International Journal of Applied Chemistry.
ISSN 0973-1792 Volume 12, Number 3 (2016) pp. 293-308

http://www.ripublication.com

The Effect Of Acid Mine Water On Ground Water Hydro-Chemical, In Mantewe, Tanah Bumbu Regency, South Kalimantan, Indonesia

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Abstract

Openly coal mining can damage the layer structure so that the groundwater aquifers that are in the aquifer layer filling out the coal mining pond. Free oxygen available at the mine accelerate the process of formation of acid mine water as the negative impact of mining coal. When the rainy season rain fell increase the amount of water that is mixed with coal at the mine pond, so the acid mine drainage can melimpas form the surface flow. The research location is in the district. Mantewe Kab. Land of Spices. At this location there are several coal mining sites openly. The purpose of this study was to determine the impact of acid mine drainage on water quality in the vicinity of the study. Test parameters on this research activity is determined only a few chemical elements that exist in South Kalimantan Governor Decree No. 05 of 2007 on the standard allotment and river water quality standard. Parameters-The parameters are: DHL, TDS, pH, Fe and Mn. From the data analysis lab, coal mining in the District Mantewe a negative impact in the form of acid mine drainage. Acid mine water accumulating in an ex-mine coal with a concentration parameters-the selected parameters exceed the quality standard limits allowed. Acid mine water flowing on the surface does not pollute the river that flows near the site of research and acid mine water that infiltrated into the soil into groundwater will not pollute wells-wells closest to the sites.

Keywords: Coal, Acid Mine Water, DHL, TDS, pH

1. INTRODUCTION

According Murtianto [9] South Kalimantan coal is a contributor to the national second largest after East Kalimantan. Activity coal mine in South Kalimantan, one of which is in the district. Mantewe Kabupetan Land of Spices. The high activity coal mines in the region, causing a risk of water pollution both surface water and ground water is getting higher. Acid mine drainage is one of the products of coal mines often become pollutants of surface water and groundwater [2], [4]. Openly coal mining can damage the layer structure so that the groundwater aquifers that are in the aquifer layer filling out the coal mining pond. Free oxygen available at the mine accelerate the process of formation of acid mine water as the negative impact of mining coal. When the rainy season rain fell increase the amount of water that is mixed with coal at the mine pond, so the acid mine drainage can melimpas form the surface flow.

For the prevention of adverse effects of acid mine water as a result of coal mining on water quality, the South Kalimantan Governor issued regulations. Based on South Kalimantan Governor Regulation No. 05 Year 2007 concerning the standard designation and river water quality standard. Stipulate that the maximum limit values for multiple parameters: iron (Fe) total $\leq$0,3 mg / L; Manganese (Mn) total $\leq$0,1 mg / L; Cadmium (Cd) total $\leq$0,1mg / L; TDS $\leq$ 1000 mg / L and a pH of 6-9. Therefore, do need to investigate groundwater contamination as a result of coal mining activities in the district Mantewe and to determine the distribution patterns by analyzing the chemical elements selected.

2. RESEARCH METHODS

The research location is in the Village and Village Mantewe Sukadamai Mantewe Tanah Bumbu District of South Kalimantan (Figure 1). The point-the point of sampling include: community wells, coal mining pits, swamps-swamps, and rivers. Test parameters on this research activity is determined only a few chemical elements that exist in South Kalimantan Governor Decree No. 05 of 2007 on the standard allotment and river water quality standard. Parameters-The parameters include: DHL, TDS, pH, Fe and Mn

Parameter-test parameters mentioned above have the ability unchanged to air and different light-different parameters TDS, DHL and pH measurements were taken on the spot by using a portable water quality cheking. Parameter Fe, Mn and Cd have to do the analysis in the chemical laboratory. Direct measurement of the parameters mentioned above using a Water Quality Multi Probe brand HORIBA, this tool has the ability to measure or read several parameters simultaneously, while the measurement procedure in the field using this tool as follows: (1) Calibration of Water Quality Multi Probe with standard solution which has been prepared. (2) Wash sensor-the sensor with distilled water until clean. (3) Dip the tool directly to the point of measurement (water bodies) for some time before the measurement. (4) Record the readings as a means of measuring results.

Retrieval and measurement or analysis of samples is conducted in UPT Environmental Laboratory Regional Environmental Agency Government of Tanah Bumbu which has been accredited by the National Accreditation Committee. The results of the analysis in the laboratory is used as the measurement data. Based on the results of chemical analysis, can be used to know the impact of open-pit mining on groundwater quality in the vicinity of the study. The results of the chemical analysis, then correlated with the analysis of geology [3], hydrogeology [5, 6, 7], surface flow analysis and analysis of land cover. From a combination of analalisa is expected to answer the processes occurring in acid mine water in the vicinity of the study [1, 8].

