

## TRENDS OF ELEMENTS FE AND MN IN COAL MINING WASTE AT TENGGARONG DISTRICT KUTAI KARTANEGARA EAST KALIMANTAN

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This study aims to determine the condition of Fe and Mn waste and determine the tendency of Fe and Mn elements in several coal mine depositional ponds in Kutai Kartanegara Regency, East Kalimantan. The results showed that in one mine the concentration of Fe at the inlet settling pond location was between 0.0268 – 6.454 mg/lit and Mn (0.022-1.38) mg/lit, and at the out let location it was between 0.149-2.69 mg/lit and Mn between (0.01-1.33) mg/lit. At the inlet settling pond mine location 2 is between (1.26 – 62.3) mg/lit, Mn (0.022-0.96) mg/lit, and at the out let location is between (0.067-2.27) mg/lit, and Mn between (0.010-1.17) mg/lit. At mine three locations, between (0.15 – 3.21) mg/lit, Mn (0.022-1.52)mg/lit, and at the out let location, between (0.079-1.521) mg/lit and Mn was at between (0.01-0.72). ) mg/lit. Meanwhile at mine site 4, between (1.67 – 27.00) mg/lit and Mn (0.001-0.658) mg/lit, and at the outlet location, between (0.11-1.387) mg/lit, Mn between ( 0.01- 1.13) mg/lit The trend of Fe waste in mine 1, January to March 2020 shows an increase, where in March it was very high up to 6,454 mg/lit. Then it fell again to 0.899 mg/lit in May, then rose slightly again until September. The trend of Fe concentration in mining for nine months is still below the quality standard set by the government. Meanwhile in Mine 4 the concentration of Fe tends to be high in February 2020. Meanwhile, for other months the concentration is quite good.

**Keywords:** Condition of Fe and Mn, The Tendency of Fe and Mn, Settling Pounds of Coal

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## INTRODUCTION

The trend of the impact of mining in different countries is different. For example, mining in southern Brazil shows that mining waste products have a very low pH between 3.2 to 4.6, but after being managed, the pH becomes 7.2 to 7.5 (Campaner. V.P. et al. 2013). It is different from mines in Pennsylvania that the pH resulting from various mining processes is between 2.5 to 4, which has an impact of 8 km on the watershed (Cravotta. A.C. et al. 2015)

Research conducted by Levens. R.L., Marcy. A.D., and Boldt 2016. In general, the impact of mining in the United States by backfilling can reduce the occurrence of acid mine drainage because areas with high acid mine drainage can be covered with this material. In addition, it also has a negative impact, such as having uneven grains. Meanwhile, the behavior of Fe and Al elements in acid mine drainage, if the acid water has a pH below 4.5, then the Fe elements present in the minerals Melanterite ( $\text{Fe}_2\text{SO}_4 \cdot 7\text{H}_2\text{O}$ ), Rozenite  $\text{Fe}_2\text{SO}_4 \cdot 4\text{H}_2\text{O}$ , Szomolnokite  $\text{Fe}_2\text{SO}_4 \cdot \text{H}_2\text{O}$ , Copiapite  $\text{Fe}_2\text{Fe}_4(\text{SO}_4)_6(\text{OH})_2 \cdot 20\text{H}_2\text{O}$ , Coquimbite  $\text{Fe}_2(\text{SO}_4)_3 \cdot 9\text{H}_2\text{O}$ , Rhomboclase  $(\text{H}_3\text{O})\text{Fe}_3(\text{SO}_4)_2 \cdot 3\text{H}_2\text{O}$ , Halotrichite  $\text{Fe}_2\text{Al}_2(\text{SO}_4)_4 \cdot 22\text{H}_2\text{O}$ , and if the pH is 4.5 to 5 then formed is the element Al in the minerals Gibbsite  $\text{Al}(\text{OH})_3$ , alunite  $\text{KAl}_3(\text{SO}_4)_2(\text{OH})_6$ , Jurbanite  $\text{Al}(\text{SO}_4)(\text{O.H.}) \cdot 5\text{H}_2\text{O}$ , Basaluminite  $\text{Al}_4(\text{SO}_4)(\text{O.H.}) \cdot 5\text{H}_2\text{O}$ , Hydrobasaluminite  $\text{Al}_4(\text{SO}_4)(\text{OH})_{10} \cdot (\text{España JS, 2007})$ .

