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# CHEMICAL PROPERTIES ANALYSIS OF DISPOSAL SOIL AT COAL MINING CV. INTAN KARYA MANDIRI OF BANJAR DISTRICT, SOUTH KALIMANTAN PROVINCE, INDONESIA

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## ABSTRACT
Coal mining activities using the open pit mining method can affect depreciation of the quality of the surrounding environment, one of which has an impact on reducing the classification criteria for soil chemical properties. The soil organic matter shrinks after being mined due to the lifting of the top layer due to the dismantling of the coal covering material. This study aims to analyze the chemical properties of the soil, namely soil pH, C-organic, Nitrogen (N), Phosphorus (P-Total) and Cation Exchange Capacity (CEC) in the disposal area. The research method is descriptive analysis. Sampling and observation in Cintapuri Village, Cintapuri Darussalam District, Banjar Regency. Soil classification in Disposal 1, soil pH is classified as "Very Acid" to "Sour", C-organic is classified as "Very Low", N-Total is classified as "Very Low" to "Low", phosphorus is classified as "Very Low", Cation-exchange capacity (CEC) is classified as "moderate". Disposal 2, Soil pH is classified as "acid", C-organic is classified as "Very Low", N-Total is classified as "Very Low" to "Very Low", phosphorus is classified as "Very Low", CEC is classified as "Medium" and "High". Based on the research, the existence of coal mining activities causes the chemical properties of the soil in the disposal area as low criteria.

## KEY WORDS
Chemical classification of soil, disposal, open pit mining.

Coal mining in South Kalimantan is dominated by the open pit method. Coal mining using the open pit method results in land degradation that arises due to damage to the soil (Effendi, et al., 2019). Mining activities disrupt environmental ecosystems through changes in morphology and soil structure (Wasi and Fathia, 2010). Post-coal mining will have the effect of topographic changes which cause degradation of the physical and chemical properties of the soil (Subhan, et al., 2019). Coal mining land is classified as poor soil in nutrients, resulting in land improvements over a long period of time (Oktavia, 2019). In general, ex-mining soil contains low levels of nutrients, therefore research on chemical properties is needed to arrange disturbed land so that it functions according to its designation (Tambunan, 2022). Research related to soil chemical properties can be a reference for future reclamation activities to improve post-mining land, with research references it is hoped that plants that will be planted in the reclamation area can grow well and in accordance with the conditions of the land (Oktorina, 2017).

CV. Intan Karya Mandiri (CV IKM) is a coal mining company in Cintapuri Village, Banjar Regency, South Kalimantan with open pit mining method. The research was carried out in the CV IKM area because so far there has been no reference available regarding soil classification in the disposal area and proof that the criteria for land classification in the disposal area have low criteria due to coal mining activities. Evaluation of soil quality aims to determine changes in existing conditions of soil properties through a study of chemical, physical and biological properties due to mining activities (Rachman, et al. 2017).

## METHODS OF RESEARCH

This research was carried out using an analytical-descriptive approach through sample testing in the laboratory, sample analysis and documentation of activities. Sampling from disposal using hand boring with a depth of 20 cm as much as 5 points in two disposal. The soil sample testing method is as follows:

1. Soil pH using the H2O Extraction Method;
2. C Organic using the Walkley and Black Methods;
3. Nitrogen (N) using the Kjeldahl Method;
4. Phosphorus (P-Total) using the Bray 1 method, 25% HCl;
5. Cation Exchange Capacity (CEC) using the Percolation Method.

The classification of soil chemical properties refers to LPT, 1983.

## RESULTS OF STUDY

Sampling of disposal soil from the field using hand boring with a drill depth of 20 cm in 5 points at two disposal sites, sample points can be seen in Table 1. After taking soil samples in the field, the next process is testing the chemical properties of the soil, based on the results from the Soil Science Laboratory, Faculty of Agriculture ULM obtained the test results presented in Table 2.

