TOP SOIL USAGE EFFICIENCY UP TO 73% WITH THE IMPLEMENTATION OF GROOVE SYSTEM AT LIMESTONE MINE RECLAMATION AREA PT SEMEN INDONESIA (PERSERO) TBK

Eko Purnomo, S.T.¹; Putri Elma Octavya, S.T.²

¹Unit of Mining, PT. Semen Indonesia (Persero) Tbk; ²General Directorate of Mineral and Coal, Ministry of Energy and Mineral Resources **E-mail: eko.purnomo@sig.id ; putri.octavya@esdm.go.id*

ABSTRACT

Based on Law Number 3/2020, Good Mining Practice's criteria are mining safety provisions, environmental management, and monitoring, including reclamation and post-mining activity, conservation of minerals and coal, and management of mine waste before being released into the environment. Directorate General of Mineral and Coal state's Strategic plan reclamation target for 2021 is 7.025 hectares and 7.050 hectares in 2022. PT Semen Indonesia, as one of the mining companies, is committed to supporting the reclamation target as stated in their Yearly Land Reclamation Plan. Mine floor reclamation on limestone quarry was generally performed using top soil spreading which cost up to $3,000 \text{ m}^3$ of top soil per hectare area. Whereas top soil availability on site is limited. As a result, the existing top soil reserve could not fulfill the needs of reclamation to cover entire mining floor. The practice of Spreading Method depletes reserved top soil, causes excessive planting media preparation and revegetation cost. This challenging condition encourages PT. Semen Indonesia to innovate to suppress reclamation cost without reducing the success rate. The company concluded that Groove Planting System could reduce both top soil transport cost and revegetation cost, even increase the survival rate of the trees. This method reduced up to $2,200 \text{ m}^3$ of top soil usage per hectare area, reduced top soil hauling cost, reduced tree planting and treatment, even increased the success rate of reclamation. With this innovation, company could suppress reclamation cost without sacrificing reclamation quality.

Benefits emerging from Groove System Implementation include; Reduced top soil volume usage for reclamation up to 73%; Reduced revegetation cost up to 49% or IDR 66,794,354/ha; Cost efficiency of planting media preparation up to IDR 168,000,000/ha; Increased tree survival rate up to 100%; Regulation mandate compliance of Post Mining Reclamation; Best practice pioneer of Post Mining Reclamation using Groove System.

Keywords: reclamation, top soil, groove system

ABSTRAK

Sesuai UU No 3 Tahun 2020, Aspek Kaidah Teknik Pertambangan yang baik meliputi pengelolaan keselamatan pertambangan, pengelolaan dan pemantauan lingkungan ,termasuk reklamasi dan aktifitas pasca tambang, konservasi mineral dan batubara, dan manajemen limbah pertambangan sebelum dilepas ke lingkungan. Rencana Strategis Nasional Direktorat Jenderal Mineral dan Batubara Tahun 2021 adalah 7.025 hektar dan 7.050 hektar di tahun 2022. PT. Semen Indonesia sebagai salah satu perusahaan yang melakukan aktifitas penambangan berkomitmen untuk mendukung target reklamasi yang telah tertuang dalam Rencana Reklamasi Tahunan Perusahaan. Reklamasi pada lantai selesai tambang pada kuari batu gamping umumnya dilaksanakan dengan menebarkan top soil yang membutuhkan hingga 3000 m3 top soil per hektar. Sedangkan ketersediaan top soil di lapangan sangat terbatas. Sehingga, ketersediaan top soil tidak dapat meemnuhi kebutuhan reklamasi untuk seluruh lantai selesai tambang. Metode penebaran top soil untuk reklamasi yang besar.

Kondisi yang menantang ini mendorong PT. Semen Indonesia untuk berinovasi menekan biaya reklamasi tanpa mengurangi tingkat keberhasilan reklamasi. Perusahaan menyimpulkan bahwa sistem alur dapat mengurangi biaya penyiapan top soil sekaligus mengurangi biaya revegetasi, bahkan meningkatkan tingkat pertumbuhan tanaman. Metode ini mengurangi penggunaan hingga 2200 m3 top soil per hektar, mengurangi biaya pengangkutan top soil, dan perawatan tanaman bahkan mningkatkan tingkat keberhasilan reklamasi. Dengan inovasi ini, perusahaan dapat menekan biaya reklamasi tanpa mengabaikan kualitas tanaman reklamasi.

