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and Built Environment
in Developing Countries

SABUGA ITB, Bandung - Indonesia
2nd - 3rd November 2009

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Faculty of Civil and Environmental Engineering
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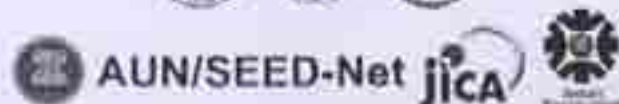
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Rehabilitation Mining Site in PT. X

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Abstract

Natural resource utilization through mining provides a substantial contribution on human welfare. One of general mining activity is an open pit mining system. Such mining activities affect soil and vegetation ecosystem, causing a quality reduction in physical, chemical, biological and socio-cultural aspects. To prevent these potential negative impacts, it is required to take strategic steps as preventive actions. This activity is known as rehabilitation of mining site, aiming to return the function of such a location to its former condition before its utilization. PT X is mining company in Pulau Sambarwa mines copper and gold using an open pit method. Rehabilitative efforts had been carried out by PT. X in accordance with the needs of land utilization. Such rehabilitative activities include reclamation, revegetation, monitoring and maintenance as well as reclamation supportive activities as such nursery and tree phenology. This research aim to evaluate the rehabilitation activities of PT. X using observation, effective regulation and theoretical design methods. The result showed that PT. X has successfully planned and implemented rehabilitation activities in accordance with The Decree of Forestry and Plantation Minister Number 146/kpts-II/1996. In order to support the success of this rehabilitation efforts it is urgently needed local community be involved, so they can obtain information and skill to create ever lasting survival within such rehabilitative site.

Keywords : mining, reclamation, revegetation.

1. Introduction

One of general mining activities is an open pit mining system. This system digging, unloading and transportation using equipments of mine as the method to get mining product. Mining activities affect soil and vegetation ecosystem, causing a quality reduction in physical, chemical, biological and social-cultural aspects. For temporary or continuation duration, degradation of environment quality could be disturbing balance ecosystem. To prevent these potential negative impacts, it is required to take strategic steps as preventive actions. This activity is known as rehabilitation of mining site, aiming to return the function of location to its former condition before its utilization.

The mining products in PT. X (called Batu Hijau Project in Pulau Sambarwa NTB) are copper and gold. Land rehabilitation, have been done based on land benefit in line with mining activity. Land/site already mined is not going to explore again, but it have to rehabilitated to take care equilibrium condition. In general, programs to manage land rehabilitation in Batu Hijau project are reclamation, revegetation, monitoring and maintenance and also nursery and tree phenology.

The aim of the research is to evaluate rehabilitation activities in PT. X using observation, effective regulation and theoretical design methods and also to get recommendation to improve land rehabilitation effort.

2. Research Method

2.1. Field Survey :

The purpose is to get illustration about location, condition, and rehabilitation activities in Batu Hijau Project

2.2. Literature Study :

As a guidance and supporting the research. The literature are books, text book, journal, and any other sources from internet.

2.3. Data Collection : Primary data and secondary data.

a. Primary data : is obtained from observation, interview and discussion with operators, employees, and engineers. This process contain land rehabilitation activities such as method, type and also specification of regulation which applied in PT. X.

b. Secondary data : is obtained from public data in PT. X. This data contain wide of mining land, reclamation wide area, amount of conservation soil and planted location of trees for land rehabilitation.

2.4. Data Analysis : is to evaluate method and equipment which applied in rehabilitation land by elaborating effectiveness and also to evaluate applied regulations in Indonesia

2.5. Conclusion and Suggestion

3. Result and Discussion

3.1. Reclamation

The aim of reclamation is to stabilize the land. Reclamation in Batu Hijau project divided in three (3) activities. There are land analysis, land construction and erosion control installation.

a. Land analysis. Samples have to be analyzed to know the substances of them. Table 1 shows result soil sample for subsoil and topsoil and Figure 1 shows activity of land analysis.

Table 1 Determination Criteria Subsoil and Topsoil

Parameter	Acceptance Interval	
	Subsoil	Topsoil
Total Copper	≤ 900 ppm	≤ 500 ppm
Net Carbon value	≥ -0.01 %	≥ -0.01 %
pH	> 5	> 5
Gravel Percentage	5 - 35	0 - 25
Sand Percentage	10 - 60	10 - 60
Fines Percentage	30 - 75	30 - 85
Plasticity index	5 - 35	5 - 35

Source : *Revegetation Techniques 2H - IV Slopes for Final Reclamation May 2005, PT. X*



Figure 1 Land Analysis Activity

b. Land construction is divided in three phase, they are :

