tr><td>Begining</td><td rowspan="2">Naintipo</td><td rowspan="2">Jelai</td></tr>
<tr><td colspan="2">Olisogen</td></tr>
<tr><td colspan="2">Eosen</td><td>Sembakun</td><td></td></tr>
<tr><td colspan="2">Paleosen</td><td rowspan="3">Bengarea</td><td></td></tr>
<tr><td rowspan="2">Chalk</td><td>End</td><td></td><td></td></tr>
<tr><td>Lower</td><td></td><td></td></tr>
</table>

➢ *Regional Geology*

Based on the lithological characteristics, the rocks deposited at PT. Lamindo Inter Multikon are grouped into several formations, namely:

- Alluvium Formation, composed of mud, silt, sand, gravel and oral lithologies which are beach, river and swamp sediments.
- The Sajau Formation, composed of quartz sandstone, claystone, siltstone, coal, lignite and conglomerate, layers of planar cross-sectional sediments and bowls, bioturbation, parallel waters, iron nodules and fossil wood.
- The Tabul Formation, composed of cross lithology of claystone, mudstone, sandstone, limestone and coal at the top, the age of this formation is late Miocene.
- Meliat Formation, composed of crosses of sandstone, claystone and shale with coal inserts, having a layered layer structure, bioturbation and containing limestone nodules, this formation is of middle Miocene age and deposits in shallow marine circles.
- The Naintipo Formation, olisogenous and early Miocene in age, is composed of cross- marl lithology, conglomerate rock, planar and cross-bedding sedimentary layer bowls, bioturbation, parallel waters, iron nodules and fossil wood.
- The Sinjin Formation, composed by cross lithology, this formation is Pleitocene in age.
- The Sembakung Formation, deposited unconformably above the lake formation, has a middle Eocene age. At the bottom, this formation consists of red sandstone and conglomerate. At the top consists of carbon-rich mudstone.

➢ *Calculation of Productivity*

In this study the productivity calculations obtained at PT. Lamindo Inter Multikon are as follows:

- *Tool Work Compatiblity (Match Factor)*

Tool work compatibility done using Equation (1). The data used in the process of calculating the work compatibility of the tool is data cycle time, the number of loading and hauling equipment. From the calculations that have been done, the following data is obtained:

$$MF = \frac{n \ x \ Na \ x \ Ctm}{Nm \ x \ Cta} \qquad (1)$$

Information:
MF = *Match Factor*
N = Lots of charging
Na =Number of means conveyance
Nm =Number of means of loading
Ctm = *Cycle Time* loading tools
Cta = *Cycle time* conveyance

From these data and equations, it is obtained that the work compatibility of each tool is 1.21 ; 1,4 ; 1.5. With matching factor(MF) obtained from each unit > 1, it can be concluded that the loading equipment has worked 100% but the transportation equipment has worked <100% so that: there is a waiting time for the transportation equipment.

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Table 2 Data Produktifitas Alat Muat

| **Unit Excavator** | **Waktu Tersedia (T)** | **Waktu Kerja Efektif (W)** | **Waktu *Breakdown* (R)** | **Waktu *Standby*** |
|---|---|---|---|---|
| Doosan 520LCV (EX-01) | 720 *Hours/Mounth* | 471,9 *Hours/Mounth* | 109,1 *Hours/Mounth* | 139 *Hours/Mounth* |
| Doosan 520LCV (EX-02) | 720 *Hours/Mounth* | 471,9 *Hours/Mounth* | 109,1 *Hours/Mounth* | 139 *Hours/Mounth* |

- *The Effectiveness of Loading and Conveying Equipment*

To get the Effectiveness of Loading and Conveyance equipment, it is carried out using equations (2) to (5) and the input data can be seen in Table 3.

$$MA = \frac{W}{W+R}\ x\ 100\% \quad (2)$$

$$PA = \frac{W+S}{W+R+S}\ x\ 100\% \quad (3)$$

$$UA = \frac{W}{W+S}\ x\ 100\% \quad (4)$$

$$EU = \frac{W}{W+R+S}\ x\ 100\% \quad (5)$$

Information:
R = Time maintenance heavy equipment
S = Time standby heavy equipment
W = Tool working time

The effectiveness obtained in this OB Removal activity can be seen from table 5 & table 6.

Table 3 Effectiveness of Load Tool

| **Unit Excavator** | **PA (%)** | **MA (%)** | **UA (%)** | **EU (%)** |
|---|---|---|---|---|
| DX 520LCV (PC01) | 88% | 77% | 97% | 58% |
| DX 520 LCV (PC02) | 88% | 78% | 95& | 58% |