Table 1 – Soil Sample Point Coordinates

| Sample Code | Coordinate | |
|---|---|---|
| | East longitude | South latitude |
| IKM1 | 115° 00’ 37,10” | 03° 13’ 55,90” |
| IKM2 | 115° 00’ 47,60” | 03° 13’ 52,70” |
| IKM3 | 115° 00’ 42,90” | 03° 13’ 56,00” |
| IKM4 | 115° 00’ 30,50” | 03° 14’ 08,80” |
| IKM5 | 115° 00’ 29,30” | 03° 14’ 06,30” |

*Source: Data Processing in 2023.*

Table 2 – Soil Sample Test Results

| No | Parameter | Sampling | Location | Value | Unit | Classification |
|---|---|---|---|---|---|---|
| 1 | pH | IKM 1 | Disposal 1 | 4,86 | | Sour |
| | | IKM 2 | Disposal 1 | 4,41 | | Very Sour |
| | | IKM 3 | Disposal 1 | 4,66 | | Sour |
| | | IKM 4 | Disposal 2 | 4,61 | | Sour |
| | | IKM 5 | Disposal 2 | 4,98 | | Sour |
| 2 | C Organic | IKM 1 | Disposal 1 | 0,12 | % | VL |
| | | IKM 2 | Disposal 1 | 0,55 | | VL |
| | | IKM 3 | Disposal 1 | 0,55 | | VL |
| | | IKM 4 | Disposal 2 | 0,67 | | VL |
| | | IKM 5 | Disposal 2 | 0,49 | | VL |
| 3 | Nitrogen | IKM 1 | Disposal 1 | 0,11 | % | L |
| | | IKM 2 | Disposal 1 | 0,10 | | VL |
| | | IKM 3 | Disposal 1 | 0,09 | | VL |
| | | IKM 4 | Disposal 2 | 0,18 | | L |
| | | IKM 5 | Disposal 2 | 0,09 | | VL |
| 4 | Phosphor | IKM 1 | Disposal 1 | 2,06 | mg/100g | VL |
| | | IKM 2 | Disposal 1 | 1,89 | | VL |
| | | IKM 3 | Disposal 1 | 3,94 | | VL |
| | | IKM 4 | Disposal 2 | 4,17 | | VL |
| | | IKM 5 | Disposal 2 | 5,00 | | VL |
| 5 | KTK | IKM 1 | Disposal 1 | 20,26 | me/100 g | L |
| | | IKM 2 | Disposal 1 | 19,12 | | L |
| | | IKM 3 | Disposal 1 | 21,81 | | L |
| | | IKM 4 | Disposal 2 | 24,79 | | H |
| | | IKM 5 | Disposal 2 | 21,52 | | M |

Description: VH – Very High; VL – Very Low; L – Low; M: Moderate; H – High.

Soil samples obtained in the field will then be tested on the chemical properties of the soil. Based on the results from the Soil Science Laboratory, ULM Faculty of Agriculture, the test results are presented in Table 2.

## DISCUSSION OF RESULTS

Based on the results of laboratory tests, it was obtained that the soil pH value at the disposal of 1 IKM 1 sample was classified as "sour" (pH 4.86), IKM 2 was classified as "very acid" (pH 4.41) and IKM 3 was "sour" (pH 4.66). . Disposal 2 for IKM 4 samples is classified as "sour" (pH 4.61), IKM 5 is classified as "sour" (pH 4.98). As a comparison, in research related to soil pH, soil pH is classified as "Very Acidic" where the soil pH is 2.2 to 3.5 (Erfandi, 2017), the pH of overburden samples from coal mines is classified as "Very Acidic" to "Slightly Acidic" with a value ranged from 4.11 to 5.63 (Rai, et al., 2010). A lack of soil pH of 5.5 can cause a loss of plant absorption of nutrients, resulting in plant death (Susilo, et al., 2010). The pH of mine soil is classified as "low" indicating that it is not suitable for use as a planting medium for plants (Ramadhani, et al., 2022), on the other hand if the high pH will facilitate the plants to utilize the elements K, P, N, as well as other nutrients needed, phosphorus absorption optimally so that plants develop well, pH above 5.5 organisms found in the soil can grow well (Hardjowigeno 2007; Gunawan et al. 2019; Ramadhani, et al., 2022).