The content of Fe, Mn and Al in postal areas in Malaysia that Fe content is between (0.15-0.77) mg/lit, Mn elements are between (0.04-0.08) mg/lit, and Al elements are between (0.04-0.08) mg/lit ( Othman. R., Ali QAM, Ramya. R., 2016). Meanwhile, the results of research from Pan.L., 2021

regarding the impact of coal mining in southern China according to F. m. et al. 2012 that the results of Brazilian coal mining indicate that the pH is increasingly acidic, with the presence of metallic minerals Fe, Mn, Cu, Zn and others that make poison for life.

The waste results around the research site at PT Kaltim Prima Coal East Kutai, the concentration of Fe metal in three samples at three settling pond locations, the first containing 6.810 mg/l, the second 11.00 mg/l and the third 10.60 mg/l. This concentration shows that it is already above the environmental quality standard. So there is a need for serious management (Nugeraga. Sumiyati. S., and Samudro. G., 2010)

According to the Kutai Kartanegara Regency Government, the Protocol and Communications Section of the leadership of Jl. Wolter Monginsidi No.1 Tenggara 75511 - Kutai Kartanegara - East Kalimantan, published in the daily news on 27 February 2022 that the coal mining area is the largest in East Kalimantan, with an area of 1.2 million hectares or 400 mining business permits which will have severe environmental impacts.

## METHODS

This research was conducted in Kutai Kartanegara Regency, East Kalimantan, with the following types and sources of data: The sample taken is the wastewater from coal mining activities originating from several mines in Kutai Kartanegara Regency. The Fe and Total Mn waste concentration in mine wastewater by giving lime and alum coagulant.

## RESULT AND DISCUSSION

The laboratory analysis results taken from pollutants at the inlet and outlet of the waste collection pond from 4 locations of coal mining activities, which were taken every month from January to September 2020, are shown in Tables 1 to 4.

**Table 1. List of waste analysis results from mine inlet and outlet 1**

No.	Location	Quality Standards		Quality In let		Quality Out let		Month of Measured Year 2020
		Fe (mg/l)	Mn (mg/l)	Fe (mg/l)	Mn (mg/l)	Fe (mg/l)	Mn (mg/l)	
1		7,00	4,00	0,268	0,129	0,571	0,023	January
2		7,00	4,00	2,440	0,064	0,871	0,010	February
3		7,00	4,00	6,454	0,022	0,149	0,099	March
4	Mine 1 BL-TS-II	7,00	4,00	2,372	0,026	0,305	0,071	April
5		7,00	4,00	0,899	0,059	0,531	0,055	May
6		7,00	4,00	2,540	1,380	2,690	1,330	June
7		7,00	4,00	1,049	0,051	1,423	0,027	July
8		7,00	4,00	1,640	0,010	0,080	0,010	August
9		7,00	4,00	2,339	0,054	0,552	0,057	September

Mining waste 1 shows that the condition of the wastewater at both the inlet and outlet does not exceed the environmental quality standard. Only from the results of environmental management that the concentration of Fe and Mn elements decreases every month, indicating that the company complies with existing regulations.

