

# Study on the environmental state in Tan Rai bauxite mining area Bao Lam district, Lam Dong province

*Nghiên cứu hiện trạng môi trường vùng khai thác mỏ bauxite Tân Rai tại huyện Bảo Lâm, tỉnh Lâm Đồng*

Research article

Pham Thi Thu Ha<sup>1\*</sup>, Mai The Duong<sup>2</sup>, Duong Ngoc Bach<sup>3</sup>, Nguyen Viet Hoai<sup>3</sup>, Phi Thi Ly<sup>3</sup>

<sup>1</sup>Faculty of Environmental Sciences, VNU University of Science, 334 Nguyen Trai, Thanh Xuan, Ha Noi; <sup>2</sup>Center of Industrial Environment, National Institute of Mining – Metallurgy Science and Technology, 79 An Trach, Dong Da, Ha Noi, Vietnam; <sup>3</sup>Research Center for Environmental Monitoring and Modeling, VNU University of Science, 334 Nguyen Trai, Thanh Xuan, Ha Noi, Vietnam

Planting trees in mining zones for post-mining rehabilitation is of great interest. Therefore, it is important and necessary to study the current state of the air, water, and soil environment in the mine exploited area. Therefore, this article studied and assessed the environmental state in Tan Rai bauxite mining area at Bao Lam district, Lam Dong province through the environmental components of air, water and soil, as a basis for selection of suitable crops for post-mining rehabilitation. The research result showed that the air quality in the bauxite mining area met the standard 3733/2002/QĐ-BYT. Almost monitoring parameters of surface water and wastewater is within the allowed threshold of Vietnam standards. However surface water had a sign of TSS and COD pollution (TSS and COD at the Danos stream after the received point of wastewater from No.6 tailing lake were 1.6 times and 1.07 times higher than those in standard). Ground water was polluted by Coliform (20-63,3 times over standard) and cation  $\text{NH}_4^+$  (1.1-1.5 times over standard); Soil in exploiting region was strongly impacted, soil profile has changed, red-yellow soil dominated, soil fertility is pretty high,  $\text{pH}_{\text{H}_2\text{O}}$  and  $\text{pH}_{\text{KC}}$  were from acid to neuter. This studied environment state is very suitable for planting pine and acacia. These results will be useful references, as a basis for orientation of post-mining rehabilitation.

*Việc trồng cây xanh để phục hồi các vùng mỏ sau khai thác hiện đang rất được quan tâm. Do vậy, việc nghiên cứu hiện trạng môi trường không khí, nước và đất ở vùng khai thác mỏ là rất quan trọng và cần thiết. Bài báo nghiên cứu đánh giá hiện trạng môi trường vùng khai thác mỏ Bauxite Tân Rai, huyện Bảo Lâm, tỉnh Lâm Đồng thông qua các thành phần môi trường không khí, nước, đất, làm cơ sở cho việc lựa chọn loại cây trồng phù hợp cho công tác phục hồi môi trường sau khai thác mỏ. Kết quả nghiên cứu cho thấy, chất lượng môi trường không khí tại vùng khai thác mỏ Bauxite đạt tiêu chuẩn 3733/2002/QĐ-BYT. Hầu hết các thông số quan trắc của nước mặt và nước thải đều nằm trong giới hạn cho phép theo tiêu chuẩn Việt Nam, tuy nhiên môi trường nước mặt cũng đang có dấu hiệu ô nhiễm TSS và COD (TSS và COD tại suối Danos phía dưới điểm tiếp nhận nước thải hồ quặng đuôi số 6 tương ứng gấp 1,6 lần và 1,07 lần so với tiêu chuẩn). Nước ngầm đang bị ô nhiễm Coliform (vượt quy chuẩn cho phép từ 20-63,3 lần) và  $\text{NH}_4^+$  (vượt quy chuẩn cho phép từ 1,1-1,5 lần); Đất tại khu vực khai thác bị tác động mạnh mẽ, phân diện đất bị thay đổi, đất đỏ vàng chiếm ưu thế, đất có độ phì khá,  $\text{pH}_{\text{H}_2\text{O}}$  và  $\text{pH}_{\text{KC}}$  từ chua đến trung tính. Kết quả hiện trạng môi trường như vậy là phù hợp với trồng thông và keo. Những kết quả này là tài liệu tham khảo hữu ích, làm cơ sở cho việc định hướng phục hồi đất sau khai thác mỏ.*

**Keywords:** environmental state, bauxite mining, Tan Rai

## 1. Introduction

Vietnam has a great potential for bauxite in the region and in the world. Bauxite ore is found in both the North and the South of Vietnam, but the largest concentration is in the South-Central Highlands. Total bauxite ore reserves in Vietnam are forecasted at 5.5 billion tons, of which about 91 million tons are in the North, and 5.4 billion tons are in the south [1].

