Characterization of chemical content tailings sand and water from the tin post-mining in Merawang Subdistrict, Bangka Regency

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Abstract. The characteristics of the six sand samples taken from the location of the former tin mining land on average contain heavy metals such as Ti, Sn, Mn, Pb, Cu, Zn, Cu, and As. Nb rare earth metal contains all sand samples except PDTF 1. The highest content is in the PDTF 2 sample which is 103 ppm. While the Y metal content is found in samples of PDTF 2A, 3, 3A, and 4. The highest content for Y metal is in the sand sample PDTF 3A with levels of 59 ppm. The largest metal content of the six samples is generally iron (Fe) and followed by sulfur (S). There are only a few samples that contain element V, namely in samples 2A, 3A and 4. The highest Fe content is in the water sample PDTF 2A which is 0.953 mg / L. This value is not much different from the Fe content in the PDTF 1 sample (0.923 mg / L). Sand samples in PDTF 3 A have the highest Fe content but water close to the PDTF 3A sampling location has the lowest Fe content compared to the other five samples.

1. Introduction
Bangka Island is one of the largest tin producers in the world which makes tin as its main economic sector. In 2014 tin production on the island of Bangka was 19,719.32 tons / year. Although it produces many negative impacts on the environment, tin mining continues to flourish [1].

Mining activities generally use large tracts of land, utilize non-renewable resources that are non renewable, produce a lot of waste and create degraded land that is not productive. The environmental damage experienced by some parts of the Bangka Belitung Islands Province has become a phenomenon and even seemingly endless conflicts, it is because of the potential and natural wealth in the form of minerals owned by this region namely tin is abundant [2-4]. Mining in the form of lead mineral carrier (Cassiterite) and associated minerals believed to be future mineral commodities in the form of rare earth metal carrier (REE) [5-8]. The potential of abundant natural wealth causes many companies to the community trying to participate in mining the mineral ranging from legal mines to illegal mines or unconventional mines which are often known as TI (Tambang Ilegal).

The impact of tin mining not only removes soil fertility but alters existing ecosystem landscapes and produces large tailings and opening holes called kolong [9]. Sometimes the mining area that has been
reclaimed is still being mined, causing constraints to restore land functions [10]. Then the utilization of the results of tin mining discharges (tailings) has not been maximally managed, it is just left alone even there are some people who are still looking for the presence of tin even from simple equipment [3]. Therefore, this research will examine the characteristics of the chemical content of tailing which is used as a tin gourd so that in the future it can be used to reduce the environmental impact.

2. Method
The research location is in the former tin land in the Merawang sub-district which is divided into 6 sectors of the former tin mining area. At each tin mining area, sand and water samples were taken to be analyzed for their chemical characteristics (Figure 1). Sand samples were taken about 2.5 kg which were being dried and analyzed for their chemical content. Water samples were taken as much as 2 L and the samples were put in polyethylene bottles and stored in a refrigerator in a laboratory, then analyzed the contents.

![Figure 1. Location of sampling.](image)

2.1 Chemical and Instrumentation
Instrumentation for sand analysis using Handheld XRF Analyzer by Olympus NDT and AAS for Fe metal analysis in water samples. While other equipment used is polyethylene bottles, GPS (Global Positioning System), and paper labels.

2.2 Sand Analysis Procedure
Analysis of metal content in tailing sand using the Handheld XRF Analyzer by Olympus NDT PT Timah Tbk. Sand from each sample is washed and dried in the sun then sand is crushed and sieved based on > 200 mesh. The sand powder is then analyzed using the Handheld XRF Analyzer.

![Figure 2. Sand samples being drained (from left to right: PDTF 3A, PDTF 4, PDTF 2-A, PDTF 2, PDTF 3 and PDTF 1 samples).](image)
2.3 Water Analysis Procedure

Analysis of heavy metal content in the water around the sample (Kolong) was analyzed using the AAS method that refers to SNI. Quality standards are based on the Minister of Environment Regulation No. 34 of 2009 dated October 5, 2009 concerning Wastewater Quality Requirements.

3. Results and Discussions
3.1 Chemical Content Analysis of Sand Samples

The tailings sample consisted of soil / sand and water in the 6 zonation areas selected based on visualization of baseline, topography and post-mining land conditions. Visualization of the location of sand sampling is presented in Figure 3.