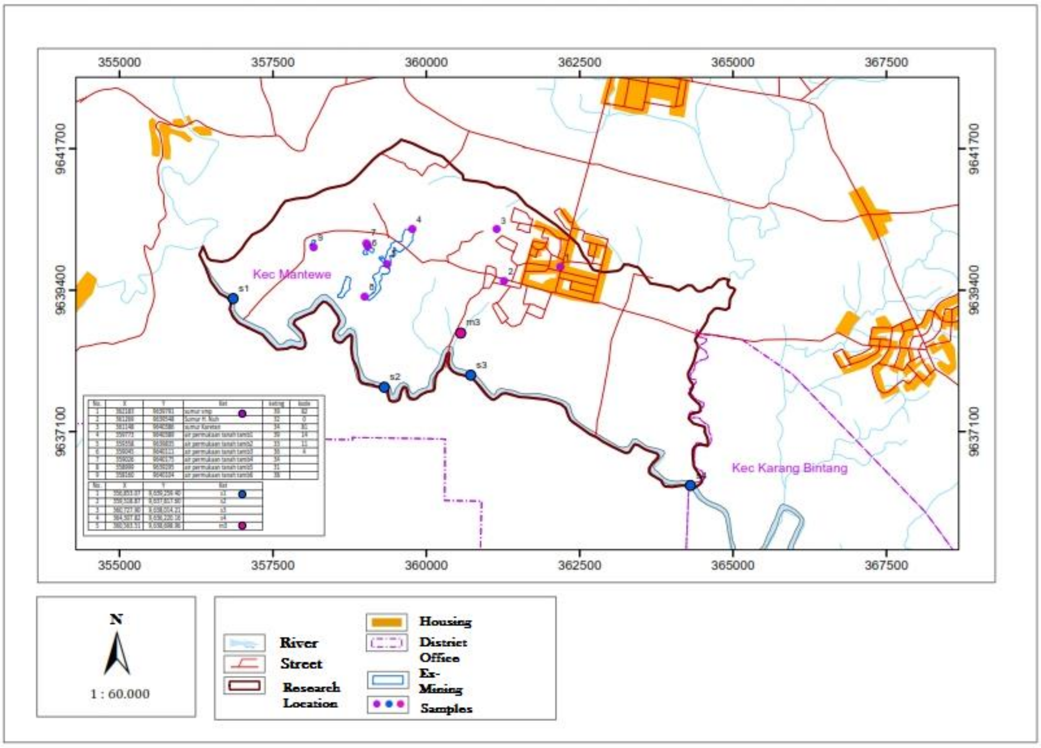

Figure 1. Map of sampling locations

3. RESULT AND DISCUSSION

3.1. Chemical Analytic

Collecting data on water chemistry research site is divided into four categories. This division is based on the type and location of the water analyzed. The categories in the form of water chemistry data on ex-mining ponds (void); Chemical data of water in the marshes surrounding the mine; Chemical data of water in wells near the mine, and chemical data of water in the river which is in the vicinity of the mine [9, 10, 11].

Sampling was first performed on the water contained in the former mine pond. Chemical analysis of water in the former mine pond was used to determine whether the water in the former mine pond is transformed into acid mine water or not. Data from laboratory analysis of water in the former mine pond shown in Table 1.

Table 1: Data quality of the water in the former coal mine

Samples	Temperature (ºC)	pH	Conductivity	TDS	Fe	Mn
1	32.75	2.80	1243.33	795.78	3.13	6.40
2	33.50	2.94	1430.00	843.40	50.18	13.47
3	33.87	3.36	1798.75	1150.00	2.87	2.92
4	33.27	3.01	881.00	563.89	3.76	13.89
5	32.23	3.18	532.75	340.75	6.42	13.63

3.1.1. Accidity (pH)

PH or acidity indicates the concentration of hydrogen ions. If the water hydrogen ions (H +) as positive ions only increases then the solution is acidic (water with a pH lower 7), whereas if the hydroxyl ions (OH-) as a negative ion only increases the solution is alkaline (water larger pH 7). In general, the river water and ground water has a pH ranging from 6 to 8.5, while the water contaminated by mining waste can cause the water becomes acidic with a pH of less than 5. Similarly to the water that is not contaminated, but has a low pH of less than 4 can occur because of the influence natural environment, among others, from the oxidation of sulphide minerals (eg pyrite, chalcopyrite), volcanic gases containing hydrogen sulfide, carbon dioxide, and ammonia. The value of water quality standards are allowed 6-9.

Based on water quality data for the parameters pH in 5 ex-mining ponds worth 2.8 to 3.36. pH in the pond former coal mines included in the category of very sour even far from water quality standard threshold allowed. The low pH value is a result of the high activity of free hydrogen ions in the water pool. Hydrogen ions derived from oxidation of pyrite (FeS2) which are contained in the coal. The opening of coal seams by mining activities cause contact with air or oxygen and the accumulation of rainwater and groundwater at the mine sites can accelerate the process of oxidation of pyrite. Pyrite oxidation process as follows:

$$2FeS_2 + 7O_2 + 2H_2O \text{-->} 2Fe^{2+} + 4SO_4^{2-} + 4H^+ \qquad (1)$$

The first reaction of pyrite weathering merupakah reaction with the oxidation process. Compounds of pyrite oxidized form of ferrous iron ions, sulfate ions and hydrogen ions. 1 mole of oxidized pyrite produces 2 moles of acidity. In addition to the direct oxidation of pyrite compounds can also be oxidized by water conditions that contain a lot of iron (Aqueous Ferric Ion). The process of oxidation as follows:

$$FeS_2 + 14Fe^{3+} + 8H_2O \text{-->} 15Fe^{2+} + 2SO_4^{2-} + 16\ H^+ \qquad (2)$$

Oksidai pyrite by ferric iron ions ferrous iron, sulfate ions and hydrogen ions. In this process produces more acidity. 1 and 2 of the reaction conditions of acidity increases so that the pH of pool water more acidic former mine reaches the value <4. In this condition, the former mining pool water is called acid mine drainage.