Tan Rai Bauxite mine covers an area of 42 km<sup>2</sup> in Loc Thang, Loc Phu and Loc Ngai communes in Bao Lam district, 20 km far from Bao Loc town in the Northeast. This mine has been licensed for exploitation under the Mineral License No. 1084 / GP-BTNMT dated 21/06/2010 of the Minister of Ministry of Natural Resources and Environment [2] with the licensed mining reserve of 119,361,000 tons of ore, and the mining capacity of 4,318,000 tons per year. With these identified bauxite ore resources, Tan Rai Bauxite Mining Project in Bao Lam district, Lam Dong province plays a very important role in the economy and industrialization of the country. However, the exploitation of bauxite ore can adversely affect the environment of soil, water, air and organisms, especially the soil environment. Mine soil will be eroded very quickly, the fertility of soil will be decreased if it is not covered or planted by forest. Surface water may be polluted by the increase of suspended solids, acid content and turbidity. Deforested areas will lose their landscape, negatively affecting human vision: dust, mechanical noise and explosives can disrupt the ambient environment, affecting the health of the surrounding population [2, 6].

Impact of bauxite mine was investigated in some previous studies [19, 20, 21]. These studies were carried out to evaluate the environmental effect of bauxite mine activities on the ecology, benthic foraminifer from two sides along the Cassidaigne Canyon [19, 20]. However, there were rare studies on assessment of environmental state in bauxite mine area for the purpose of post-mine rehabilitation.

Rehabilitation of the post-mining environment is of great interest. Currently, the selected improvement plan for post-mining rehabilitation is often planting trees in mining zones right after mine exploitation. Therefore, in order to be able to select plants suitable for the environment in mining area, it is important and necessary to study the current state of the air, water, and soil environment in the mine exploited area, as a basis for the selection of suitable crops under the environmental conditions that have been changed by bauxite mining activities.

Due to the above issues, the study on the environmental state in the exploitation process at Tan Rai Bauxite mine - Bao Lam - Lam Dong is very necessary, as a basis for orienting the post - mine rehabilitation.

## 2. Research objectives, scope and methods

### 2.1. Research objectives and scope

- Overall research objective: Study on the status of air, water and soil environment in Tan Rai Bauxite mining area, as a basis for selection of suitable crops for post-mining rehabilitation. In order to realize this objective the air, water and soil in the Tan Rai Bauxite mining area were collected and investigated. Base on the result obtained we will select suitable plants for post-mining rehabilitation.

- Research scope: Tan Rai Bauxite mining area in three communes: Loc Thang, Loc Phu, Loc Ngai in Bao Lam district, Lam Dong province from March to September 2017. There are some activities in the mine area which included: preparing mining operations (cutting trees, constructing roads), exploiting bauxite ore, transporting ore to the refinery and transporting waste soil to the dumping area. In the un-exploited areas, the status remains the same as in the beginning, where there is still the cultivation of the population, mainly the cultivation of forest trees such as coffee, cashew, pine, tea. Rehabilitation, backfill and green cover by planting trees for the areas that have been exploited was done after the discharge and soil fill activities.

### 2.2. Methods

#### 2.2.1. Field survey and sampling method

In order to carry out an assessment of the environmental status at Tan Bauxite mine, the study implemented the field survey, on-site monitoring and taking the air and surface water samples at the Tan Rai Bauxite mine site for laboratory analysis. Data on groundwater, wastewater and soil were taken from the monitoring reports of the study area.

The survey was conducted in 02 phases: 1st round on June 08-12th, 2017 and 2nd round on September 21-23rd, 2017. These selected environmental sampling points were affected by current and future mining activities, such as exploitation areas, transport areas, unexploited areas, discharge area, and affected residential areas.

Methods of sampling and preservation were implemented in accordance with the guidelines in the current regulations of Vietnam. All the methods in the guidelines are standard analytical methods which were carefully tested.