Table 4 The Effectiveness of Conveyance

| **Unit *Dumptruck*** | **PA (%)** | **MA (%)** | **UA (%)** | **EU (%)** |
|---|---|---|---|---|
| DA01 (ADT01) | 88% | 84% | 92% | 58% |
| DA 02 (ADT02) | 87% | 88% | 86% | 58% |
| DA 03 (ADT03) | 87% | 89% | 87% | 58% |
| DA 04 (ADT04) | 88% | 82% | 77% | 58% |
| DA 05 (ADT05) | 85% | 88% | 90% | 58% |
| DA 06 (ADT06) | 84% | 91% | 80% | 58% |
| DA 07 (ADT07) | 88% | 84% | 81% | 58% |
| DA 08 (ADT08) | 89% | 87% | 83% | 58% |
| DA 09 (ADT09) | 84% | 80% | 89% | 58% |
| DA 10 (ADT10) | 85% | 86% | 90% | 58% |
| DA 11 (ADT11) | 85% | 85% | 79% | 58% |
| DA 12 (ADT12) | 86% | 85% | 83% | 58% |
| DA14 (ADT14) | 83% | 83% | 83% | 58% |

Productivity of Transportation & Loading equipment to find the percentage value of the productivity of a tool, you can use equation (6) for loading equipment & (7) for transportation equipment, namely:

$$Q = \frac{Kb\ x\ Eff\ x\ 3600}{Ct} \quad (6)$$

$$Q = \frac{n\ x\ Kb\ x\ Eff\ x\ 3600}{Ct} \quad (7)$$

- *Case Studies*

open pit mining project (open PIT) PT.Lamindo Inter Multikon will carry out a reclamation activity. It can be seen that reclamation activities are very calculated cost/ cost. From several methods can be determined method backfilling is a very efficient method that can be used in the closure of ex-mining holes (voids). This is because the distance (distance) which can be set accordinglyplanning design. The following is known reclamation project data below:

OB volume target in area 1 = 220.000 Bcm/ Mounth
OB volume target in area 2 = 205.000 Bcm/ Mounth
Dumping distance area 1 = 400 m
Dumping distance 2 = 500 m
Average production 1 hour/dt = 84 Bcm
Transport capacity hauler = 14 Bcm
Available Work Hours = 15,73/day

If some of these data are known, then here the author determines the level of production efficiency in areas 1 & 2 by calculating the use of tools (match fleet) using the simplex method.

## III. RESULTS AND DISCUSSION

➢ *Area 1 Strategy Calculations*

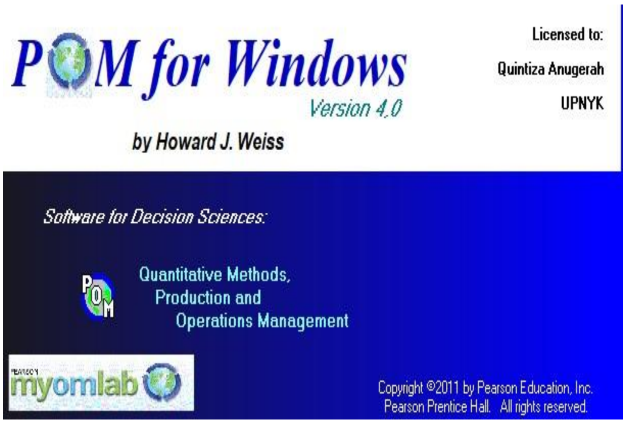


Fig 2 Opening Software POM

Objective
Maximize
Minimize
Instruction
There are more results available in additional windows. These ma
(unti

| Cj | Basic Variables | 1 X1 | 1 X2 | 0 artfcl 1 | 0 surplus 1 | 0 artfcl 2 | 0 surplus 2 | Quantity |
|---|---|---|---|---|---|---|---|---|
| Phase 1 - Iteration 1 | | | | | | | | |
| 1 | artfcl 1 | 26 | 0 | 1 | -1 | 0 | 0 | 189 |
| 1 | artfcl 2 | 0 | 26 | 0 | 0 | 1 | -1 | 189 |
| | zj | -26 | -26 | 1 | 1 | 1 | 1 | 378 |
| | cj-zj | 26 | 26 | 0 | -1 | 0 | -1 | |

Fig 3 Completion of Iteration 1 Area 1

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Iteration 2 | | | | | | | | |
| 0 | X1 | 1 | 0 | 0,0385 | -0,0385 | 0 | 0 | 7,2692 |
| 1 | artfcl 2 | 0 | 26 | 0 | 0 | 1 | -1 | 189 |
| | zj | 0 | -26 | 2 | 0 | 1 | 1 | 189 |
| | cj-zj | 0 | 26 | -1 | 0 | 0 | -1 | |

Fig 4 Completion of Iteration 2 Area 1

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Iteration 3 | | | | | | | | |
| 0 | X1 | 1 | 0 | 0,0385 | -0,0385 | 0 | 0 | 7,2692 |
| 0 | X2 | 0 | 1 | 0 | 0 | 0,0385 | -0,0385 | 7,2692 |
| | zj | 0 | 0 | 2 | 0 | 2 | 0 | 0 |
| | cj-zj | 0 | 0 | -1 | 0 | -1 | 0 | |

