IJFAC

Indonesian Journal of
Fundamental and Applied Chemistry

Article http://ijfac.unsri.ac.id

The Seasional Trends of Dissolved Oxygen and pH in Sugihan River, South Sumatra, Indonesia

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Abstract

The concentrations of DO and pH of Sugihan Rivers from the upstream at Riding, Pangkalan Lampam, OKI to the offshore region of Sugihan Estuary were analyzed at 15 sampling points during dry and rainy seasion. All measurements of DO and pH were direct analysis at the river stream. The concentrations as the average values of DO in dry seasion was 1,97 mg / L while in rainy seasion was 2,57 mg / L, and for the pH degree was 3,63 in dry seasion and 4,04 in rainy seasion, respectively. Based on the DO and pH values, this study shown the natural forests and peat lands gave contribution to the low of pH degree. The low of DO values also influenced by the pH, because decomposition in the peatlands made higher solubility of biomass to the rivers stream and decreasing the ability of oxygen to penetration into the waterbody.

Keywords: DO, pH, Sugihan river, natural forest, peatland

Abstrak (Indonesian)

Konsentrasi DO dan pH Sungai Sugihan dari hulu di Kuda, Pangkalan Lampam, OKI ke wilayah lepas pantai Sugihan Muara dianalisis pada 15 titik sampling selama musim kering dan hujan. Semua pengukuran DO dan pH adalah analisis langsung di aliran sungai. Konsentrasi sebagai nilai rata-rata DO di musim kering adalah 1,97 mg / L sedangkan di musim hujan adalah 2,57 mg / L, dan untuk tingkat pH adalah 3,63 di seasion kering dan 4,04 di musim hujan. Berdasarkan nilai-nilai DO dan pH, penelitian ini menunjukkan bahwa hutan alam dan lahan gambut berkontribusi pada rendahnya tingkat pH. Rendahnya nilai DO juga dipengaruhi oleh pH, karena dekomposisi di lahan gambut membuat kelarutan yang lebih tinggi dari biomassa ke aliran sungai dan penurunan kemampuan oksigen untuk penetrasi ke aliran sungai tersebut.

Keywords: DO, pH, Sungai Sugihan, hutan alam, lahan gambut

Article Info

Received 10 September 2016
Received in revised 30 September 2016
Accepted 5 October 2016
Available online 12 October 2016

INTRODUCTION

All aerobic life forms, including aquatic/rivers system require oxygen for respiration. A warm-water aquatic ecosystem in tropic area should have dissolved oxygen (DO) concentration of at least 5 mg/L in order to support a diversified biota, including fish. DO concentration is a function of temperature, pressure, salinity and the biological activity in the water body. The solubility of oxygen in fresh water at sea level and at 25 °C is; 8.3 mg/L. In seawater, at the same conditions, the solubility of oxygen is 6.7 mg/L. Photosynthesis by plants can produce O_2 during daylight [1,2].

Sugihan river is located in the district of OKI, South Sumatra province where the river Sugihan region consists of Watershed of Gaja Mati,

Pelimbangan, Beberi, Olok, Daras, Medang, dan Padang. Hydrological systems that make up the lake in the OKI region in principle included in the geomorphic unit swamps, because the water that accumulates in the basin is generally derived from the swamp in the vicinity. Like other areas, OKI is influenced by a tropical climate with two seasons, dry and rainy season with an average rainfall of 1,096 mm per year and an average of 66 days of rain per year. In the rainy season the water level rise or an increase in the volume of water, the result tends to flooded lowlands. Whereas in the dry season the water to shrink and even some areas experiencing drought.

This research is preliminary research that examines the effect of season on changes in chemical physics of DO and pH in the Sugihan river. Accordingly, it is quite important to understand the distribution of DO and pH phenomenon because of its relationship with the presence of other chemicals in aquatic system, as weel as distribution and pollution status in the water environments of Sugihan river in order to manage the quality of water in estuarine and coastal areas [3,4]. The aim of the current study is to investigate the phenomenon of the DO and pH of Sugihan waters and the river status.