![Figure 3. Visualization of sand samples (top (left to right): PDTF 1, PDTF 2, PDTF 2-A); Bottom (left to right): PDTF 3, PDTF 3-A, PDTF 4).](image)

Analysis of the metal content in each sand sample using XRF. XRF is a tool used to analyze the composition of clams along with the concentration of elements contained in a sample by spectrometry/spectroscopy methods. XRF is commonly used to analyze elements in minerals or rocks. Elemental analysis is done both qualitatively and quantitatively. Qualitative analysis is done to analyze the types of elements contained in the material and quantitative analysis is carried out to determine the concentration of elements in the sample [2]. X-Ray Fluorosity/Fluorescence is particularly suitable for investigations involving bulk chemical analysis of the main elements (Si, Ti, Al, Fe, Mn, Mg, Ca, Na, K, P) in rocks and sediments, bulk chemical trace element analysis (in abundance> 1 ppm; Ba, Ce, Co, Cr, Cu, Ga, La, Nb, Ni, Rb, Sc, Sr, Rh, U, V, Y, Zr, Zn) in rocks and sediments [1]. Based on XRF analysis the sand samples are presented in Table 1.

The PDTF 1 sand sample has the characteristic brown color with its main content being iron (Fe) with a level of 3380 ppm. This sample contains a lot of heavy metals such as Ti, Sn, Mn, Pb, Cu, Zn, Cu, and As. This sample also contained 2288 ppm sulfur (S). Whereas rare earth metals such as Nb and Y are not contained in this sample.

Whereas the PDTF 2 sample which has the characteristics of white sand contains various types of heavy metals such as Fe, Ti, Sn, Mn, Pb, Cu, Zn, Cu, As, Zr, Th, Cr, Sr, and Ta. In this sand sample
contains some rare earth metal elements such as Nb with the amount of 103 ppm and Th with the amount of 43 ppm. This PDTF 2 sample has the highest sulfur content.

Unlike the PDTF 1 and 2 samples, the PDTF 2A sample does not contain Pb content. The saddle has the largest heavy metal content is Fe with an amount of 2903 ppm. The PDTF 2A sample has blackish characteristics. This sand sample still has a tin element (Sn) with a fairly high content of 2581 ppm. This makes the color of the sand black. This sample contained rare earth metals such as Nb and Y with levels of 30 and 25 ppm.

The PDTF 3 sample has reddish characteristics. The metal content in it is Fe, Ti, Sn, Mn, Pb, Zn, Cu, As, Zr, Th, Sr, Nb, Th, Ta, and Y. The most content is iron metal (Fe). In this sand sample there are also rare earth metals Nb and Y with levels 72 and 10 ppm. While the PDTF 3A sample concentration does not far from the location of sample 3 has chemical characteristics similar to the PDTF 3A sand sample. But the PDTF 3A sample has a high content of Potassium (K) which is 4152 ppm. While the Nb and Y content of this sample are 39 and 59 ppm. Likewise also for the PDTF 4. The location of the PDTF 4 sand sampling is also not too far from the PDTF 3 and 3A. The type of metal contained in it is also not too much different, namely containing metals Fe, Ti, Sn, Mn, Pb, Zn, Cu, Cr Zr, Th, Sr, Nb, Ta, Y and V. The locations that are not too far away have similar characteristic of metal content.

| Tabel 1. Metal Content of Sand and Water Tailings from The Tin Post-Mining At The Merawang Sub-District. |
|----------------------------------------------------------|
| Tailing Sample  | PDTF 1 | PDTF 2 | PDTF 2A | PDTF 3 | PDTF 3A | PDTF 4 |
|-----------------|--------|--------|---------|--------|---------|--------|
| S               | 2288   | 3834   | 2452    | 2215   | 2412    | 3639   |
| Fe              | 3380   | 3551   | 2903    | 9173   | 6516    | 3005   |
| Ti              | 672    | 127    | 865     | 175    | 506     | 368    |
| Sn              | 114    | 116    | 2581    | 83     | 51      | 231    |
| Mn              | 36     | 90     | 47      | 91     | 165     | 57     |
| Pb              | 11     | 21     | -       | 34     | 30      | 11     |
| Cu              | 73     | 45     | 71      | -      | -       | 44     |
| Zn              | 68     | 59     | 56      | 24     | 43      | 38     |
| As              | 9      | 13     | 5.8     | 65     | 70      | -      |
| K               | -      | 3460   | 580     | -      | 4152    | 1766   |
| Rb              | -      | 304    | 13.1    | 25.5   | 573     | 99     |
| Zr              | -      | 183    | 1545    | 244    | 290     | 336    |
| Ba              | -      | 127    | 95      | -      | 127     | 207    |
| Nb              | -      | 103    | 30      | 72     | 39      | 31     |
| Th              | -      | 42     | -       | 66     | 58      | 56     |
| W               | -      | 34     | 31      | -      | -       | -      |
| Cr              | -      | 12     | 17      | -      | 19      | 18     |
| Sr              | -      | 8      | 12      | 16     | 31      | 11     |
| Ta              | -      | 7.3    | -       | 10     | 13      | 12     |
| Ca              | -      | -      | 284     | -      | -       | -      |
| Y               | -      | -      | 25      | 10     | 59      | 44     |
| V               | -      | -      | 9       | -      | 18      | 7      |

