Monitoring of mine waste from copper ore flotation

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Abstract. The copper ore flotation conducted by PT XYZ produces copper, and other metal concentrates as tailings. The copper concentrate will then be processed as industrial raw material, while the tailing waste is dumping a waste dump. The copper ore flotation tailings must follow the tailings waste management rules. Monitoring tailings quality testing must be done, which includes physical and chemical parameters. The results of the analysis of copper ore flotation tailings are comparing with the provisions issued by the Ministry of Environment No. 92 of 2011. And 382 in 2016. Furthermore, to monitor the state of seawater around the mining site, water quality testing is divided into three zones, Zone A with into> 120 m, Zone B 0 - 120, and Zone C (tailings free). Seawater quality monitoring is carrying out in zone B. The quality test results tailing flotation Copper ores how physical and chemical parameters are below the threshold set by the Ministry of Environment. Whereas monitoring of seawater quality carried out in zone B, TDS exceeds the intensity at S15B, while dissolved metal concentrations are below the threshold at all stations.

1. Introduction
Mining, mineral processing and metallurgical extraction are the three principal activities of gold mining industries which produce wastes. Mineral processing also known as beneficiation aims to physically separate and concentrate the ore mineral(s) using physical, chemical and sometimes microbiological techniques. Metallurgical extraction breaks the crystallographic bonds in the ore mineral in order to recover the desired element or compound [1].

PT XYZ's business activities are in the copper ore mining and processing sector. Processing activities produce copper metal concentrates and other metal minerals, which referred to as the rest it flotation or tailings. Tailings will be placed in a waste dump, and then flowed into the deep sea. Monitoring activities on the quality of tailing need to be done so that tailing that will place in the deep sea does not change the quality of seawater [2].

Tailing disposal due to contamination of dangerous heavy metal pollution material contained in the tailings practice [3]. The results of monitoring the copper ore flotation tailings will be compared with the stipulated wastewater quality standard, namely Decree of the Minister of Environment No. 92 of 2011 concerning the Placement of Deep Sea Tailings.

Based on field conditions as explained, the purpose of this activity is to find out the physical and chemical quality of copper ore flotation tailings, then to determine the quality of seawater in the tailings disposal site.
2. Method
The research methods carried out in this activity include physical and chemical tailings analysis, then monitoring the quality of deep seawater.

2.1. Tailings analysis
Tailings are a combination of fine-grained solid material (generally the size of dust, ranging from 0.001 to 0.6 mm) remaining after metals and minerals are an extract from mined ore, as well as the remaining processing water [2]. The physical and chemical properties of tailings vary depending on the nature of the ore. Tailing that is was mix with water are called slurry.

Physical parameters analysed were specific gravity slurry, pH, and percent solid slurry. Whereas chemical parameters include metal mineral content consisting of Arsenic, Cadmium, Chromium, Copper, Lead, Zinc, Sulfide, Nickel and Mercury [4].

The quality standard for tailings analysis as in showing Table 1.

| No. | Parameter          | Quality Standard |
|-----|--------------------|------------------|
| 1.  | S. Gravity Slurry  | Minimum 1,202    |
| 2.  | pH                 | 6 – 10           |
| 3.  | Present Slid       | Minimum 25 %     |

2.2. Monitoring the quality of deep seawater
Seawater quality monitoring, divided into three zones [6]:

- Zone A, or the impact zone with a depth of > 120 meters to the bottom. For the standard quality of Seawater, Ministry of Environment Decree No. 51 of 2014 does not apply.
- Zone B is a tailings placement area with a depth of monitoring in 0 - 120 meters regulated in Ministry of Environment Decree No. 51 of 2004.
- Zone C is an area that is free from tailings from the surface to the seabed. In this zone must meet Sea Water Quality Standards, Ministry of Environment Decree No. 51 of 2004.

Seawater quality monitoring was carried out regularly. This activity is carrying out monthly. Seawater quality that must be monitoring includes the physical factors of seawater (Temperature, Turbidity, Suspended Solids) and chemical parameters (pH, Salinity, Dissolved Oxygen, and Dissolved Metals).

In this activity, monitoring is carried out in zone B, the physical factor of seawater is observing, namely Total Dissolved Solid [7,8]. In contra monitoring of chemical element, control is the solubility of arsenic in seawater [9].

Based on the Decree of the Environment No. 92 of 2011 stipulates zone B to be monitored at depths of 50 m and 120 m. In the data table, each name of the monitoring station was adding with the suffixes S, M, C, B which, are signs for S (surface), point M (middle) at a depth of 50m, C at a depth of 120 m and B. (bottom).
3. Research results and discussion

3.1. Analysis tailings

The results of the tailings analysis, which include physical parameters and chemical parameters monthly, are carried out for three consecutive boastings, then compared with the standard values of physical and chemical parameters used in monitoring.

The results of the tailings analysis showed monitoring of physical parameters for three months, the pH value, percent solids, and specific gravity slurry were within the threshold. While the chemical parameters of the tailings assessed were the concentration of dissolved metals in the liquid tailings fraction, the intended metal was Copper (Cu), Sulfide (H2S), Mercury (Hg), Arsenic (As), Cadmium (Cd), Chromium (Cr), Zinc (Zn), Lead (Pb), Nickel (Ni). Are under the threshold.

| Parameter      | Unit | Quality Standard | July xx | Augst xx | Sep xx |
|----------------|------|------------------|---------|-----------|--------|
| pH             | -    | 6 – 10           | 8,3     | 8,69      | 8,61   |
| Present Solid  | %    | Min. 25 %        | 31,11   | 23,2      | 24,32  |
| S. Gravity     | -    | Min. 1,202       | 1,274   | 1,199     | 1,209  |

3.2. Sea water quality monitoring

Figure 1 shows that the value of suspended solids in zone A observed at S15B station shows the number of suspended solids above the quality standard of 20 mg/liter. This condition is because the tailings disposal pipe is very close to Station 15. The amount of suspended solids is related to the turbidity level. So if the suspended solid value is high, the turbidity level at the station will increase. While observations at other stations are below the quality standard.

Source: Data Monitoring and Analysis Results.
Chemical parameters observed were focused on arsenic metals. This is due to the arsenic metal toxicity is higher than other metals. Based on Figure 2, the concentration of dissolved metal arsenic in Zone A does not exceed the seawater quality standard set by the Minister of Environment No. 382 of 2016. The impact of the increase in the value of arsenic dissolved metals makes the value of toxicity to the seawater ecosystem will increase.
4. Conclusion

- Observation results of analysis tailing copper ore flotation for three consecutive months, showing the value of physical parameters and chemical parameters are below the quality standard limits set by the Ministry of Environment.
- Observation of seawater quality in zone A, conducted at eight observation stations. Observation results of physical parameters, namely the number of suspended solids, shows that they are still below the quality standard, except at the S15B station near the tailings disposal pipe. Based on chemical parameters, the content of dissolved metal arsenic in zone A is below the quality standard.

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