- For air samples: The methods of measuring temperature, humidity and wind speed were carried out in accordance with guidelines in QCVN 46: 2012/BTNMT [7]; noise, SO<sub>2</sub>, NO<sub>2</sub>, TSS in accordance with TCVN 7878-2:2010 [8], TCVN 5971:1995 [9], TCVN 6137:2009 [10], and TCVN 5067:1995 [11], respectively.

- Sampling and preservation of water samples were carried out according to the methods specified in TCVN

6663-1:2011 [12], TCVN 6663-3:2008 [13], TCVN 6663-6:2008 [14], TCVN 5994-1995 [15]; method for pH was according to TCVN 6492:2011 [16].

**2.2.2. Analytical methods in the laboratory**

The samples that could not rapidly measured in the field were stored and analyzed in the laboratory. Methods of analysis are performed in accordance with TCVN 6625:2000, TCVN 6626:2000, TCVN 6658:2000, TCVN 7877:2008, TCVN 6177:1996, SMEWW 3113B:2012, SMEWW 5520B:2012, SMEWW 2540C:2012 [17].

**2.2.3. Method of data process**

After collecting, measuring and analyzing the environmental samples, data was processed using Microsoft Excel 2010 software in order to assess the environmental state in the study area, as a basis for the environmental rehabilitation and restoration after mining for Tan Rai Bauxite mine.

**Table 1. Monitoring result of air environmental status**

Sampling locations	Sampling time	Temperature (°C)	Humidity (%)	Wind speed (m/s)	Noise (dBA)	SO <sub>2</sub> (µg/m <sup>3</sup> )	CO (µg/m <sup>3</sup> )	NO <sub>2</sub> (µg/m <sup>3</sup> )	Suspended dust (µg/m <sup>3</sup> )
Exploiting area (K1)	Phase 1	25.8	78.6	1.2	74.5	44	4,200	34	550
	Phase 2	22.6	87.4	1.1	72.4	43	4,100	33	518
Area of dumping soil after mining (K2)	Phase 1	25.6	76.4	1.3	69.4	36	3,900	21	289
	Phase 2	22.8	83.5	0.9	68.2	37	3,700	24	266
Area of ore transport route (K3)	Phase 1	26.1	77.8	1.4	71.1	42	4,400	36	820
	Phase 2	22.4	84.5	1.2	72.8	43	4,300	35	801
Unexploited area (K4)	Phase 1	25.2	80.5	0.8	55.4	35	3,500	20	170
	Phase 2	21.9	90.4	0.7	55.7	32	3,500	19	165
<b>Decision 3733/2002/QD-BYT (Maximum times)</b>		-	-	-	<b>85</b>	<b>10,000</b>	<b>40,000</b>	<b>10,000</b>	<b>4,000</b>

Microclimate: Tan Rai Bauxite mine is characterized by the climate of southern Lam Dong province, cool weather, high relative humidity. With the above micro climatic conditions, the operation and production activities of the mine will not be affected and take place relatively smoothly.

Suspended dust and noise: Although waste rock and soil at the locations of ore mining and transportation is relatively high and higher than the location of unexploited area, the concentrations of suspended dust and noise at these sites are still within the allowable limits of the regulations.

The results of SO<sub>2</sub>, NO<sub>2</sub>, CO and Suspended dust at four sampling sites in two times phases are shown in Figure 2 and Figure 3. The concentrations of SO<sub>2</sub>, NO<sub>2</sub>, CO and Suspended dust were lower than the allowable thresholds in Decision 3733/2002/QD-BYT. The values of SO<sub>2</sub>, NO<sub>2</sub>, CO and Suspended dust were not much different between two phases. The concentrations of SO<sub>2</sub>, NO<sub>2</sub>, CO and Suspended dust at K1 (Exploiting area) and K3 (Area

**3. Results and discussion**

**3.1. Air environmental state**

The major sources of air pollution in the Tan Rai Bauxite mine include mining operation activities such as drilling, blasting, unloading, machinery and equipment using diesel fuel and from material transportation activities. Therefore, in order to assess the effects of mine activities on air environment, several typical air parameters for mining such as suspended dust, SO<sub>2</sub>, CO, NO<sub>2</sub>, and some microclimate parameters were selected.