Manfaat dari penerapan sistem alur antara lain ; mengurangi penggunaan top soil hingga 73% ; mengurangi biaya revegetasi hingga 49% atau Rp. 66.794.354 per hektar ; mengurangi penyiapan media tanam hingga Rp. 168.000.000 per hektar ; meningkatkan keberhasilan reklamasi hingga 100% ; pemenuhan regulasi reklamasi pasca tambang ; sebagai praktik terbaik dalam reklaamsi pasca tambang.

Kata kunci: reklamasi , tanah pucuk , sistem alur

A. INTRODUCTION

A.1. Problem Definition

Mine floor reclamation on limestone quarry was generally performed using top soil spreading which cost up to 3,000 m³ of top soil per hectare area. Whereas top soil availability on site is limited. As a result, the existing top soil reserve could not fulfill the needs of reclamation to cover all mining floor. The practice of Spreading Method depletes reserved top soil, causes high planting media preparation and revegetation cost.

Facing with those difficulthis, we need to develop alternatif methode to unsure sustainability of post mining reclamation operation.



Pigure 1. Problem Identification Scheme.

First problem is the remaining unreclaimed post mining area is very large. Only thirteen percent of total mining area has been reclaimed. Secondly, the current method to reclaim post-mining floor area is Top Soil Spreading. This method consumes up to three thousand cubic meter of top soil per hectare area. Next, top soil needs is far larger than the reserved top soil in the field. The fourth point is, top soil spreading method is very costly, which is more than 18.000 (eighteen thousand) US Dollars per hectare.

In addition, the existing revegetation cost is very high reaches 10.600 (ten point six thousand) US Dollars per hectare, which caused by the next problem, which is excess density of trees that almost triples the minimum regulation. The next point is, top soil itself is the best planting media. And the final problem is the new regulation which requires Mine Permit Holders to achieve 100% of reclamation success.

A.2. Project Goals

This project aims to :

- 1. Reduce Reduced top soil volume usage for reclamation up to 73%;
- 2. Reduced revegetation cost up to 49% or IDR 66,794,354/ha;
- 3. Cost efficiency of planting media preparation up to IDR 168,000,000/ha;
- 4. Increased tree survival rate up to 100%;
- 5. Regulation mandate compliance of Post Mining Reclamation;
- 6. Best practice pioneer of Post Mining Reclamation using Groove System.

B. RESEACRH METHODE

B.1. Root Cause Identification

The idea of this project arose from various problems we faced on field. To identify root causes of this problem, we utilise ishikawa diagram.



Pigure 2. Fishbone Digram (Ishikawa Diagram).

According to diagram above, the problems were caused by ; 1. excessive use of top soil method 2. high cost method 3. high tree density method 4. limited top soil 5. poor quality of top soil



Pigure 3. NGT (Nominal Grup Technique) Method.

From those causes we need to find the most dominant ones. After we conducted interview to field supervisors, the most dominant cause were excessive use of top soil, high cost revegetation, need long time to complete and plants struggle to grow.

We already tried various solution alternatives to solve those problem. From Potting System, Ridge System, Spreading System, and Groove System.



Pigure 4. Alternatif Solutions Project .

Potting system

This method performed by digging holes on post mining floor and then filled with top soil as planting media. This method need very few top soil, on other hand survival rate of plants is very low.

Ridge System

This method performed by making long paralel ridges of top soil on post mining floor. This method need farely few top soil, but fullnerable to soil erosion as specially from heavy rain.

Spread System

This method is the conventional method for post mining reclamation. This method require huge amount of top soil.

Groove System

This method is performed by digging long paralel groove on post mining floor. And then filled with top soil as planting media. This method require few top soil compare to exsisting method. Furtheremore, the groove prevent erosion on top soil.