**Table 2: List of waste analysis results from mine inlet and outlet 2**

No.	Location	Quality Standards		Quality In let		Quality Out let		Month of Measured Year 2020
		Fe (mg/l)	Mn (mg/l)	Fe (mg/l)	Mn (mg/l)	Fe (mg/l)	Mn (mg/l)	
1	Mine 2	7,00	4,00	14,25	0,022	0,900	0,075	January

2	PDL- HDK- CHARLIE	7,00	4,00	34,14	0,031	0,689	0,214	February
3		7,00	4,00	62,30	0,020	0,138	0,027	March
4		7,00	4,00	5,56	0,054	0,231	0,100	April
5		7,00	4,00	5,37	0,074	1,242	0,051	May
6		7,00	4,00	1,72	0,960	2,270	1,170	June
7		7,00	4,00	3,34	0,033	1,206	0,021	July
8		7,00	4,00	2,18	0,010	0,067	0,010	Agustust
9		7,00	4,00	1,26	0,055	0,774	0,004	September

There is a condition of mine waste two that needs to be watched out from January to May 2020. From January to March 2020, the Fe content exceeds the quality standard set by the government. Meanwhile, April-May 2020 is still within the set limits, but we still have to be careful. After managing the waste and reanalyzing it, the water is in normal condition.

**Table 3:** List of waste analysis results from mine inlet and outlet 3

No.	Location	Quality Standards		Quality In let		Quality Out let		Month of Measured Year 2020
		Fe (mg/l)	Mn (mg/l)	Fe (mg/l)	Mn (mg/l)	Fe (mg/l)	Mn (mg/l)	
1		7,00	4,00	0,27	0,129	0,571	0,023	January
2		7,00	4,00	2,95	0,017	0,675	0,022	February
3		7,00	4,00	1,28	0,022	0,149	0,099	March
4	Mine 3	7,00	4,00	2,37	0,026	0,491	0,066	April
5	CB-VD	7,00	4,00	0,90	0,059	1,521	0,060	May
6	BL-TSII	7,00	4,00	2,54	1,380	1,120	0,720	June
7		7,00	4,00	3,21	0,032	1,423	0,027	July
8		7,00	4,00	0,15	0,010	0,079	0,010	Agustust
9		7,00	4,00	1,72	0,056	0,552	0,057	September

The condition of mine wastewater 3 shows that both the inlet and outlet do not exceed the environmental quality standards from government regulations. Only from the results of environmental management that the concentration of Fe and Mn elements decreases every month, indicating that the company complies with existing regulations.

**Table 4:** List of waste analysis results from mine inlet and outlet 4

No.	Location	Quality Standards		Quality In let		Quality Out let		Month of Measured Year 2020
		Fe (mg/l)	Mn (mg/l)	Fe (mg/l)	Mn (mg/l)	Fe (mg/l)	Mn (mg/l)	
1		7,00	4,00	14,25	0,031	0,796	0,042	January
2		7,00	4,00	27,00	0,037	0,807	0,244	February
3		7,00	4,00	9,51	0,658	0,110	0,010	March
4	Mine 4	7,00	4,00	5,56	0,043	0,277	0,028	April
5	PDL- HDK-	7,00	4,00	9,46	0,091	0,799	0,059	May
6	ROMEO	7,00	4,00	1,67	0,900	2,350	1,130	June
7		7,00	4,00	2,64	0,041	1,387	0,227	Julu
8		7,00	4,00	2,18	0,010	0,076	0,010	Agustust
9		7,00	4,00	2,58	0,250	0,770	0,064	September

The condition of this mine waste 2 needs to be watched from January to May and June 2020. From January to May and June 2020, the Fe content exceeds the quality standard set by the government. After managing the waste and reanalyzing it, the water is in normal condition.

### The trend of Fe and Mn elements in coal mine waste.

Mine 1. The laboratory analysis results at the in let settling pond location in mine one from March to September 2020, total Fe and Mn decreased. Meanwhile, the trend of Fe concentration from January to March 2020 showed an increase of up to 6,454 mg/l. Then it again reduced to 0.899 mg/l in May, then rose slightly again until September. It is due to the mining process from January to March, namely, taking overburden on sandstones with hematite mineral nodules. During that month, the concentration of iron values is high.

The concentration of Mn is not too high, still below the required quality standard, but after management, in the settling pond with the addition of lime and alum, the concentration of Fe and Mn is very low, as shown in Figure 1.