The test results at the disposal of 1 sample of IKM 1, IKM 2 and IKM 3 have a "Very Low" classification (C-organic value of 0.12%, 0.55% and 0.55%). In disposal 2 for samples IKM 4 and IKM 5 are classified as "Very Low" (C-organic 0.67% and 0.49%). The low C-Organic content is due to the stripping of the top layer of coal during coal mining which generally contains organic matter and its placement after excavation is generally mixed, during backfilling generally the topsoil is not placed at the top and the organic matter is mixed (Fitriani, et al., 2018), This is in line with what happened in the field because overcut material was found in the OB stockpile which contaminated the OB stockpile, which is thought to have caused the low C-organic content in research disposal soil. C-organic that is classified as “very low” indicates a very acidic soil pH, resulting in infertile soil (Aipassa, et al., 2020). As a comparison with related research, the percentage of organic carbon accumulated overburden in coal mines at 5 locations in Jharkhand ranges from 0.61% to 0.83% which is classified as "very low" (Rai, et al., 2010). Low C-organic content is an indicator of a lack of available organic matter (Gerson, 2008 in Widiyatmoko, et al., 2017), a lack of soil organic matter results in reduced litter from the leaves and twigs of a vegetation (Widiyatmoko, et al., 2017). The very low availability of C-organic indicates low chemical fertility in ex-mining areas which has a negative impact on planting crops (Chaubey, et al., 2012 in Hamid, et al., 2017).

Testing soil nitrogen or N-Total in the field at disposal 1 sample IKM 1 is classified as "Low" (0.11%), IKM 2 is classified as "Low" (0.10%) and IKM 3 is "Very Low" (0.09%) ). In disposal 2, IKM 4 is classified as "Low" (0.18%), IKM 5 is classified as "Very Low" (0.09%). Prior to mining activities, the area around the study site was dominated by vegetation in the form of shrubs, weed fields and part of the forest. Changes in land cover are thought to have affected the low nitrogen value in the research soil. Oksana, et al, (2012) said that the transformation of the n-total soil content could be due to land function, so it is feared that during land rehabilitation vegetation will be difficult to develop, where Aipassa, et al, (2020) stated that if vegetation is very difficult to grow and infertile soil shows Total N classified as "Very Low" by very acidic soil pH. Lack of n-total results in reduced plant weight and protein, because n-total is needed in large quantities by plants, while large amounts of soil nitrogen are good for plants because they are needed by plants to accelerate cell division and albumin, accelerate flower, seed and fruit formation. also strengthening plant stems (Gunawan, et al., 2019).

Phosphorus (P-Total) from laboratory tests at the disposal of 1 sample IKM 1 (2.06 mg/100 g), IKM 2 (1.89 mg/100 g) and IKM 3 (3.94 mg/100 g) have the classification "Very low". In disposal 2 for IKM 4 samples (4.17 mg/100 g) and IKM 5 (5.00 mg/100 g) were classified as "Very Low". In the research disposal, it was found that coal overcut material was suspected of triggering a low soil phosphorus content, this is in line with the opinion of Allo (2016) which states that if the reduced soil phosphorus content starts from poor soil stripping to stockpiling mixed with other materials, the impact on the soil solum turns shallow and without a top soil layer. The "Very Low" test classification in research is equivalent to research (Tampubolon, et al., 2020) with the results of the phosphorus test in the former coal mining soil where the total P is 3.63 mg/100g which is classified as "Very Low". The minimal content of phosphorus in the soil will inhibit plant growth because its availability is affected by the presence of pH elements in the soil (Aprillia, et al., 2021). Soil phosphorus levels that are classified as "high" are very good for plants because they are needed by plants to speed up the ripening process and are also able to strengthen plant stems (Gunawan, et al., 2019). The high content of soil phosphorus will maximize the absorption of nutrients through plant roots (Susilo, et al., 2010).