Fig 5 Completion of Iteration 3 Area 1

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Phase 2 | | | | | | | | |
| 1 | X1 | 1 | 0 | 0,0385 | -0,0385 | 0 | 0 | 7,2692 |
| 1 | X2 | 0 | 1 | 0 | 0 | 0,0385 | -0,0385 | 7,2692 |
| | zj | 1 | 1 | -,0385 | ,0385 | -,0385 | ,0385 | 14,5385 |
| | cj-zj | 0 | 0 | 0,0385 | -0,0385 | 0,0385 | -0,0385 | |

Fig 6 Final Output Phase Area 1

From these calculations, for area 1 use hauler as many as 7 units. If proven by manual calculation, the calculation is as follows:

- *Area 1*

Target = 220.000 Bcm/ Mounth (Actual/effective working days 24 days) So;

Target be achieved in 1 day if actual time 16 work hours:

$$\frac{220.000}{24} = 9.666{,}67\ Bcm/day$$

Hourly Target:

$$\frac{9.166{,}67}{16} = 573\ Bcm/Hours$$

Calculations of the use tools:

$$= \frac{Target\ perjam}{BCM/DT} = \frac{573}{84} = 6{,}82$$

From these calculations, for area 1 use hauler as many as 7 units. This is the same as the results of calculations using simplex era.

➢ *Area 2 Strategy Calculations*

Objective
Maximize
Minimize
Instruction
There are more results available in additional windows. These ma
IterasiArea 2 Jurnal Peng

| Cj | Basic Variables | 1 X1 | 1 X2 | 0 artfcl 1 | 0 surplus 1 | 0 artfcl 2 | 0 surplus 2 | Quantity |
|---|---|---|---|---|---|---|---|---|
| Phase 1 - Iteration 1 | | | | | | | | |
| 1 | artfcl 1 | 28 | 0 | 1 | -1 | 0 | 0 | 172 |
| 1 | artfcl 2 | 0 | 28 | 0 | 0 | 1 | -1 | 172 |
| | zj | -28 | -28 | 1 | 1 | 1 | 1 | 344 |
| | cj-zj | 28 | 28 | 0 | -1 | 0 | -1 | |

Fig 7 Completion of Iteration 1 Area 2

| Iteration 2 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 0 | X1 | 1 | 0 | 0,0357 | -0,0357 | 0 | 0 | 6,1429 |
| 1 | artfcl 2 | 0 | 28 | 0 | 0 | 1 | -1 | 172 |
| | zj | 0 | -28 | 2 | 0 | 1 | 1 | 172 |
| | cj-zj | 0 | 28 | -1 | 0 | 0 | -1 | |

Fig 8 Completion of Iteration 2 Area 2

| Iteration 3 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 0 | X1 | 1 | 0 | 0,0357 | -0,0357 | 0 | 0 | 6,1429 |
| 0 | X2 | 0 | 1 | 0 | 0 | 0,0357 | -0,0357 | 6,1429 |
| | zj | 0 | 0 | 2 | 0 | 2 | 0 | 0 |
| | cj-zj | 0 | 0 | -1 | 0 | -1 | 0 | |

Fig 9 Completion of Iteration 3 Area 2

| Phase 2 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 1 | X1 | 1 | 0 | 0,0357 | -0,0357 | 0 | 0 | 6,1429 |
| 1 | X2 | 0 | 1 | 0 | 0 | 0,0357 | -0,0357 | 6,1429 |
| | zj | 1 | 1 | -,0357 | ,0357 | -,0357 | ,0357 | 12,2857 |
| | cj-zj | 0 | 0 | 0,0357 | -0,0357 | 0,0357 | -0,0357 | |

Fig 10 Final Output Phase Area 2

From the stages of completion above it can be determined that for area 2 usedumptruckas many as 6 units. If proven by manual calculation, the calculation is as follows:

- *Area 2*

Target = 205.000 Bcm/ *Mounth* (Actual/effective working days 24 days) So;

Target be achieved in 1 day if actual time 16 work hours :

$$\frac{205.000}{24} = 8.541{,}67\ Bcm/day$$

Hourly Target:

$$\frac{8.541{,}67}{16} = 534\ Bcm/Hours$$

Calculations of the use tools:

$$\frac{Target\ perjam}{BCM/DT} = \frac{534}{84} = 6{,}35$$

From these calculations, for area 2 use dump truckas many as 6 units. This is the same as the results of calculations using simplex iterations.

## IV. CONCLUSIONS AND SUGGESTIONS

➢ *Conclusions*

From the analysis that has been done by the author, it can be concluded that:

- In area 1 the target of 220,000 Bcm can be achieved if you use 7 tools. This is in accordance with manual calculations obtained at 6.82 and on software POM through iteration calculations obtained the number 7.26.
- In area 2 the target of 205,000 Bcm can be achieved if you use 6 tools. This is in accordance with manual calculations obtained by 6.35 and through software POM via Iteration calculations get the number 6.142

➢ *Suggestions*

From the research that has been done, there are several suggestions from the author, as follows:

- Preferably a review is needed, if discussing the issue of production efficiency then the mine design must be analyzed
- We recommend that you need to add several parameters in planning production activities, namely safety factor& safety plan according to the procedure in force. This can be described in the mine planning design.

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