The survey and monitoring results of four air samples (see the sampling locations in Figure 1) are shown in Table 1. In general, all the parameters at the monitoring points are within the thresholds stipulated in Decision 3733/2002/QD-BYT on the promulgation of 21 labor sanitation standards, 05 principles and 07 labor sanitation parameters.

of ore transport route) were higher than at K2 (Area of dumping soil after mining) and K4 (Unexploited area). The cause of this phenomenon is due to the effects of soil digging activities for ore mining at K1 and of ore transporting means at K3.



**Figure 1. Locations of air monitoring points**

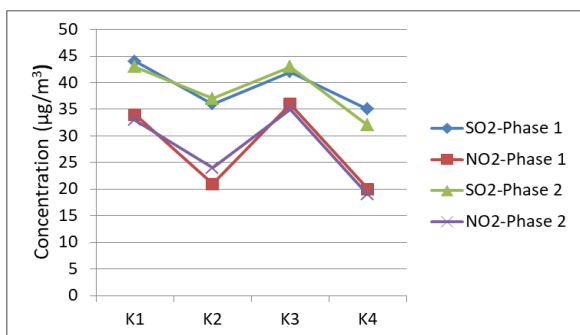


Figure 2. Results of SO<sub>2</sub>, NO<sub>2</sub> concentrations

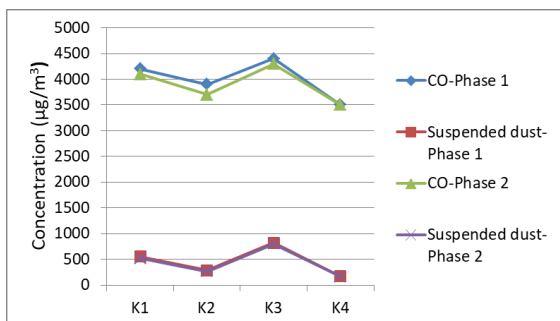


Figure 3. Results of CO and Suspended dust concentrations

### 3.2. Water environmental state

- *Surface water*

The mine belongs to the upstream area of Dargna River Basin, in which the Danos Stream flows across the mine. The main river systems and tributaries have formed the regional hydrological system and all flow into the Dargna River in the southwest. The water supply for the bauxite-aluminum complex is taken from Dargna River by damming the reservoir on the river [4].

Surface water sampling sites at Tan Rai Bauxite mining area are shown in Figure 4, including water at Cai Bang lake (NM1), Danos Stream water at the runoff area from raw ore region of ore sifting plant (NM2), and Dagrana Stream water after Cai Bang Lake Dam (NM3). Twelve selected parameters are the typical parameters for mine activities such as pH, TSS, heavy metals... The results of surface water quality monitoring and analysis are shown in Table 2.

The results showed that the concentrations of most parameters were within the allowable thresholds by QCVN 08-MT:2015/BTNMT (column B1). However, Mn<sup>2+</sup> concentration at Danos Stream in phase 2 reached the allowable threshold. TSS at Danos Stream was also higher than other monitoring points. In addition, according to the monitoring data of the mine in 2015, 2016, 2017 [3], the concentrations of TSS and COD at Danos Stream after the receiving point of wastewater from the tailings sewage lake No. 6 were over the allowable thresholds in QCVN during the sampling period from 09 ÷ 11/5/2016, 1.6 times and 1.07 times higher than the standards for TSS and COD, respectively.

It can be said that the surface water quality in the mining area was affected by the bauxite mining activities, especially for TSS parameter.

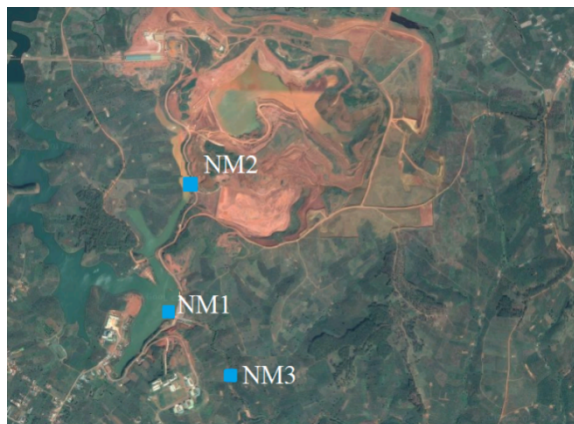


Figure 4: Locations of surface water monitoring points

- *Underground water*

Currently, there are still people living in the ore unexploited areas, to evaluate the groundwater environment in this area, the authors used the monitoring results in 2017 conducted by VITE Company [5].