Laboratory test results for soil CEC in disposal 1 on samples IKM 1 classified as "Medium" (20.26 me/100 g), IKM 2 was classified as "Medium" (19.12 me/100 g) and IKM 3 "Medium" (21 .81 me/100 g). Disposal 2 for the IKM 4 sample is classified as "High" (24.79 me/100 g), IKM 5 is classified as "Medium" (21.52 me/100 g). The results of the soil CEC test in coal mining land at 3 points classified as "High", and two points classified as "Medium", but other soil chemical elements KB, C-organic, N-total, K-dd dominant were classified as very low making the soil fertility level very low. low (Subhan, et al., 2019). At the disposal, very clay stockpile material was found followed by a high CEC test value, in line with Nyaing's research (2021) which stated that the low CEC value of soil illustrates the high clay content in ex-mining land. CEC that is classified as "low" can inhibit plant development, conversely if the soil CEC is "high" then the ability of the soil to capture the nutrients needed by plants for growth increases its capacity (Widiyatmoko, et al., 2017). Soil CEC test results above 16 me/100g make plant growth maximally sustainable, which also facilitates plant growth (Setiadi, 2002 in Widiyatmoko, et al., 2017).

Based on field research, at several disposal points there was overcut material, because when unloading the overburden (OB) material the excavator dug too far so that the coal under the OB was dredged. When OB dismantling activities are often found there are no staff supervising these activities, even though with the presence of a supervisor, overcuts can be prevented earlier, material overcuts can be seen in Figure 1.

Figure 1 - Material *Overcut* pada *Disposal*

The results obtained from the research can be used to formulate suggestions for environmental management of post-mining land which is carried out focusing on soil chemical properties. Mining methods that move around need to be avoided, as far as possible use a per-hill mining system (Widiatmaka, et al., 2010). Margaretha (2010 in Subhan, et al., 2019) said that mining can cause changes in the physical properties as well as reduced chemical properties of the soil because often coal excavated material is piled on top of productive soil material (the arrangement is reversed from its initial arrangement).

The overcut that causes coal to also be buried in the disposal has the potential to contaminate the soil so that it can affect the chemical properties of the soil. In order to minimize the company being able to carry out trial activities in the OB pit on excavators against digging benches so that overcuts do not occur, try to make trial activities not have too much of an impact on reducing the productivity of diggers and loading equipment (DT).