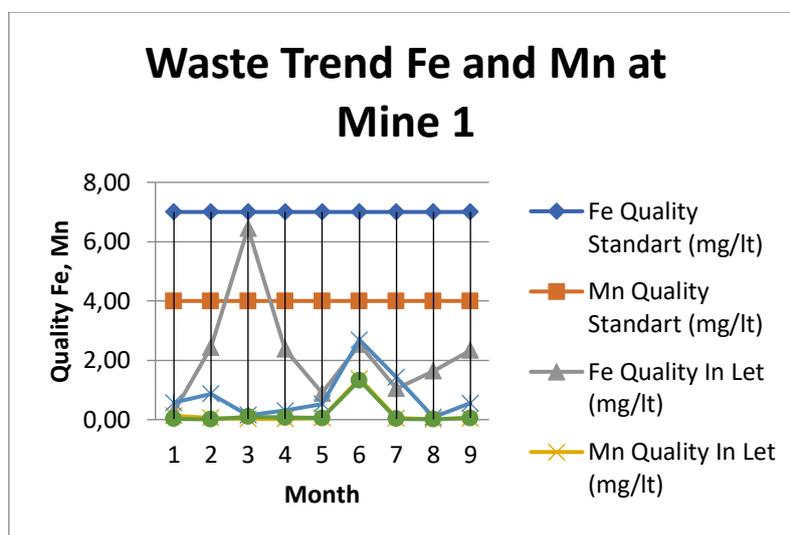


Fig.1. Waste Trend Fe and Mg at Mine 1 for 9 Month

Mine 2. at the in let settling pond location, shows a decrease in total Fe and total Mn as in mine 1. The trend of Fe concentration from January to March 2020 shows an increase, whereas, in March, it was very high, up to 62.30 mg/l. Then it decreased again until September. This location has a sandstone lithology containing iron metal elements, so the concentration is very high, as shown in Figure 2.

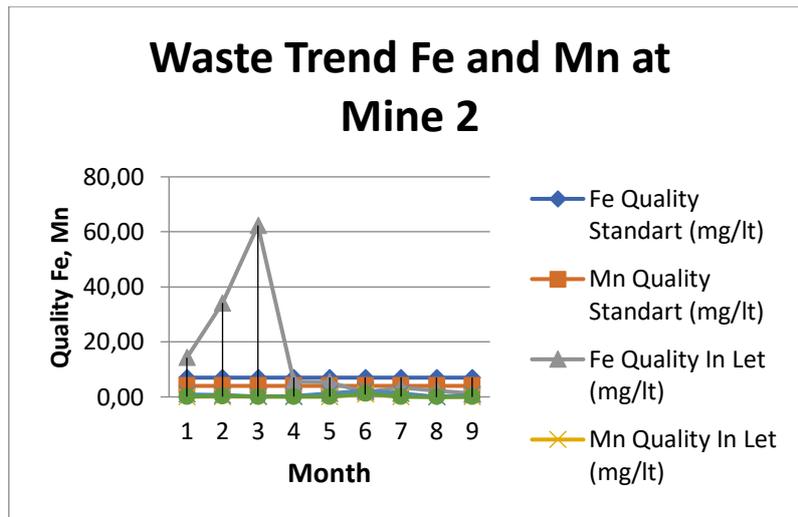


Fig.2. Waste Trend Fe and Mg at Mine 2 for 9 Month

Mine 3. The Fe and Mn waste concentration at the Mine 3 location is not too high. The trend of the concentration of Fe for nine months is still below the quality standard set by the government. The trend of Fe and Mn elements in coal mine waste is shown in Figure 3.