The results showed that all groundwater samples at Tan Rai Bauxite mine and surrounding areas were seriously polluted by Coliform, over the allowable standards from 20-63,3 times (Figure 5). In addition, two thirds of the samples at NN3 had ammonium concentrations exceeding the standard threshold of 1.1-1.5 times. Other parameters met the standards according to QCVN MT:2015/BTNMT. The cause of Coliform and NH<sub>4</sub><sup>+</sup> pollution is due to the water samples taken at wells of neighboring areas, the wells have a small depth (about 5-10m), so the water source is contaminated by sanitation and livestock activities of people.

- *Wastewater*

Currently, the mining area has a capacity of 4,318,000 tons/year (original bauxite ore). With the form of open mining, the mine site does not use water for mining operations. Therefore, the mining operation does not generate waste water, there are mainly rainfall overflowing on the site, rainwater flowing over internal transportation roads in the field.

The monitoring results at the output of tailings discharge reservoir No. 6 before pouring into the receiving water source in 2016 and 2017 implemented by the Center for Monitoring and Natural Resources, Environment of the Department of Natural Resources and Environment in Lam Dong province showed that the concentrations of all monitoring parameters were within the thresholds specified in QCVN 40:2011/BTNMT-National technical regulation on industrial wastewater (Table 3) [18].

**Table 2. The analytical results of surface water at Tan Rai Bauxite mining area**

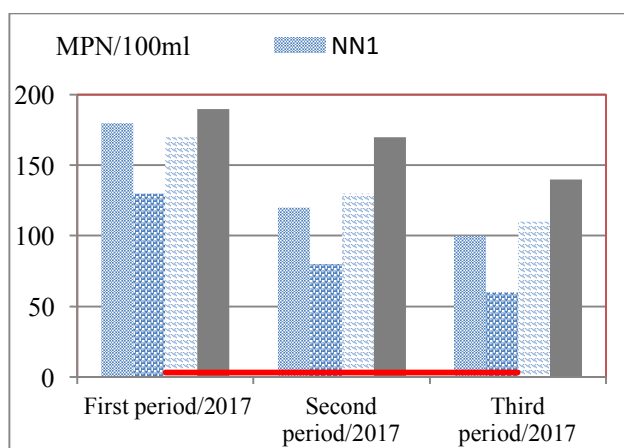
Code	Monitoring points	Monitoring phase	pH	TSS (mg/l)	As (mg/l)	Cd (mg/l)	Pb (mg/l)	Cr <sup>6+</sup> (mg/l)	Cu (mg/l)	Mn <sup>2+</sup> (mg/l)	Hg (mg/l)	Fe <sub>tp</sub> (mg/l)	Oil (mg/l)	Total sediment (mg/l)
NM1	Water at Cai Bang lake	Phase 1	6.55	33	<0.001	0.003	<0.001	<0.002	0.04	0.4	0.0006	0,21	0,5	79
		Phase 2	6.53	29	<0.001	0.003	<0.001	<0.002	0.05	0.3	0.0005	0,19	0,6	70
NM2	Danos Stream water at the runoff area from raw ore region of ore sifting plant	Phase 1	6.71	37	<0.001	0.004	<0.001	<0.002	0.08	0.3	0.0008	0,13	0,8	72
		Phase 2	6.79	40	<0.001	0.004	<0.001	<0.002	0.06	0.5	0.0004	0,15	0,9	75
NM3	Dagrana Stream water after Cai Bang Lake Dam	Phase 1	6.82	30	<0.001	0.002	<0.001	<0.002	0.05	0.2	0.0004	0,15	0,3	58
		Phase 2	6.77	31	<0.001	0.002	<0.001	<0.002	0.05	0.3	0.0003	0,12	0,3	60
<b>QCVN 08-MT:2015/BTNMT (Column B1)</b>			<b>5.5-9</b>	<b>50</b>	<b>0.05</b>	<b>0.01</b>	<b>0.05</b>	<b>0.04</b>	<b>0.5</b>	<b>0.5</b>	<b>0.001</b>	<b>1.5</b>	<b>1</b>	<b>-</b>

**Table 3. The analytical results of wastewater at Tan Rai Bauxite mining area (Q1, Q2, Q3, Q4: Quarter 1,2,3,4 of the year)**