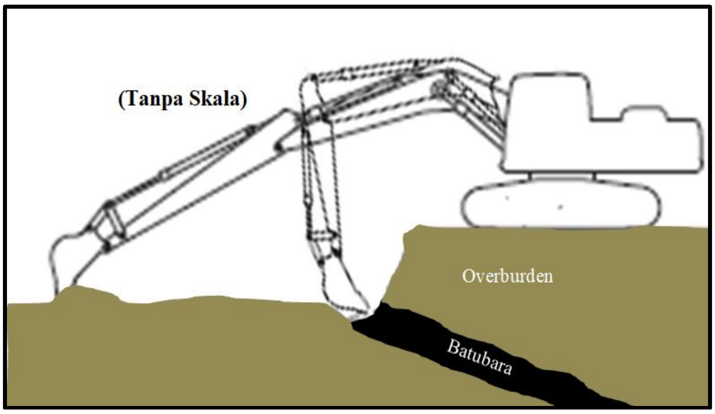


Figure 2 – Illustration of Coal Overcut

The OB bench in the field is about 2 meters which is recommended to use a smaller digging unit, such as an excavator of the Komatsu PC 400 type which is more ideal when digging OB, digging tools in the field have digging dimensions and height that are larger than the PC 400 so it is not ideal. OB material excavation is recommended to be left at least 10 cm thick on the coal roof to avoid coal overcut. Supervision by company staff (foreman staff and production supervisors) during OB dismantling activities in the pit is necessary to reduce the potential for overcut. Technical recommendations regarding the types of tools for the mine level are based on the height-width standards for mining ladders in several mining companies in South Kalimantan, with comparisons using Komatsu brand diggers. Illustrations of the overcut process and recommendations related to the height of the digging ladder can be seen in Figure 2 and Table 3.

Table 3 – Recommended Mine Ladder Height-Width

| Bench | Komatsu Excavator | | | |
|---|---|---|---|---|
| | PC 400 | PC 800 | PC 1100 | PC 1600 |
| Minimal Width | 20 | 25 | 30 | 35 |
| Maximal Height | 3,5 | 4,5 | 4,5 | 5 |
| Optimal Height | 2 | 3 | 3 | 3,5 |
| Minimal Height | 1,5 | 2 | 2 | 3 |

The limited IUP land causes the company to be unable to maximize its disposal heaps, unorganized and compact piles of material pose a physical risk in the form of avalanches and contamination of the stockpile material if there is coal contained in the OB material dumped from the conveyance or OB material piling up the surrounding vegetation. The lack of orderly embankment also makes it difficult to control the overcut material because mountains are often found so that the overcut material between the mounds of embankments is difficult to monitor.

Efforts to improve through the physical can be by deploying a compactor (compactor) which functions to compact the stockpiled material at the disposal. The dense material at the disposal makes the amount of OB material that can be accommodated more. The process of arranging disposal piles also needs to be supervised so that the means of transportation or maintenance such as bulldozers and motor graders can still move, because the company is constrained by limited land so that material compaction needs to be done as soon as possible, illustration in Figure 3.

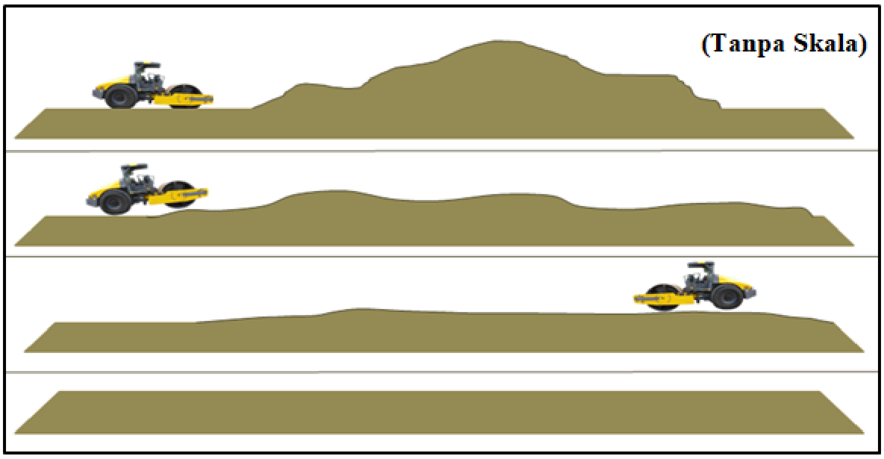


Figure 3 – Illustration of Repairing Disposal Stockpiles

Physical improvement efforts to improve soil chemistry can also be through placing layers of heaped soil according to the layer level, by placing top soil at the very top so that it can support the availability of nutrients for plants and avoid the presence of overburden at the top, land use through making drainage channels so that this does not occur. erosion and carrying of top soil which can affect and reduce soil nutrients and is followed by planting of cover crop species to prevent potential erosion of the soil surface and it is hoped that it can increase soil organic matter and nutrients (Rande, 2016).