3.1.2. Electrical Conductivity (DHL)

The ability to conduct electricity in one cubic centimeter of water at temperatures of 25oC. Parameter DHL provides the big picture content of cations and anions in the water. The bigger DHL, the greater the number of ions present in water and vice versa. Mine area which contains sulfuric oxides DHLnya value reached more than 100 micromhos / cm. Based on water quality data for the parameters of electrical conductivity shows ex-mining ponds worth 532.75 to 1798.75 micromhos / cm and included in the high category. The high electrical conductivity values indicate the presence of chemical processes that occur in the water ex-mining ponds and generate a lot of free ions therein. Ions causes acidity and mineral ions coal constituent rocks dominate as a contributor to the high value of electrical conductivity. These ions including iron ions, the hydrogen ions and sulfate ions.

3.1.3. Total Disolved Solid (TDS)

Levels of mineral elements dissolved in water that indicate the presence of dissolved mineral elements. Elements of dissolved minerals generally consists of carbonate, bicarbonate, chloride, sulfate, phosphate, nitrate, magnesium, sodium, calcium, potassium, and some other elements. Normal surface water and ground water are generally less than 500 mg / L. The value of water quality standards are allowed $\leq$ 1000 mg / L. Based on water quality data for total dissolved solids parameters indicate that the former mining pool water is worth 340.75 to 1150 mg / L and in the high category. This indicates the occurrence of contamination on the former mining pool water, pollution is a result of the formation of acid mine water. Mineral elements formed by the process of acid mine drainage results in a high value of total dissolved solids. The elements which greatly contributed to the value of total dissolved solids diataranya is the element hydrogen, sulfate and mineral elements other metals.

3.1.4. Iron (Fe)

The element iron are in most rocks on earth. In igneous rocks of elemental iron in the form of mineral amphibol, pyroxene, magnetite, pyrite, biotite, and garnet, whereas in sedimentary rocks in the form of iron oxides, carbonates and sulfides of clay minerals. Iron in groundwater is generally present in the form of ferrous (Fe +) of the ferrous Fe bicarbonate (HCO 3) 2, at the moment of contact with free oxygen from the air to form the ferry (Fe 3+) from the ferry hydroxide. In bodies of water such as marshes and lakes with calm water and does not flow, the iron-containing fine sediment deposition perfect experience, resulting in iron oxidation with oxygen from the air. The oxidation process to form hydroxide and hydrogen-free ferries that meet the water so that the water will be acidic. The value of water quality standards are allowed to $\leq$ 0.3 mg / L. Based on water quality data for iron parameters indicate that the ex-mining ponds water worth 2.87 to 50.18 mg / L, the ex-mining ponds water contains a lot of iron ions in it and its value exceeds water quality standards are allowed. In the process of oxidation of pyrite (FeS2) by oxygen in the water of ex-mining ponds produce elemental iron is very abundant, so the data analysis results in the laboratory showed levels of iron in each pool the former colliery value is very high and exceeds the standards of water quality standards are allowed. Chemical processes that show the abundance of elemental iron in the water ex-mining ponds as follows:

$$2FeS_2 + 7O_2 + 2H_2O \text{-}> 2Fe_2+ + 4SO_4^{2-} + 4H^+ \quad (3)$$

$$FeS_2 + 14Fe^{3+} + 8H_2O \text{-}> 15Fe^{2+} + 2SO_4^{2-} + 16\,H^+ \quad (4)$$

$4Fe^{2+} + O_2 + 4H^+ -> 4Fe^{3+} + 2H_2O$ (5)
$Fe^{2+} + 1/4O_2 + 5/2H_2 -> 4Fe(OH)_3 + 2H^+$ (6)
$FeS_2 + 15/4O_2 + 7/2H_2O -> Fe(OH)_3 + 2SO_4^{2-} + 4H^+$ (7)

3.1.5. Mangan *(Mn)*

The element manganese is naturally derived from weathered sedimentary or metamorphic rocks of the mineral mica, biotite, amphibole and hornblende. In nature the element manganese is a minor element by having a small amount, generally not more than 0.02 mg / L. If the manganese content in water is greater than 1 mg / L, the water has suffered material contamination by acid mine or others. The value of water quality standards are allowed to ≤ 0.1 mg / L. Based on the results of data analysis in the laboratory for water quality parameters show that manganese in ex-mining ponds worth 2.92 to 13.89 mg / L. The content of manganese in the water ex-mining ponds in the high category or exceeded water quality standard limits the exposure so that the former mine pond water is polluted acid mine drainage material. Metal manganese dissolved in water with a weakly acidic conditions to form manganese ion (II) and hydrogen.

$Mn + 2H^+ \rightarrow Mn^{2+} + H_2$ (8)

In addition to manganese (II) there are several complexes containing manganese in the +3 oxidation state, Vogel (1985). In acidic conditions which contains sulfate will form manganese (II) sulfate and oxygen compounds are released into the air.

$2Mn_2O_3 + 4H_2SO_4 \rightarrow 4Mn^{2+} + O_2 + 4SO_4^{2-} + 4H_2O$ (9)

3.2. Water chemistry data swamp-marsh around the mine site

Sampling was then performed on the water contained the marshes surrounding the mine. Chemical analysis of water in the marshes used to determine the chemical content of water marshes and compare it with the water in the mine. Data from laboratory analysis of water in the former mine pond shown in Table 2.

Table 2: Water Quality Data in the Swamp-Swamp Around Former Coal Mine

Samples	Temperature (°C)	pH	Conductivity	TDS	Fe	Mn
1	26.90	6.64	339.40	1392.50	14.74	2.42
2	28.40	5.52	118.95	212.50	11.36	0.31
3	28.90	5.59	48.15	128.00	1.53	<0.035

3.2.1. Accidity (pH)

Based on water quality data for the parameters pH at three locations near the swamp ex-mining ponds worth 5.52 to 6.64. pH of the water in the swamp included in the category of weak acid to neutral.