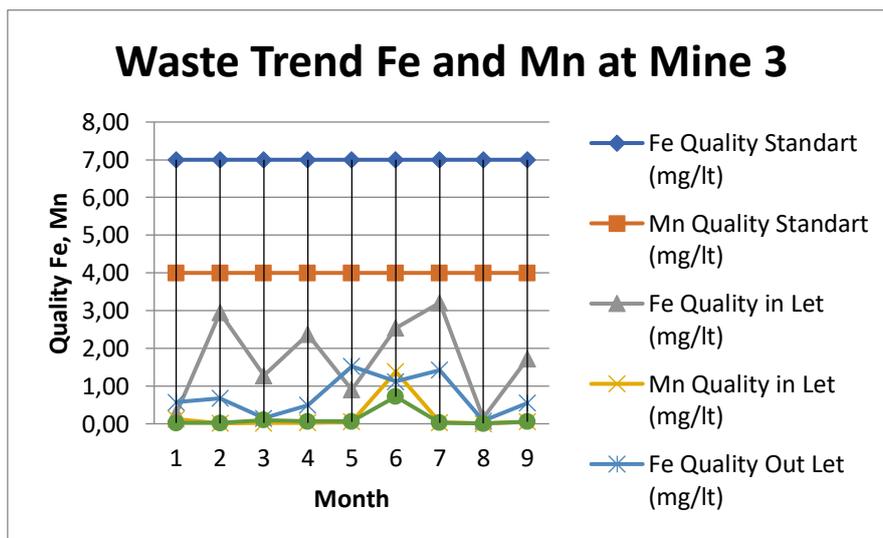


Fig.3. Waste Trend Fe and Mg at Mine 3 for 9 Month

Mine 4. The laboratory analysis results at the in let settling pond at mine four total Fe and total Mn showed a decrease. The tendency for high concentrations of Fe in February 2020. Meanwhile, for other months the concentration is low. Due to the mining process in February, it took overburden on sandstones containing mineral fragments containing iron elements. While the concentration of Mn is not too high, it is still below the required quality standard, but after management in the settling pond with the addition of lime and alum, the concentrations of Fe and Mn are very low. The trend of Fe and Mn elements in coal mine waste is shown in Figure 4.

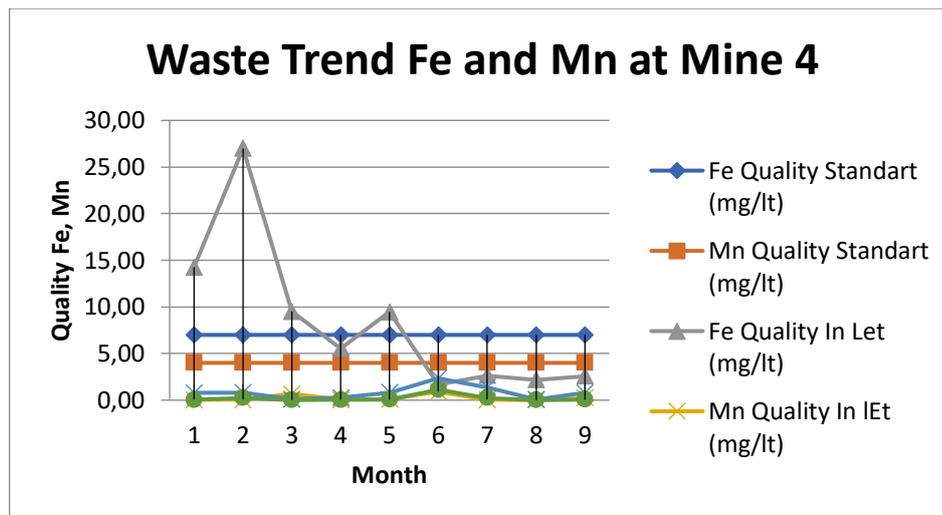


Fig.4. Waste Trend Fe and Mg at Mine 4 for 9 Month

## CONCLUSION

The results of this study and conclusions that can be drawn are as follows: The laboratory analysis results at the inlet settling pond location of 4 mines in Kutai Kartanegara Regency show that only three mines are still below the environmental quality standard. While mines 1,2, and 4, the results are above the environmental quality standards. The trend of Fe and Mn wastes, in general, decreased, both at the inlet and outlet locations of all mines.

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