Disposal that has been arranged by a coal company sometimes physically also has the potential for landslides due to standing water. Technically waterlogging also affects soil material which is eroded by water movement on the surface of overburden heaps at disposal so that the soil classification becomes low.

The technique of tackling water stagnation at the disposal, Prayoga, Toha and Bochori (2014) suggests making a "V-drain" channel design, which is made with the remaining area for a 5 meter wide channel for the drainage of rainwater that is blocked at the disposal and the surrounding area, with the disposal made slanted towards the channel so that the water that is above the disposal heap easily flows into the channel that is made, the illustration design can be seen in Figure 4.

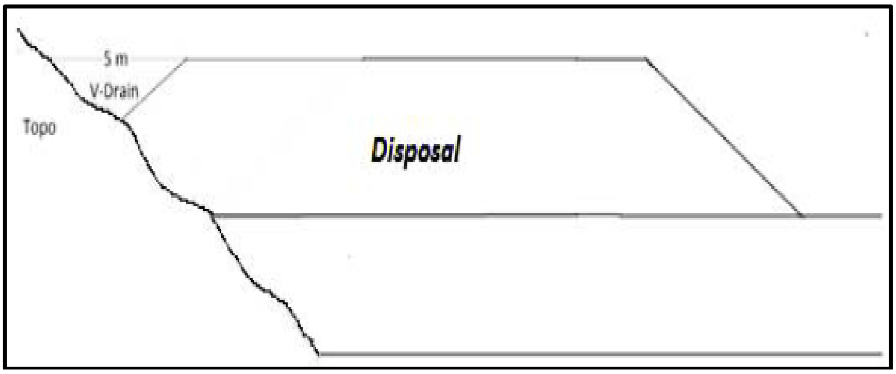


Figure 4 – “V-drain” *Disposal*

Changes in soil chemistry in C-organic transformation, soil pH, can make it difficult for plants to grow in ex-mining soil (Hardjowigeno, 2003 in Subhan, et al., 2019). It is feared that soil characteristics disturbed by mining activities with heavy equipment will worsen the water system as well as aeration which will affect plant development (Sembiring, et al., 2016). Improving the soil chemical properties of ex-fill material is an important factor in the success of the reclamation activities to be carried out (Rachman, et al. 2017). Efforts to improve the chemical properties of former coal mining soil can be done through:

a. Soil pH, ex-coal mining can be improved by composting city waste and the best dose is obtained in the P3 treatment (5 kg soil + 200 g compost), where the soil pH is 5.8, the "Slightly Acidic" classification becomes 7.16 "Neutral" (Palupi, et al., 2020). The pH of ex-mining soil can be improved by composting city waste and the best dose is obtained in the P3 treatment (5 kg soil + 200 g compost), the soil pH is 5.8, the "Slightly Acid" classification rises to 7.16 "Neutral" (Palupi, et al. , 2020). Landscape restoration by means of post-coal mining land reclamation can be through the addition of natural top soil (top soiling) on the piled up soil, where topsoil can improve soil quality (Borůvka, Kozák, Mühlhanselová, Donátová, Nikodem, Němeček, Drábek, 2010);

b. C-organic, improving the quality of ex-coal mining land can be through increasing organic matter (plant residues, compost, animal manure and green manure/legumes), soil amendments and other organic fertilizers (Asmarhansyah, 2017). The percentage of C-organic ex-coal mining soil treated with BPS isolates increased, from 0.65% in the "Low" classification to 1.44% in the "Rather Low" classification (Sembiring, et al., 2016);

c. Soil nitrogen, application of municipal waste compost using the POME bioactivator method B1 treatment (5 kg soil + 100 g of golden snail compost and Trichoderma sp) increases soil nitrogen from former coal mines from 0.11% to 0.21% (Palupi, et al, 2021) . Dosage of bokashi organic matter such as kiapu and krinyu plants in the T3 treatment (22.5 g polybag-1 as much as 45 tons/ha) improved coal mining soil with an increase of 0.16 (low) from 0.08 (very low) (Fachrul, et al., 2019). Composting made from cow manure with treatment D (25% soil: 75% compost) for 30 days was able to increase total N, namely 0.45% from 0.36%, after the composting process the soil color turned darker (Natanael, et al., 2020);

