

Hydrogen Sulfide Distribution in Sediments Collected From Cockle Farm at Bandon Bay, Thailand

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Abstract— Hydrogen sulfide naturally occurs in the process of decomposing organic substances containing sulfur used by bacteria in anaerobic conditions. The study of hydrogen sulfide in the sediment of cockle farming area was aimed to determine the influence of the season and the area conditions to the amount accumulated in the soil. The collected samples covered the east coast and the west coast of Bandon Bay, Thailand, in rainy season (June and August 2013) and summer (March 2014). Six stations with seven layers of each 1 cm soil depth were assembled and total acid volatile sulfides (AVS) were analyzed. It was showed that the amount of AVS accumulated in the sediment in summer (0.008-0.379 mg/g) was higher than those in rainy season (0.001-0.282 mg/g) and the content in the east coast (0.019-0.379 mg/g), loamy clay soil, was higher than the sandy soil at the west coast (0.001-0.125 mg/g). The high concentration of AVS in June (0.235 mg/g) and August (0.282 mg/g) was found at the top level at 1-2 cm, while the layer of 6-7 cm appeared in March (0.379 mg/g). The soil pH was shown in the range of 6.17 to 8.37. It was indicated that characteristics of sediment effected the accumulation of AVS. Mud flat had capacity to hold organic content tending to stimulate the high process of degradation compared to sand soil. This will lead to the absence of oxygen in the sediment resulting to increase the amount of hydrogen sulfide showing by acidic condition.

Keywords— HYDROGEN SULFIDE, SEDIMENT, COCKLE, BANDON BAY

I. INTRODUCTION

SEDIMENT is the important habitat for organisms living in the surface and into the bottom ground. Characteristics of the sediment play an important role in determining the population structure, abundance and distribution boundary of organisms. Environmental factors influenced sediment and water qualities are mainly come from the activities in the sea and runoff from the coastal areas which gathered amount of organic matter and washed down to accumulated in the

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bottom. Organic matter is decomposed by microbes that require oxygen for the reactions. If the amount of oxygen is insufficient, the decomposition process without oxygen is required and hydrogen sulfide (H₂S) was produced. Sulfide in sediment is occurred in the form of hydrogen sulfide or iron sulfide. It is mentioned as the dangerous substance for the environment. High concentrations of sulfide can affect the respiratory and metabolic depression of organisms in the ground such as various types of shells [1].

II. MATERIALS AND METHODS

Sediment Sampling

The sampling sites were located at the east coast (stations 1, 2 and 3) and the west coast (stations 4, 5 and 6) of Bandon Bay, in rainy season (June and August, 2013) and summer (March, 2014) (Fig. 1). Sediment samples were collected at the cockle culture area by hand corer with three replicates and cut into 7 layers, each 1 cm depth, before kept frozen at -20°C until analysis.

Sediment analysis

Total acid volatile sulfides (AVS) and pH of the sediments were analyzed. AVS was assayed by changing sulfide in various forms (HS⁻, S₂⁻, FeS and FeS₂) into hydrogen sulfide (H₂S) using 18N sulfuric acid (H₂SO₄). The amount of hydrogen sulfide in the sediment was then measured using Hedrotek column (AVS test column). The analysis of pH was done according to [3]10 g of wet sediment was filled with 1N KCl 20-25 ml, mixed well and left for 30 min. The clear supernatant was measured with pH meter.

Statistical analysis

Data were analyzed by comparing average and analysis of hydrogen sulfide and pH in the sediment of each area, time (season) and sediment layers of collecting by analysis of variance (ANOVA).



Fig. 1 Sampling stations of cockle culture area at the east and the west coast of Bandon Bay, Surat Thani Province, Thailand

III. RESULTS AND DISCUSSION

Hydrogen sulfide in sediment of cockle area culture

Total amount of sulfide in soil demonstrated the accumulation of organic matter in soil and then digested in anaerobic conditions. The amount of in the sediment of cockle culture area was shown in the range of 0.001-0.282 and 0.008-0.379 mg/g in rainy season and summer, respectively (Fig. 2). The high amount of hydrogen sulfide showed in summer (mainly 6-7 cm depth) than in rainy season (mainly 1-2 cm depth) (Figure 3). The highest content of sulfide was occurred in sediment of station 2 because it was intensive cockle culture for a long time, resemble as [4]. However, our study revealed the difference from [5] which reported that high sulfide content was caught in winter, next to rainy season and winter, respectively.