1. Subsoil location phase

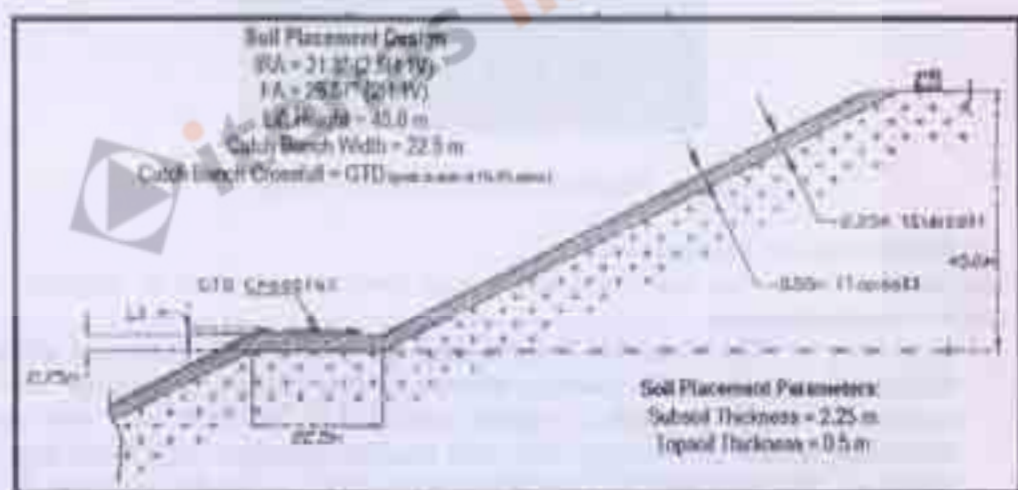
This process started with transportation and spreading of soil land. They using haul truck, then land soil disseminated again in flatten to all part of land by using excavator. The next process is to compact the soil using sheep foot roller. This process has to be done in every layer subsoil and in every time after compaction process. This phase will be checked by the supervisor team to fulfilled the criteria. After that compaction process will be done for the next layer. Total thickness of subsoil is 2,25m and usually divided become 4 layers and every each thickness layer : 75, 50.50 and 50cm.

1. Topsoil location phase

Overall the process of this phase is just the same from previous phase, the difference is in this phase the compaction process use track dozer and only consisting of one layer. Thickness of layer topsoil is 0,5m.

2. Drainage Channel

Roadside channel (drainage channel) is made to control run off water at reclamation area and as sediment trap. The design is made according to contour with deepness 1 m, wide 3 m and inclination of channel wall is 2H : 1V. The sewerage through into contact drain and end at a pond. Drainage channel construction made by material concrete. To manage run off water from mining area outside its built run off sewerage at external boundary of area mined. The purpose is to separate run off water from outside area and water in mining location. This sewerage built in external boundary of mining area and through in to river. The design has wide 6 m, deepness 2.5m with inclination of channel wall is 1.5H : 1V. Material concrete is not used in this construction, but only entrenchment land with sprayed by seed grassing (hydroseeding). Final reclamation construction are fill and slope which recontour by two types. The first type is 3 : 1 with gradient of angle of equal to 18,3° and the second type is 2 : 1 with gradient of angle of equal to 26,6° (figure 2)



Source: *Revegetation Techniques 2H : 1V Slopes for Final Reclamation May 2005, PT. X*

Figure 2 Soil Placement Design

c. Erosion Control Installation : Erosion control installation which applied in Batu Hijau project is using java wood. This installation is planted by row (row sprigging) according to contour with planted space about 15 cm and row interval about 15 m. The distance from top slope is 15 m combined with ijuk blankets as sediment filter and jute net for mulch covering soil surface

3.2. Revegetation

The purpose of revegetation is to reflate native species which is natural vegetation in location and to bringing back the function of such a location to its former condition before its utilization, so the stability of environment would be safe for a next period.

Activities of revegetation are :

- Hydroseeding** : Hydroseeding is one of revegetation step by spraying grasses seeds which have been mixed with other materials. This has to be done for the ex-mining land or a land which required to be taken care due to the stability. High pressured pump at hydroseeder vehicle used for hydroseeding activity. The purpose of hydroseeding is to take care the stability of surface land and to prevent erosion by composing grass layer at the land surface.
- Seed Plantation** : The purpose is to compose new vegetation and to bringing back the condition of land to its early condition and also to take care the stability of land and to prevent the run-off due to reclamation process. Seed plantation is done at a land which have ready for cultivation and usually done at the rain season. Manual technique by making planting hole with dimension at 30x30x30cm with a plant spacing is 2x3m is used as cultivation method. Seed which being planted is divided in to 2 categories. (1) seed having ability of relative quickly grow (1-2 year) (2) seed having ability of slowly grow (fast and slow growing tree). Figure 3 shows seed plantation activity.



Figure 3 Seed Plantation Activity

3.3. Monitoring and Maintenance

The purpose monitoring and maintenance is to know the progress of reclamation and to maintain reclamation site.