MATERIALS AND METHODS

Study location

Along the Sugihan river there are a conservation area of Padang Sugihan and the under construction of the largest pulp paper mills in Southeast Asia, namely PT. OKI Pulp and Paper Mill. The main conservation programs in the Padang Sugihan landscape include protection and restoration of natural forests and peat lands, establishment of a wildlife corridor between conservation areas, community empowerment and protection of the Sumatran elephant population. The Padang Sugihan landscape covers 1,650,213 hectares and is located on the east coast of South Sumatra province. This landscape consists of peat swamp forests, freshwater swamp forests, and mangrove ecosystems.

Sampling and analysis

The measurements of DO and pH were direct analysis at the river stream, for the measurement of pH in situ the pH meter is equipped with temperature sensors used Hanna HI 8242, while the DO meter was used Lutron DO-5510, all instruments are calibrated perior the measurements. The measurements jurney were done in two seasion, during June represent the dry seasion and December represent the rainy seasion at 2014. All 15 sampling points ranging from the upstream of Sugihan River at Riding, Pangkalan Lampam, OKI to the offshore region of Sugihan Estuary (figure 1).

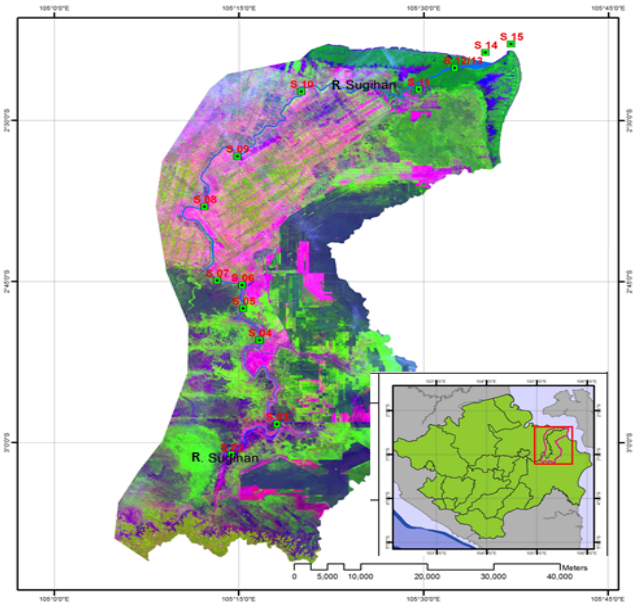

Figure 1. Map of river Sugihan region, OKI district South Sumatra, Indonesia. Filled cube indicate the sampling points/stations.

RESULT AND DISCUSSION

Trends in heavy metal concentrations

Dissolved oxygen is essential for the aquatic life. The presence of oxygen in the water is a positive sign because most aquatic plants and animals need oxygen to survive. DO can change during the day as a result of photosynthesis of different activities. Large daily fluctuations in dissolved oxygen is a characteristic of a body of water with extensive plant growth. During dry periods, the flow can be reduced, the air and water temperatures are often higher [1,3,5]. Both of these factors tend to reduce dropout rates. Figure. 2 shows the dropout rate of Sugihan River lower than 3 mg/L. The DO levels of Sugihan Rivers in dry seasion (DS) and rainy seasion (RS) did not show a pattern and significant diffrence values, the levels of DO at the point S1 and S2 are located in the upper stream of the river have relatively higher levels of DO ie. between 4 and 6 mg/L compared with levels of DO on other points along the river up to the estuary. DO value increased at the sampling point S14 and S15 does not indicate the DO real of rivers water, because at the points already in the estuary and has been influenced by the mixing of sea water. As the average values of DO in dry seasion was 1,97 mg/L while in rainy seasion was 2,57 mg/L, respectively. No significance

differences were found in dissolved oxygen content vertically between the surface and the bottom of the river, and horizontally a cross the river on the left-right edge of the river and the middle of the river [6].