3.2.2. Electrical Conductivity (DHL)

Based on water quality data for the parameters of electrical conductivity shows swamp water worth 48.15 to 339.40 micromhos / cm. Rated electrical conductivity in swamp water tends to be lower than the electrical conductivity of the water ex-mining ponds, this shows that the ion content-free ions in a water marsh greatly reduced significantly. Free cations and anions sulphate-free hydrogen is abundant in water ex-mining ponds, chemically bonded to the compound calcium carbonate becomes calcium bisulfate compounds and carbonic acid compounds.

3.2.3. Total Disolved Solid (TDS)

Based on water quality data for total dissolved solids parameters indicate that the swamp water is worth 128 to 1392.50 mg / L and in the high category, especially in the areas of swamp 1. This shows the number of solids in the form of salt-salt dissolved in water marsh. In addition to salt solids-salts of iron oxide from acid mine runoff ex-mining ponds as well as salts-salt reaction process limestone with acid mine drainage material.

3.2.4. Iron (Fe)

Based on water quality data for iron parameters indicate that the swamp water worth 1.53 to 14.74 mg / L, the swamp water still contains a lot of iron ions in it and its value exceeds water quality standards are allowed. But the value of iron in the water marsh is much lower than the value of iron in the water marsh. Most irons have undergo hydrolysis to form iron hydroxide precipitate on the basis of ex-mining ponds, while the iron is not yet perfect hydrolyzed water-borne melimpas into the swamp water.

3.2.5. Mangan *(Mn)*

Based on the results of data analysis in the laboratory for water quality parameters show that manganese in the swamp worth <0.035 to 2.42 mg / L.

3.3. Data quality of well water in the residential area around the mine

Sampling was then performed on the well water contained residents in the vicinity of the mine, precisely the eastern part of the mining area. Chemical analysis of water in wells is used to determine the chemical content of water wells and determine whether the water is contaminated. Data from laboratory analysis of water in the former mine pond shown in Table 3.

Table 3: Well Water Quality Data in Residents in Nearby Ex-Mine

Samples	Temperature (ºC)	pH	Conductivity	TDS	Fe	Mn
1	26.42	5.33	29.00	19.00	<0.081	<0.031
2	27.88	6.74	254.40	165.40	<0.081	<0.031

3.3.1. Accidity (pH)

Based on water quality data for the parameters pH at two locations near the residents' wells ex-mining ponds worth 5.33 to 6.74. pH of the water in the wells included in the category of weak acid to neutral.

3.3.2. Electrical Conductivity (DHL)

Based on water quality data for the parameters of electrical conductivity showed well water is worth 29 to 254.40 micromhos / cm. The value of the electrical conductivity of well water tends to be lower than the electrical conductivity of the water ex-mining ponds. Ion-free ions contained in the well water is the result of condensation of minerals-mineral rocks were passed. Ion-free ions in the wells is not associated with the ion-ion-free acid mine of ex-mining ponds, because of differences in the hydrogeological system and akuiklud bulkhead between the two systems.

3.3.3. Total Disolved Solid (TDS)

Based on water quality data for total dissolved solids parameters indicate that the well water is worth 19 to 165.40 mg / L and included in the low category. It shows the large number of solids in the form of salt-salt dissolved in water is very small wells. Dissolved solids in the water wells are not associated with dissolved solids in the water ex-mining ponds a much higher value.

3.3.4. Iron (Fe)

Based on water quality data for iron parameters indicate that the well water-value <0.081 mg / L, the well water contains little iron ions inside and well below the water quality standards are allowed. Rock minerals that are dissolved by groundwater flowing wells contain little iron element. This is quite different from the characteristics of the former mining pool water that contains a lot of iron, especially coming from pyrite (FeS2). The results of well water quality data also show that there is no excessive iron metal pollution.

3.3.5. Mangan *(Mn)*

Based on the results of data analysis in the laboratory for water quality parameters show that manganese in the wells worth <0.031 mg / L. The content of manganese in the water wells below the water quality standard limits allowed. Rock minerals that are dissolved by groundwater that flows in wells containing manganese bit. This is quite different from the characteristics of the former mining pool water that contains manganese metal, either manganese (II) mapun manganese (III). The results of well water quality data also show that there is no excessive manganese metal pollution.

3.4. River water quality data in District Mantewe

Sampling was then performed on Sungi water around the mine. Chemical analysis of water in the river was used to determine the chemical content of the water stream and compare it with the water in the mine. Data from laboratory analysis of water in the former mine pond shown in Table 4.

Table 4: Water Quality Data river Nearby Ex-Mine

Samples	Temperature (ºC)	pH	Conductivity	TDS	Fe	Mn
1	30.00	6.75	242.50	162.00	0.37	0.08
2	29.00	7.19	246.60	177.00	0.64	0.09
3	30.00	7.10	246.70	178.00	0.60	0.09
4	28.00	7.21	232.90	154.00	0.49	0.09

3.4.1. Accidity (pH)

Based on water quality data for the parameters pH at 4 points of the river near the mine site is worth 6.75 to 7.21. pH of water in the river is included in the neutral category. Melimpas former quarry pond water to the swamp-marsh around the pond, then if the water level in the swamp-marsh beyond surface topography melimpas no water will pass through the channel leading to the larger stream. In the upper reaches of the river water pH 6.75 and then the water flows toward the confluence with water from the swamp-marsh around ex-mining ponds, water pH 7.19. An increase in the pH value becomes more neutral, suggesting that the flow of water from the swamp-marsh able to raise the pH of the river.