d. Phosphorus (P-Total), soil test results after a month of incubation through the application of city waste compost fertilizer using the POME bioactivator P3 treatment (5 kg soil + 200 g compost) resulted in phosphorus from 6.7 (low) ppm to 66.02 ppm (very high) (Palupi, et al., 2020). Soil P can be triggered by sprinkling lime to increase and trigger plant growth in soils that are classified as acidic pH (Widiyatmoko, et al., 2017). Coal fly ash (ATB) increases soil phosphorus content, fertilization by giving 80 t ATB ha-1 raises pH and increases soil P, which triggers an increase in pH so that aluminum can exchange (Al-dd) which binds P to decrease (Fahrunsyah, et al. , 2021);

e. Cation Exchange Capacity (CEC), the addition of sludge (waste made from wood) is used as a solution to improve the chemical properties of ex-coal mining soil, effective treatment at a composition of 50% where sludge and sludge that has been composed (v/v), causes soil CEC levels to increase ( Widyati, et al, 2005). Tampubolon, et al. (2019) stated that the addition of ameliorant with a composition of 5 kg of chicken manure compost + lime (1.75 x Al-dd) + 125 g of biochar/plant increased soil CEC from 7.7 to 14.05 (me/100 g).

IUP holders as well as IUPK must comply with mineral and coal mining regulations in order to carry out governance and environmental monitoring of post-mining reclamation activities as stipulated in Law no. 3 of 2020 concerning mineral and coal mining, in order to repair the disruption of an ecosystem, the stages of revegetation activities are carried out after the land is arranged (land arrangement). The stages of revegetation namely:

1. Planting cover crops to control sedimentation-erosion;
2. Planting pioneer/pioneer and fast-growing species to protect the land and increase nutrient levels in the soil quickly;
3. If the pioneer plants are 2 to 3 years old, enrichment will be carried out by planting local/local plant species with long cycles and high economic value (usually they need shade at the beginning of planting);
4. Other relevant locations can be planted with long-cycle local plant species as soon as possible by adjusting the function of the forest (BSILH-KLHK, 2022).

Improving the chemical properties of the soil in the scenario research is good, assuming a neutral pH and the classification of other chemical properties "moderate" to "high", will result in a spatial layout or landscape that is close to the original landscape. The landscape that is ready to be the initial stage is planting cover crops with the criteria that these plants meet the criteria of fast growing, easy to decompose, have good roots and are cheap if you want to do propagation (BSILH-KLHK, 2022), selection of plant species soil cover crop in Table 4.

Table 4 – Criteria for Types of Cover Crops for Revegetation Activities (First Period)

| No. | Species name | |
|---|---|---|
| | Local | Latin |
| Creeping Group (Legum Cover Crop) | | |
| 1 | Centro | *Centrosema pubescens* |
| 2 | Kacang ruji | *Pueraria javanica* |
| 3 | Legum sawit | *Psopocarphus polustris* |
| 4 | Jicama | *Calopogonium* |
| 5 | Desmodium | *Desmodium ovalifolium* |
| 6 | Kacang mukuna | *Mucuna conchinchinensis* |
| 7 | Kacang kara benguk | *Mucuna pruriens* |
| 8 | Kacang | *Mucuna bracteata* |
| 9 | Puero | *Pueraria phascoloides* |
| Golongan Perdu | | |
| 11 | Lapa lapa | *Flemingia congesta* |
| 12 | Orok orok | *Crotalaria anagyroides* |
| 13 | Kacang babi | *Tephrosia vogelii* |
| 14 | Kaliandra merah | *Caliandra callothyrsus* |
| 15 | Kaliandra putih | *Caliandra tetragona* |
| Rumput-rumputan | | |
| 16 | Rumput ruzi | *Brachiaria ruziziensis* |
| 17 | Rumput atratum | *Paspalum atratum* |
| 18 | Rumput gajah mini | *Pennisetum purpureum* |
| 19 | Rumput vetiver | *Vetiveria zizanoides* |
| 20 | Rumput setaria | *Setaria spp.* |
| 21 | Serai Wangi | *Cymbopogon nardus* |