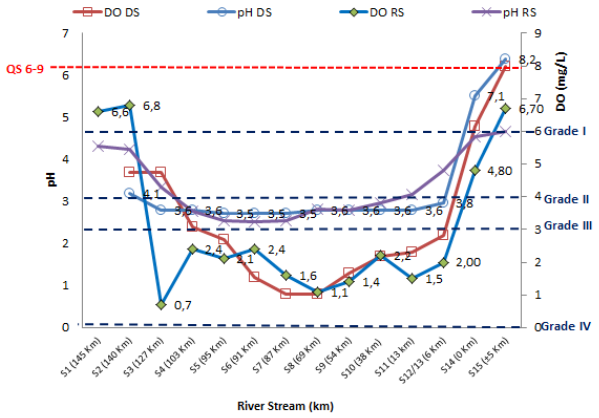

Figure 2. Concentration of DO and pH in dry seasion (DS) and rainy seasion (RS) in each sampling point of Sugihan Rivers

Beside DO, pH is an important parameter to aquatic life. Most organisms have adapted to life at pH ranging from 6.5 to 8.5. Runoff from agricultural areas, households and industry can contain iron, aluminum, ammonia, mercury or other species. pH of the water will determine the toxic effects of these metals, if any of these substances in water bodies. Especially the acetate group of water will cause heavy metals to be released into the water [7]. Figure 2 also shows the pH along the Sugihan River. pH of 25 km of river water upstream Sugihan pH decreased from 4.1 to 3.6 were then relatively constant for up to 6 km from the estuary in summer. pH in the rainy season rose slightly to 5.54 ie until 4.28 at 120 km from the mouth, which then stabilized in a pH range of 3.55 to 13 km from the estuary of the pH gradient increased to 4:08 which later became 4.80 at 6 km from the estuary. The average values of pH in dry seasion was 3,63 while in rainy seasion was 4,04 mg/L, respectively.

Acidification can cause low pH can cause the metals dissolved into water bodies and cause toxicity, such as aluminum, which will be leached into the water. One method to reverse the acidification is with calcification, but this is only a temporary solution. Another source of acidity in surface waters is mine water from sulfur, coal, iron, lead, zinc, and copper. Drinking water will have a pH lower mainly due to the presence of pyrite (FeS_2).

Pyrite reacts with air and water with the help of certain bacteria to produce sulfuric acid:

$$2FeS_2 + 7O_2 + 2H_2O \rightarrow 2FeSO_4 + 2H_2SO_4$$

Oxidation of iron (Fe^{2+}) to iron (Fe^{3+}) produce more sulfuric acid:

$$4FeSO_4 + 10H_2O + O_2 \rightarrow 4Fe(OH)_3 + 4H_2SO_4$$

Sulfuric acid soil can also act as a source of acidity under the appropriate environmental conditions. Sulfuric acid soil rich in pyrite (FeS_2) and they tend to occur in tidal marshes and coastal plains. when the drainage carries oxygen to this land, pyrite is oxidized into sulfuric acid according to the same reaction as shown above. Water pH can fall to the bottom 4 and the level of toxicity of aluminum released into the water potentially considerable danger for aquatic life. Acid sulfate soils are found mainly in tropical regions are derived from acid sulphate soils [8]. The effect of acid pollution include:

1. The destruction of aquatic life. Below pH 4 life on the water surface may be dead.
2. Improved corrosion. This can have an effect on the ship, the structure of building (eg, dock), and plumbing systems.
3. Damage to agricultural crops. If the irrigation water pH drops below 4.5 metals toxic to plants can be leached / leaching into water bodies.

In that case natural forests and peat lands as the role to contribute to the low pH degree from decomposition of biomass in peatlands, it's occurs naturally and form a swamp water ecosystem that is unique and has its own characteristics as the limiting factor for population in it.

CONCLUSION

This study investigates the distribution of DO and pH in the Sugihan River waters. The concentrations as the average values of DO in dry seasion was 1,97 mg/L while in rainy seasion was 2,57 mg/L, and for the pH degree was 3,63 in dry seasion and 4,04 in rainy seasion, respectively. Based on the DO and pH values, this study shown the natural forests and peat lands gave contribution to the low pH degree. The low of DO values also influenced by the pH, because decomposition in the peat lands made higher solubility of biomass to the rivers stream thus decreasing the ability of oxygen to penetration into the waterbody.

ACKNOWLEDGEMENT

The authors wish to acknowledge gratefully to the PPLH UNSRI and all team members of Sugihan Rivers Expedition and the financial support from PT. OKI Pulp and Paper Mill.

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