3.4.2. Electrical Conductivity (DHL)

Based on water quality data for the parameters of electrical conductivity showed the river water is worth 232.9 to 246.70 micromhos / cm. The value of the electrical conductivity of river water tend to be lower than the electrical conductivity of the water ex-mining ponds, this shows that the ion content-free ions in river water is greatly reduced significantly. In the upper reaches of the river water electrical conductivity micromhos 242.5 / cm and then flows toward the confluence with swamp water electrical conductivity value of the water of the river rose to 246.60 micromhos / cm. it demonstrates the ion-ion-free water of the marsh through the channel into the river still contains ion-free ions are relatively higher than the ion-ion-free in the river. Then the river flows to the confluence with the river passing through neighborhoods affixes, electrical conductivity increased though not significantly be 246.70 micromhos / cm. this indicates that the river water additive containing more ions-ions free from the river water. From the point of confluence with the river flows into the river water recharge downstream, at this point the electrical conductivity decreased significantly to 232.9 micromhos / cm. journey toward the downstream river water did not experience affixes again so that the river can lower ion-ion-free with the ability of the river to purify oneself (self purification).

3.4.3. Total Disolved Solid (TDS)

Based on water quality data for the parameters total dissolved solids showed the river water is worth 154-178 mg / L. The value of the electrical conductivity of river water tend to be lower than the total dissolved solids water ex-mining ponds, this shows that the salt content-salt dissolved in the water of the river is greatly reduced significantly. In the upper reaches of the river water total dissolved solids 162 mg / L then flows toward the confluence with swamp water total dissolved solids river water increased to 177 mg / L. it indicates salt-water soluble salts of the marsh through the channel towards the river is relatively higher than the river water. Then the river flows to the confluence with the river passing through neighborhoods affixes, total dissolved solids increased though not significantly to 178 mg / L. this indicates that the river water additive containing more salt-salt dissolved in the river water. From the point of confluence with the river flows into the river water recharge downstream, at this point of total dissolved solids significantly decreased to 154 mg / L. journey toward the downstream river water did not experience affixes again so that the river can lower the salt-salt dissolved in the river's ability to purify oneself (self purification).

3.4.4. Iron (Fe)

Based on water quality data for iron parameters showed the river water is worth 0.37 to 0.642 mg / L. Values of elemental iron in the water of the river tend to be lower than the water content of elemental iron in ex-mining ponds, it indicates that the iron content in the water of the river is greatly reduced significantly. On the upstream side of the element iron content in the water of the 0.37 mg / L then flows toward the confluence with the value of the element iron swamp water river water rose to 0.642 mg / L. it does show still abundant element iron contained by water from the swamp-marsh near the mine. Then the river flows to the confluence with the river passing through neighborhoods affixes, elemental iron decreased significantly despite not become 0,6mg / L. this indicates that the iron element content of the river water additive does not affect the iron content of the river water, river water even affix able to dilute the river so that the iron content which initially concentrated becomes more dilute. From the point of confluence with the river flows into the river water recharge downstream, at this point the element iron has decreased significantly to 0.49 mg / L. journey toward the downstream river water did not experience affixes again so that the river can lower iron element with the ability of the river in purifying oneself (self purification).

3.4.5. Mangan *(Mn)*

Based on water quality data for the parameters manganese showed the river water is worth 0.08 to 0.09 mg / L. The value of the element manganese in the river water tend to be lower than the content of manganese in the water ex-mining ponds, it indicates that the manganese content in the water of the river is greatly reduced significantly. On the upstream side of the element manganese content in the water of the 0.08 mg / L then flows toward the confluence with swamp water river water manganese values increased to 0.09 mg / L. it does show is still an abundance of manganese contained in the water of the swamp-marsh near the mine. Then the river flows to the confluence with the river passing through neighborhoods affixes, manganese does not change the value. this indicates that the manganese element content of the water of the additive does not affect the manganese content of the river water. From the point of confluence with the river flows into the river water recharge downstream, at this point the element manganese is also unchanged. The content of manganese in the river far below the value of water quality standards are allowed at 0.3 mg / L.

3.5. Geological Factors

From geological observations, it is known that at the study site there are rocks which include clay stone, limestone, shale, coal and sandstone. Based on the type and location of lithology-lithologic obtained at the study site, the lithology of the study sites can be divided into four units. Based stratigrafinya order from old to young is a unit layered limestone, sandstone unit, the unit between stone and clay and shale units between coal and shale. Unit layered limestone found in the west end and the eastern part of the study area. This unit is composed of limestone layered with a thick layer ranges from 20-80 cm. Bedding limestone on the western tip of the study area have a direction N160E / 280, while in the eastern part of the study area, layering limestone have a direction N1850E / 110.