*Source: Department of Agriculture, 2013 in BSILH-KLHK, 2022.*

The cover crop that has been planted needs to be monitored so that it is not damaged, then an important part of the revegetation stage is the analysis of the characteristics of the planting land such as soil physical properties (texture, solum and moisture) and soil chemistry (pH, CEC), weather, rainfall, topography and disease or local animals near the planting site, if this has been done, then species determination will be carried out. Based on the types that have been tested, the plants obtained for post-coal mining land have been presented in Table 5.

Table 5 – Revegetated Plants (second period)

| No. | Species name | |
|---|---|---|
| | Local | Latin |
| 1 | Ketapang Terminalia | *catappa* |
| 2 | Angsana | *Pterocarpus indicus* |
| 3 | Laban | *Vitex pinnata* |
| 4 | Johar | *Cassia siamea* |
| 5 | Kenanga | *Cananga odorata* |
| 6 | Jabon | *Anthocephalus chinensis* |
| 7 | Pohon Ara | *Ficus. microcarpa* |
| 8 | Mahang | *Macaranga lowii* |
| 9 | Mahang jarum | *M. gigantea* |
| 10 | Amporan | *M. hypoleuca* |
| 11 | Meniran | *Geunsia petandra* |
| 12 | Kemiri Sunan | *Reutealis trisperma* |
| 13 | Asam gunung | *Cleistanthus myrianthus* |
| 14 | Kayu balsa | *Ochroma pyramidale* |
| 15 | Pulai | *Alstonia scholaris* |
| 16 | Buta-buta | *Homalanthus populneus* |
| 17 | Parengpeng | *Croton argyratus* |
| 18 | Bengkal | *Nauclea officinalis* |
| 19 | Puspa | *Schima wallichi* |

*Source: Susilo et al., 2010; Rayadin et al., 2011; Setyowati et al., 2017; BSILH-KLHK, 2022.*

Plants that are planned to be planted in the third period or long-term period should use local plants or vegetation prior to mining activities at the research location. Rubber plants (Hevea brasiliensis) were original vegetation before mining, in the initial conditions before mining, apart from rubber plantations, there were also fields that became early vegetation, Wijaya (2020) said fields on ex-mining land could become productive land, the experimental land was located in Sawahlunto City and Sijunjung Regency where there are many small-scale coal mining and gold mining, after being given multipurpose organic substances, coal ash can form humus to fertilize plants and produce thriving corn and cassava plants. BSILH-KLHK (2022) mentions local plants that are relevant for use in the third period can be seen in Table 6.

Table 6 – Long Cycle Local Plants (continuation period)

| No. | Species name | |
|---|---|---|
| | Local | Latin |
| 1 | Kahoi | *Shorea balangeran* |
| 2 | Meranti Tembaga | *Shorea leprosula* |
| 3 | Kapur | *Dryobalanops beccari* |
| 4 | Kapur | *D. Lanceolata* |
| 5 | Meranti putih | *Parashorea smythiesii* |
| 6 | Resak | *Cotylelobium burck* |
| 7 | Ulin | *Eusideroxylon zwageri/Ulin* |

*Source: Susilo et al., 2010; Rayadin et al., 2011; Setyowati et al., 2017; BSILH-KLHK, 2022.*

## CONCLUSION

Based on the research results, it can be concluded that the chemical properties of the soil in the two dominant disposal sites are low and acid.

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