- Monitoring** : The purpose of monitoring is to know progress and efficiency of reclamation and to identify locations which requiring additions treatments. The result of monitoring process is taken as matter consideration to determine next step. Land monitoring divided in two ways. (1) plot quadrant technique and (2) rod laser intercept technique. Plot quadrant done by making plot in field 5 x 5 m then counting the material and species in the plot. Rod laser intercept is done by using laser pointer, where counting the enumeration of material and species is done in area of around which hit by its laser pointer. Monitoring activities are covering vegetation and basal, observing earthflow area, and seeing variance of plan type.
- Maintenance** : activity of maintenance divided in two main activities, such as planting maintenance and erosion repairing. Planting maintenance is doing replanting to plants seeds and fertilize in periodical times. This activity also doing controlling the weeds which can be potential to disturbing plant to grow. Erosion repairing is done at reclamations land where the erosion area happened. This technique consisting of several types based on the damage of erosion land. The technique are energy billows technique, fibre of juk, brush layering, bamboo lattice, combination of billows energy, fibre of mulch juk and cultivation of grass vetiver.

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3.4. Supporter Reclamation Activities

Nursery and tree phenology are supporter reclamation activities which has been doing in this site.

- a. Nursery : The purpose of nursery is to deliver seeds which will be used in revegetation. Nursery divided in three phases. They are :
 1. Plant material collection : The purpose is to get plant material which will be made for seeds at nursery facilities. Materials which collected at this activity are: seed, and bar cutting from original species in that area.
 2. Seed production : Activities of seed production are preparation for media, seed and cutting, treatment and evacuation seed in to polybag. Technique of seed production which applied in Batu Hijau project are seed germination technique, bar cutting technique, and transplantation technique. Multiplication process is done in nursery house which 60.000 seed capacities and the intensity about 30 - 60 %. Multiplication through germination done in germination house.
 3. Seed maintenance : Activities of seed maintenance are watering plants, fertilizing plants and controlling plants from disease, monitoring growth transplation and selecting healthy plants. Organic fertilizer use to fertilize this plants. The control of weeds is done by cleaning weed in plant area. Watering is done 2 times, in the morning and afternoon. Activities of growth monitoring are making a note about high plants, stalk diameter and wide of canopy. To get good plant, we should take healthy plant to be planted in field. Figure 4 shows result of seed production.



Figure 4 Result of Seed Production.

- b. Tree Phenology : The aim of tree phenology is to know plant reproduction, life cycles pattern in Batu Hijau area and also to know specific character of them. The activity is done in periodical time at certain locations in order to know the conditions in locations of Batu Hijau area. Growing of flower, seed, fruit and general plants condition are parameters that should be observed and noted to fulfilled with the parameters criteria

3.5. Regulation and Implementation

Minister Forestry and Plantation Degree No. 146/kpts -II/99, on 22 March 1999 explained that energy and mining company whose doing mining activity in forest area have obligation for

1. Doing reclamation for ex mining land
 2. Responsible for reclamation cost.
 3. Have properly organization to manage reclamation program
 4. Doing protection programs to protect the forest which had borrowed for mining activity.
- Implementation of land rehabilitation in PT X generally included fourth point obligation. Those obligations are implemented in special division of reclamation in environmental department, and it done according to the responsibility.

Minister Forestry and Plantation Degree No. 146/kpts -II/99, on 22 March 1999 also explained that scope of reclamation are :

- a. Investment reclamation location
- b. Determination reclamation location
- c. Reclamation planning

d. Reclamation implementation divided in some activities. They are :

1. Field/ land preparation
2. Arrangement land type
3. Controlling erosion and sedimentation
4. Top soil treatment
5. Revegetation
6. Maintenance

Fund reclamation guarantee is one of investment activity that has been done by PT. X. Determination reclamation location and reclamation planning is been done in periodical time and explained in implementation reclamation report, and after that evaluated by government. All activities which implemented for land rehabilitation based on SOP (Standard Operating Procedure). SOP is a guidance and regulation to explain basic activity in properly.

Minister Forestry and Plantation Degree No. 146/kpts -II/99, on 22 March 1999 also explained that success definition for reclamation activity is fulfilled with criteria of arrangement land type, erosion & sedimentation controlling, and revegetation .

Figure 5 shows rehabilitation land location , the result from implemented rehabilitation activities according with The Decree of Forestry and Plantation Minister Number 146/kpts-II/1996 .



Figure 5 Rehabilitation Land Location

4. Conclusion

1. PT. X have successfully done land rehabilitation activities according to criteria of mining land in minister forestry and plantation degree No 146/kpts-II/99 on 22 march 2009 about reclamation guidance.
2. Government institution take part as supervisor and observer according to their responsibility based on Minister Forestry and Plantation Degree No. 146/kpts -II/99 in land rehabilitation at PT. X.
3. In order to support the success of rehabilitation, it is urgently needed local community to beinvolved, so they can obtain information and skill to create ever lasting survival within such rehabilitative site.

5. References

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