No	Parameter	Q1/2016	Q2/2016	Q3/2016	Q4/2016	Q1/2017	Q2/2017	QCVN 40:2011/BTNMT
1	pH	7.09	6.57	5.62	7.86	7.25	7.06	<b>5.5 - 9</b>
2	Flow rate (l/s)	20.1	0.1094	0.6321	0.1040	0.048	0.03996	-
3	TSS (mg/l)	8	8	86	46	44	6	<b>100</b>
4	COD (mg/l)	14	18	<10	11	12	<10	<b>150</b>
5	BOD <sub>5</sub> (mg/l)	<3	<3	<3	<3	<3	<3	<b>50</b>
6	N-NH <sub>4</sub> <sup>+</sup> (mg/l)	1.32	0.74	0.7	1.12	1.43	0.4	<b>10</b>
7	Total N (mg/l)	3.48	3.92	2.46	3.92	3.98	2.8	<b>40</b>

No	Parameter	Q1/2016	Q2/2016	Q3/2016	Q4/2016	Q1/2017	Q2/2017	QCVN 40:2011/BTNMT
8	Total P (mg/l)	<0.03	<0.03	0.09	<0.03	<0.03	0.04	<b>6</b>
9	As (mg/l)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<b>0.1</b>
10	Hg (mg/l)	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<b>0.01</b>
11	Cu (mg/l)	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<b>2</b>
12	Zn (mg/l)	<0.08	<0.08	<0.08	<0.08	0.1	<0.08	<b>3</b>
13	Pb (mg/l)	<0.01	<0.01	<0.010	<0.01	<0.01	<0.01	<b>0.5</b>
14	Cd (mg/l)	<0.0005	<0.0005	<0.00050	<0.0005	<0.0005	<0.0005	<b>0.1</b>
15	Mn (mg/l)	<0.04	<0.04	0.222	0.14	<0.04	<0.04	<b>1</b>
16	Fe (mg/l)	0.5	<0.2	3.19	2.81	0.53	0.24	<b>5</b>
17	Ni (mg/l)	<0.010	<0.010	<0.010	<0.010	<0.01	<0.01	<b>0.5</b>
18	CN <sup>-</sup> (mg/l)	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<b>0.1</b>
19	Phenols (mg/l)	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<b>0.5</b>
20	Mineral oil (mg/l)	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<b>10</b>
21	Sulfua (mg/l)	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<b>0.5</b>
22	Crom (III) (mg/l)	<0.010	<0.010	0.022	0.014	0.022	0.022	<b>1</b>
23	Crom (VI) (mg/l)	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<b>0.1</b>
24	Total radioactive α (Bq/L)	KPH	KPH	KPH	KPH	KPH	KPH	<b>0.1</b>
25	Total radioactive β (Bq/L)	KPH	KPH	KPH	KPH	KPH	KPH	<b>1</b>
26	Coliform (MPN /100mL)	790	<3	<3	930	91	230	<b>5000</b>





**Figure 5: Coliform concentrations in groundwater samples at the area of Tan Rai Bauxite mine in 2017**

**Note:** - NN1: Water of digging well at No.15 residential area, Loc Thang town - NN2: Water of digging well at the project management board of Lam Dong bauxite-aluminum complex.

- NN3: Water of digging well at No.11 Village of Loc Ngai commune.

- NN4: Water of digging well at the collective quarter of mine workers.

### 3. Soil environmental state

In the process of exploiting bauxite, the Laterite-Bauxite and Bauxite-Laterite layers which are rich in minerals have been fully exploited, so there remains only layers of cover soil, litoma, weathered bazan and fresh bazan. The cover soil was totally disturbed, the structure of the soil layer was affected, the thickness of recovery soil layer was 0.5-1m, the texture of the soil was slightly tight, the soil porosity is from moderate to fairly good;

Litoma layer is widely distributed throughout the mine and located near the bottom of the Bauxite ore layer. The soil in this layer is brown, brownish-yellowish and has many white spots of kaolinite, heavy mechanical components, contains many clays, has plastic or sticky state. The soil

texture is not good, its organic matter is poor so it is less porous, squash, the thickness of litoma layer varies from 1.5 - 2.0m.

The layer of weathered bazan: This layer lies under the litoma layer, is the bazan eruption, the upper part is weathered bazan and below is original bazan. The layer of original bazan rock is mainly exposed in stream slots. The stone is gray, solid, less chapped, less capable to keep water. The bauxite mining process does not use chemical, people only take away the ore layer, so that these mine activities do not cause toxic substances in the soil environment. It mainly destroys the structure of the soil layers as mentioned above, affecting the quality of cover soil used to cover the zone which has been mined, and then trees will be planted at that zone. Therefore, this research focused on studying the quality of cover soil, especially the nutrients in soil to make the basis for the selection of suitable crops.