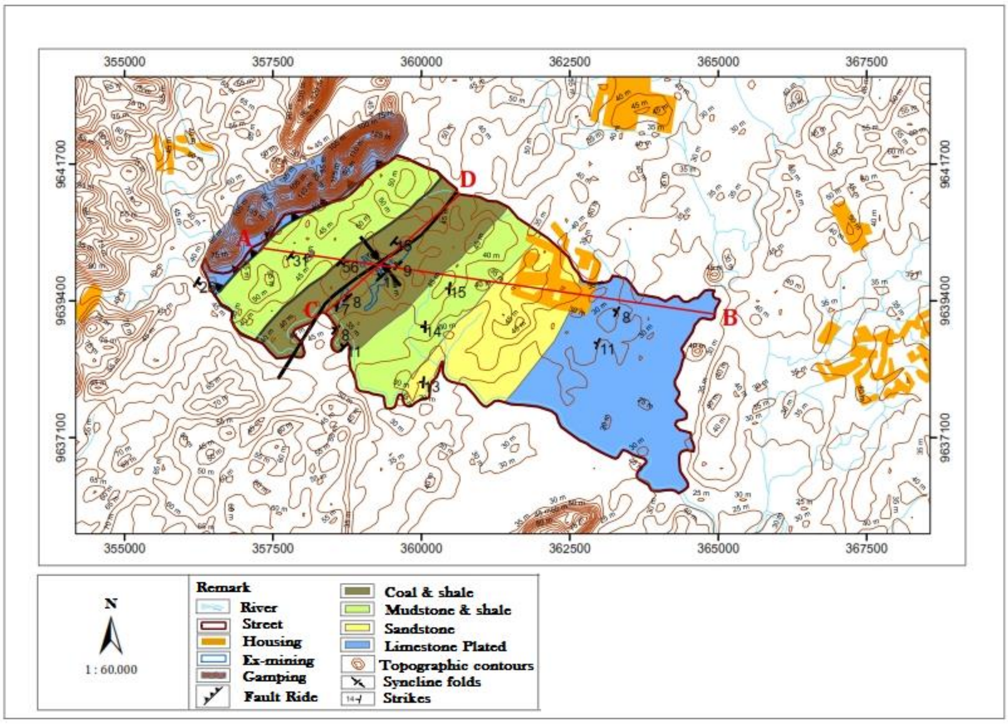

Figure 2: Geological map of the research area

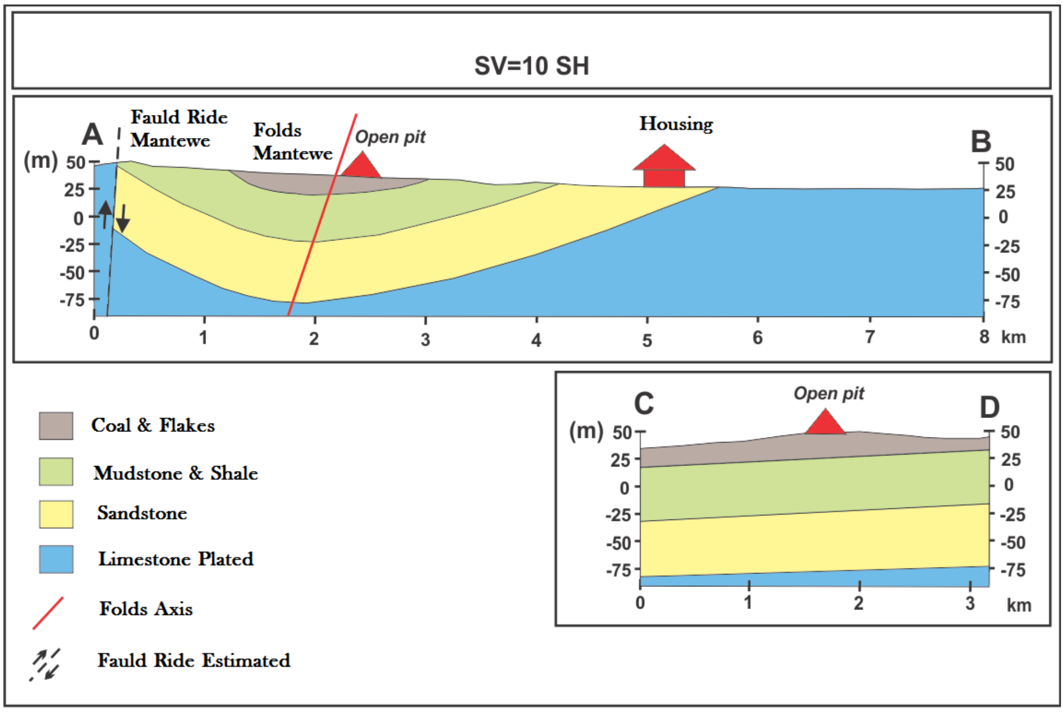

Figure 3: Profiles A-B and C-D of geological map of the research location

Based on the geological map (Figure 2) shows that the spreading of limestone is located in the western and eastern parts of the study area. This spreading of limestone in the western part of the study area to form a hill. Based on field observations of limestone in the study site has undergone dissolution by surface water or rain water so as to form a cavity or limestone experiencing karstification process. Dissolution that occurs in limestone can enter to form ground water and surface water streams.

Air dissolution of limestone by rainwater run follows the contours of the surface topography with directions to the location of a coal mine (west to east). Surface water collected in the swamp-marsh near the mine site, containing the swamp water dissolving limestone (CaCO3) has a relatively higher pH than the pH of the ex-mining ponds.

pH neutral water swamp exhibits on the swamp (1 surface water) and a weak acid in the swamp (3 surface water and surface water 4). Swamp water conductivity indicates the number of ions-ions contained in the water, to water dissolving limestone (CaCO3) contain many cations Ca2 + (calcium) and anion CO32-(carbonate). Total dissolved solids (TDS) indicates the number of compounds that are dissolved in water, the water marsh predominant compounds are compounds limestone CaCO3 dissolution results.

Acid mine drainage which contains compounds-compounds cause the degree of acidity (pH) is low, melimpas to swamp-marsh and having direct contact with water containing a lot of swamp white precipitate CaCO3 form the compound calcium sulfate (CaSO4). The results of these reactions tend to produce a weak acid pH or pH values increased significantly from the pH of acid mine drainage.

$$2CaCO_3 + SO4^{2-} + 2H^+ \rightarrow Ca_2SO_4 + 2HCO_3 \quad (10)$$

Swamp-marsh located around the ex-mining ponds capable of lowering compounds-compounds cause the degree of acidity (pH) is low so that the degree of acidity (pH) is neutral before flowing into water bodies or river.