When viewed from the rare earth Nb metal content, this metal contained all sand samples except PDTF 1. The highest content was in the PDTF 2 sample of 103 ppm. While the Y metal content is found in samples of PDTF 2A, 3, 3A, and 4. The highest content for Y metal is in the sand sample PDTF 3A.
with levels of 59 ppm. The largest metal content of the six samples is generally iron (Fe) and followed by sulfur (S). There are only a few samples that contain element V, namely in samples 2A, 3A and 4.

3.2 Analysis of Fe in Water samples From The Tin Post-Mining

Water samples taken were selected based on visualization of baseline, topography and post-mining land conditions. Visualization of water sampling locations is presented in Figure 3. Visualization of water samples (top (left to right): PDTF 1, PDTF 2, PDTF 2-A); Bottom (left to right): PDTF 3, PDTF 3-A, PDTF 4). Analysis of iron content using the AAS method. This method uses the Atomic Absorption Spectrophotometer (AAS). The measurement in this method is based on the evaporation of the sample solution so that the metal in the sample is converted into free atoms. These free atoms will be measured for absorption based on specific wavelengths according to the characteristics of each metal. Water samples were taken as much as 100 mL. Determination of Fe concentration in the sample begins with making a standard solution first. The standard solution is made from 0 ppm to 100 ppm in order to make the calibration curve first. The metal analysis was performed using the Atomic Absorption Spectrophotometer. The standard solution made is measured its absorbance at a wavelength of 248.3 nm for Fe [4]. Analysis of iron content is presented in Figure 4.

Figure 4. Analysis of iron (Fe) content in water samples.

Based on the analysis of Fe content in water samples. The highest Fe content was in the PDTF 2A water sample which was 0.953 mg / L. This value is not much different from the Fe content in the PDTF 1 sample (0.923 mg / L). When viewed in the visual water samples from Google Earth, samples 1 and 2 have a bluish green and black color. While the PDTF 3 sample which has a dark green color has the lowest Fe content with a level <0.0113 mg / L. Whereas the PDTF 3A sample which has the characteristics of light green has a Fe content of 0.0898 ppm. Sand samples in PDTF 3 A have the highest Fe content but water close to the PDTF 3A sampling location has the lowest Fe content compared to the other five samples.

4. Conclusion

From the six sand samples taken from the location of the former tin mining land, on average they contain heavy metals such as Ti, Sn, Mn, Pb, Cu, Zn, Cu, and As. Nb rare earth metal contains all sand samples except PDTF 1. The highest content is in the PDTF 2 sample which is 103 ppm. While the Y metal content is found in samples of PDTF 2A, 3, 3A, and 4. The highest content for Y metal is in the sand sample PDTF 3A with levels of 59 ppm. The largest metal content of the six samples is generally iron (Fe) and followed by sulfur (S). There are only a few samples that contain element V, namely in samples 2A, 3A and 4. The highest Fe content is in the water sample PDTF 2A which is 0.953 mg / L. This value is not much different from the Fe content in the PDTF 1 sample (0.923 mg / L). When viewed in the
visual water samples from Google Earth, samples 1 and 2 have a bluish green and black color. While the PDTF 3 sample which has a dark green color has the lowest Fe content with a level <0.0113 mg / L. Whereas the PDTF 3A sample which has the characteristics of light green has a Fe content of 0.0898 ppm. Sand samples in PDTF 3 A have the highest Fe content but water close to the PDTF 3A sampling location has the lowest Fe content compared to the other five samples.

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Acknowledgment
We gratefully acknowledge the funding from Universitas Bangka Belitung through the RKAKL FT for the publication of this paper, and also we would like to thank to all those people who have helped in this research.