For the evaluation of soil quality, the study referred the soil analysis data from the Department of Science and Technology of Lam Dong province at the locations where ore was mined. The data is shown in Table 4, which shows that the mechanical composition of soil at Tan Rai Bauxite mine was mild to medium flesh soil, pH was slightly acidic to neutral from 5.4-6pH<sub>H2O</sub>; 6- 6.8pH<sub>KCl</sub>, ability to keep water was from 57.22-77.76%. Soil samples had total N content ranging from poor to moderate (from 37.9-122mg/100g, respectively, 0.038-0.122%), total P was at rich level (from 287.1 to 492.6mg/100g, respectively 0.278-0.493%), Potassium level was at poor level (15.8-43.3 mg/kg), Total nitrogen fixation micro-organism was from 2.5.10<sup>2</sup>-9.6.10<sup>5</sup> CFU/g. It can be said that the soil at the locations where ore was mined contains low nutrients such as nitrogen, potassium, therefore, when planting trees to recover the mine soil after exploiting ore, it should focus on measures to improve humus content and organic matter in the soil by reasonable means in farming and fertilizing. Besides, in the rainy season with heavy rainfall, the soil is prone to erosion, leading to the risk of cover soil degradation if not actively protected and properly used.

**Table 4. The analytical results of soil samples at Tan Rai Bauxite mining area**

Soil samples	Nitrogen content mg/100g	Total phosphorus content, P <sub>2</sub> O <sub>5</sub> , mg/100g	Potassium content K, mg/kg K <sub>2</sub> O	pH (KCl)	pH (H <sub>2</sub> O)	Mechanical composition	Water holding capacity (water absorption), %	Total number of nitrogen fixation, CFU/g
Sample 1	80,2	405,7	24,6	5,5	6,1	Mild flesh soil	70,21	2,7.10 <sup>5</sup>
Sample 2	81,9	381,5	27,4	6	6,8	Mild flesh soil	57,22	7,4.10 <sup>4</sup>
Sample 3	122	492,6	17,8	6	6,7	Mild flesh soil	60,67	6,9.10 <sup>4</sup>
Sample 4	84,5	422,1	43,3	5,9	6,7	Medium flesh soil	68,41	2,0.10 <sup>5</sup>
Sample 5	37,9	367,3	15,8	5,8	6,3	Mild flesh soil	65,24	2,8.10 <sup>5</sup>
Sample 6	71,8	333,5	24	5,7	6	Mild flesh soil	77,76	2,5.10 <sup>5</sup>
Sample 7	64,2	287,1	22,1	5,8	6,3	Mild flesh soil	73,39	2,5.10 <sup>2</sup>
Sample 8	88,8	373,7	24	5,4	6,3	Mild flesh soil	73,39	8,9.10 <sup>4</sup>
Sample 9	64,7	319,9	29,1	5,7	6,4	Medium flesh soil	73,98	9,6.10 <sup>5</sup>

Soil samples	Nitrogen content mg/100g	Total phosphorus content, P <sub>2</sub> O <sub>5</sub> , mg/100g	Potassium contentK, mg/kg K <sub>2</sub> O	pH (KCl)	pH (H <sub>2</sub> O)	Mechanical composition	Water holding capacity (water absorption), %	Total number of nitrogen fixation, CFU/g
Sample10	84,9	294,4	27,4	5,9	6,4	Mild flesh soil	71,17	6,7.10 <sup>5</sup>

*Source: Center for analysis and quality certification - Lam Dong Department of Science and Technology*

#### 4. Conclusion

The status of the air and waste water environment in Tan Rai Bauxite mining area is generally not polluted, the surface water environment here is mainly polluted by TSS, the groundwater is being highly polluted by Coliform, the soil environment is in danger of being seriously degraded if there are no measures for the environment rehabilitation after mining. There is no vegetation cover on the surface of the post-mining site, so the possibility of dust emission, erosion and soil slide from the disposal site is very high. Moreover, waste soil is not too poor nutrition which should be improved when planting trees. The above studied environment state is very suitable for planting pine and acacia. Planting trees for green cover in mine exploiting area should be paid attention to by the investors and the local authorities.

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