Surface water entering the marsh comes from rain water which passes melimpas limestone rock formations in the western part of the location of an ex-mine. Rainwater through the limestone rock formations capable of dissolving limestone or referred to karstification process. Swamp water containing many compounds CaCO3 results karstification process and then mixed with water ex-mining ponds containing acid mine material. In the swamp water chemical reaction between calcium carbonate compounds and sulfur compounds in acidic conditions will produce a compound bisulfate precipitated calcium and carbonic acid. This process causes the pH of the water in the swamp becomes more leads to even weak acids tend to be neutral. The chemical process of lime solution reaction with acidic compounds mine as follows:

$$2CaCO_3 + SO4^{2-} + 2H^+ \rightarrow Ca_2SO_4 + 2HCO_3 \quad (11)$$

The pH of the river water also showed different values. Before flowing into the river swamp water flowing through the channel with its constituent lithologies containing limestone, the limestone dissolution occurs along the channel leading to the river. From the point of meeting with swamp water, river water flows into the confluence with the river that flows past the small affixes the residence. Mangalir water in the river comes from rain water recharge and groundwater out of the surface and has a weakly acidic pH tends. This confluence led to a decrease in pH were not significant from 7.19 becomes 7.10. From the point of confluence with the river water recharge rivers flow into downstream past the limestone formations, the pH of the river water to rise back from 7.10 becomes 7.21 because of the abundance of calcium carbonate compound that tends to be alkaline.

3.6. Hydrogeological Factors

From the analysis of hydrogeological, it is known that hidrostratigrafi research areas, from oldest to youngest, composed of (Figure 4): The unit acts as a layered limestone aquifer; Sandstone unit acts as akuitar-aquifer; Unit between clay stone and shale acts as akuiklud / non-aquifer; Unit between coal and shale acts as akuitar.

Based on the results of overlay between hydrogeological map with the location of settlements and mine openings, it is known that the location of the mine openings are at akuitar between coal and shale. At the opening of the mine, the depth of the pool ranges in 3-9 meters. At that depth, the rock penetrated the form of clay stone. Therefore, based on the hydrogeological conditions. Acid mine drainage that is in the study site will have (a) Isolated only on units akuitar between coal and shale for their bulkhead in the form akuiklud under unit akuitar between coal and shale, (b) the acid mine water that goes into soil forming ground water does not flow in the direction of a decrease in the topography, but the groundwater would flow toward the center of syncline, so the acid mine water can not flow as groundwater toward residential areas,

(c) Since the acid mine water that becomes ground water can not be family hot from sayuan the then the acid mine drainage will have the potential to interact with limestone inserts in the unit, so that the process of self-purification can take place.
Subsurface rock formations in the area of the settlement residents in the form of units of sandstone formations that are part Warukin while the mining area in the form of unit between coal and shale. Both of these units are separated by clay and shale rock unit that is akuiklud. Bisri [2] akuiklud a rock layer that has a composition such that it can accommodate the water but can not release water in an appreciable amount. This occurs because the value of conductivity is very small, for example, a layer of silt and mud (silt). Therefore, although it is in the region that memupunyai lower topography, district residents' wells. Mantewe not polluted by acid mine drainage, for their bulkhead isolating akuiklud the acidic water to remain in the unit between akuitar coal and shale.

3.7. Land Cover Factor

At the study site plant vegetation grows in many regions around the swamp-marsh and along the flow of surface water to the river naturally. Metal-metal that accumulates in water and soil contaminated acid mine water into a source of nutrients for the plants to survive. The process of phytoremediation of heavy metals by plants takes the relatively long so that the impact of plant vegetation on the reduction of metal on the location of the research need special assessment and its own.
The content of manganese in the water marsh in the low category to exceed the limit of allowable water quality standard, particularly in areas of swamp 1 and 2. Manganese reacts with warm water form a precipitate of manganese (II) hydroxide and hydrogen

$$Mn + 2H_2O \rightarrow Mn\,(OH)_2 + H_2 \qquad (12)$$

Deposition of manganese (II) hydroxide is rapidly oxidized when exposed to air becomes hydrated manganese dioxide, MnO (OH) 2 precipitate brown.

$$Mn\,(OH)_2 + O_2 + H_2O \rightarrow MnO(OH)_2 + 2OH^- \qquad (13)$$

The formation of sludge-sludge metal manganese in the bottom of the swamp led to a significant reduction in the manganese content in the water marsh. In addition to the process of phytoremediation plants manganese metal also helps in decreasing the manganese content in the water marsh.
In addition to advanced hydrolysis process of iron in the swamp that can reduce the amount of elemental iron in the water marsh, vegetation plants that grow around the swamp-marsh also able to reduce the iron content in the water. the process of absorption of heavy metals by plants in a process called phytoremediation. Firda (2015) umbrella papyrus plants can reduce iron and manganese metal effectively with the methods of phytoremediation in a certain time period. At the study site umbrella papyrus plant (Cyperusalternifolius) found live and breed well.