From those alternatives, the team decided that Groove System is the most applicable method, by reason of Low Cost, Low Top Soil Usage, 100% success rate, and regulation compliance.

Groove Planting System implementation starts from project location determination, measurement and preparation, groove forming, rock fragment removal and top soil filling, planting holes digging, planting, and monitoring.





Pigure 5. Groove Planting System Implementation Steps .

C. RESULT AND ANALYSIS

Before this project, post mining reclamation is usually carried out by spreading top soil on post mining floor by 30 cm thicknees. Thus require approximately 3000 m3/ha of top soil.



Pigure 6. Existing Post Reclamation Area Layout .

Groove Planting System is a reclamation system breakthrough on post-limestone mine land. This planting system is carried out by carving long grooves on the pit floor that needs to be reclaimed. Carving grooves on such hard substrate land required heavy equipment such as Rock Breaker. The grooves sized 80cm wide and 60cm depth with 400cm wide ridge gap between the grooves. Afterwards, each groove is filled with planting media (top soil). Saplings are planted along the grooves with 300cm gap between plants.

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Pigure 7. Post Mining Reclamation Area Layout using Groove Planting System .

Effectivity of Groove Planting System is proven on 1-year observation. The data show that trees planted with Groove Planting System grew significantly faster than those planted with spreading method from plant height, stem diameter, to number of leaves. Saplings planted on Groove Planting System (yellow and green line) show significantly higher growth rate compared to trees planted using Spread System (blue line) at same age.



Pigure 8. Effectivity of Groove Planting System.

Groove Planting System is also more efficient than spreading method with total monetary efficiency reaches 16.253 (sixteen thousand) US Dollars per hectare. With this project, we tried to improve several values. Planting media cost decreases from 18.000 (eighteen thousand) USD to 6.600 (six point six thousand) per hectare. Revegetation cost from 9.000 (nine thousand) USD to 4.600 (four point six thousand) USD per hectare. Top soil usage from 3.000 (three tousand) to 800 (eight hundred) cubic meter per hectare.

	VALUE ADDED PARAMETER	BEFORE	TARGET	RESULT
	Planting Media Cost	18,281 USD/ha	8,278 USD/ha	6,636 USD/ha
h	Revegetation Co	ost9,306 USD/ha	6,899 USD/ha	4,698 USD/ha
	Topsoil Usage	100% (3000 m³/ha)	50% (1500 m³/ha)	26,67% (800 m³/ha)
	Success Rate	< 85%	>85%	100 %
	Tree Density	1650 trees/ha	1250 trees/ha	825 trees/ha

Pigure 9. Value Added Parameter of Groove Planting System.

We can also obtain several soft saving benefits from this innovation, such as faster cycle time, safer access, quality increase, and more friendly to environment. Before this project, Reclamation Project period is carried out more than 6 months. While this project only need 3 months to complete. On safery aspect, Watering and plant care access on grrove planting system project area is safer to be passed by water truck because it's wider and more compact. In addition, plants are more healthy and grew twice faster than conventional method.

D. CONCLUSION

Conclusion of this project are :

- 1. Groove planting system is a revolutionarry method to reclaim post mining floor area especially in quarries that low on top soil stock.
- 2. Groove planting system can generate monetary benefit up to 16.253 (sixteen thousand) US Dollars per hectare compared to spreading method (existing method).
- 3. Groove planting system has other benefits such as faster cycle time, safer access, quality increase, and more friendly to environment.

DAFTAR PUSTAKA

Ruchaemi, A. (2013) : Ilmu Pertumbuhan Hutan, Mulawarman University Press, Samarinda.

- Santoso, B., M.Y. Misto, and M.A. Rakman.(2000) : Pertumbuhan Tanaman Jati dari Berbagai Ras Lahan di Kendari Selatan, *Balai penelitian dan Pengembangan Kehutanan Sulawesi*, Makassar.
- Yunianti, A.D., Muin, M. (2009): Buku Ajar Pertumbuhan Pohon dan Kualitas Kayu, Fakultas Kehutanan Universitas Hasanuddin, Makassar.