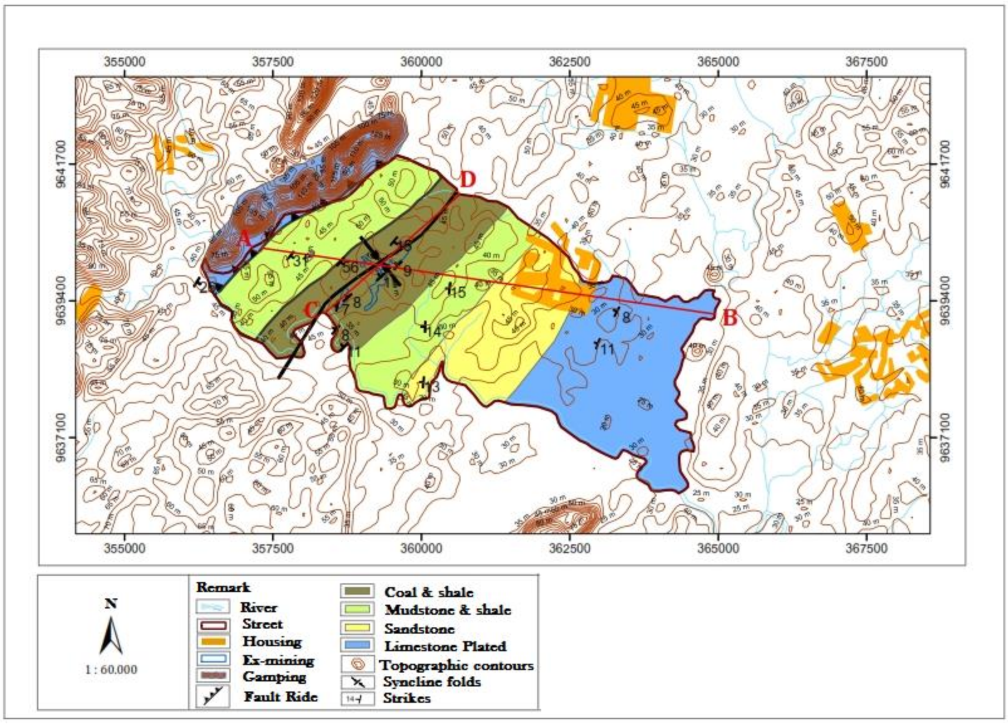

Figure 4: Map of hydro-geology of the research location

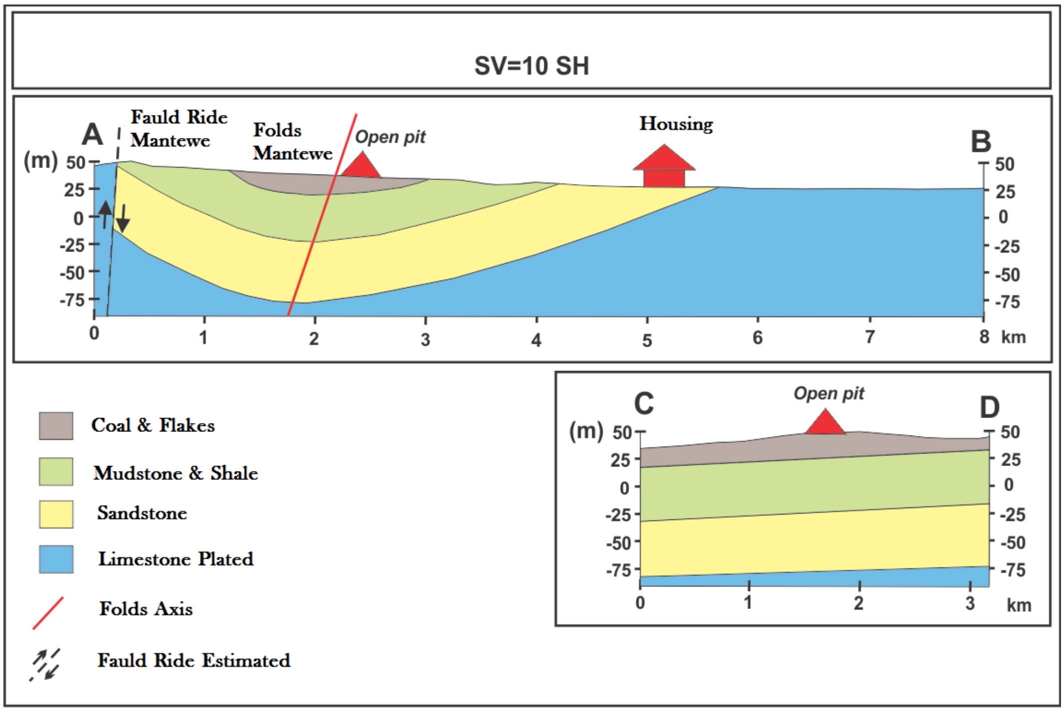

Figure 5: The profile of map of hydro-geology of the research location.

4. CONCLUSION

Based on the above, it can be concluded (1) The activity of the coal mine in the village and the village Mantewe Sukadamai Mantewe Tanah Bumbu District of South Kalimantan which produces the environmental impact of acid mine drainage; (2) surface water and river water body has the ability to dilute and self purification of the acid mine drainage so that the effects of pollution can be neutralized; (3) The ground water or wells in the residential area not affected by acid mine water pollution due to the influence of geological factors such as their Mantewe syncline structure and hydrogeological factors such as their unit between akuiklud clay stone that isolating acid mine drainage; (4) Ground water containing acid mine water in the study area to the river (south of the former mine). Hydrogeological conditions of the study site were able to prevent acid mine water pollution to ground water area neighborhoods; (5) The marshes are located around the ex-mining ponds capable of lowering compounds cause the degree of acidity (pH) is low so that the degree of acidity (pH) is neutral before flowing into water bodies or river.

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