Comparison with the area, it was found that AVS content in the east coast (0.019-0.379 mg/g) was higher than in the west coast (0.001-0.125 mg/g). It seemed due to the characteristics of soil in both areas. The east coast was quite clay soil, while sandy and sandy loam soil was occurred in the west. In the east coast, AVS contents occurred in the range of 0.019-0.235, 0.020-0.282 and 0.025-0.379 mg/g, in June 2013, August 2013 and March 2014 while the content in the west was 0.014-0.125, 0.001-0.026 and 0.008-0.103 mg/g, respectively (Fig. 2 and 3).

Hydrogen sulfide is a colorless, flammable and toxic gases smell like rotten eggs, even at low concentrations [6]. The toxicity of sulfide will affect macrofauna, especially animals that are of economic importance such as shellfish, and tended to decrease when the concentration of sulfides in the soil increased [1]. The increase of hydrogen sulfide content corresponded to the depth of the sediment. The higher accumulation was found in the deeper. It also found that the total amount of sulphide accumulation in sediments is proportional to the type, organic composition and total amount of organic matter in the sediment. Because the total amount of sulfide in sediment is caused by sulfate reduction process. The decomposition process of organic matter in sediments occurred in the absence of oxygen [7]. In nature, sand soil accumulated high concentration of hydrogen sulfide in the deep layer different from the high deposited near surface layer of clay soil.

It was found that pH of sediments in the east and west coast of Bandon Bay had distributed from light acid to alkaline and showed resemble amount from surface area to the deeper. The pH value of the sediment during rainy season played mild acid to neutral, while neutral pH to light alkaline was expressed in summer and not much different of pH was shown at the levels of soil depth. Sediment pH of the east coast was in the range of 6.86 to 8.35, 6.79 to 8.30 and 6.84 to 8.20 at a depth of 0-3, 3-6 and > 6 cm, respectively. And pH for the west coast was 6.41 to 8.07, 6.26 to 7.91 and 6.15 to 7.68 at the same depth. However, it was generally reported that appropriate soil pH for aquaculture was 6.5-7.5.

In conclusion, the accumulation of hydrogen sulfide was related to types, composition of sediment and organic matter deposited. It was found that in the east coast, loamy soil, the amount of hydrogen sulfide was higher than that in the west coast (sandy soil) and the occurrence of hydrogen sulfide was also associated with the season. In summer, hydrogen sulfide showed the high content than that in rainy season.

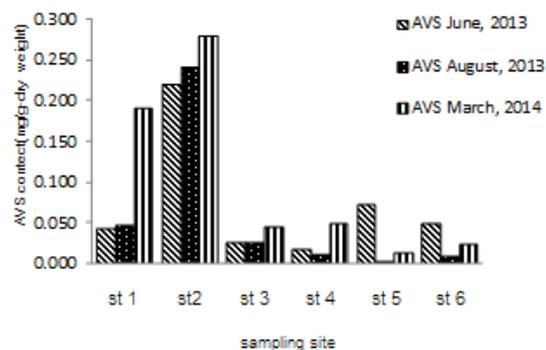
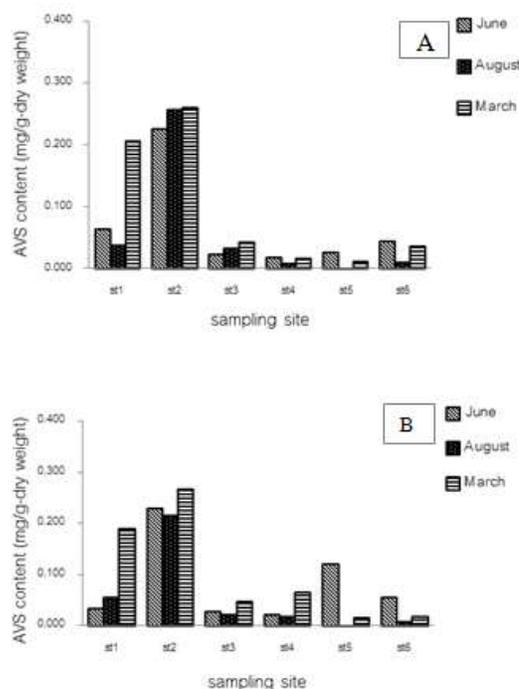


Fig. 2 Total acid volatile sulfides (AVS) average content in sediment collected from cockle farm in rainy season (June and August 2013) and summer (March 2014)



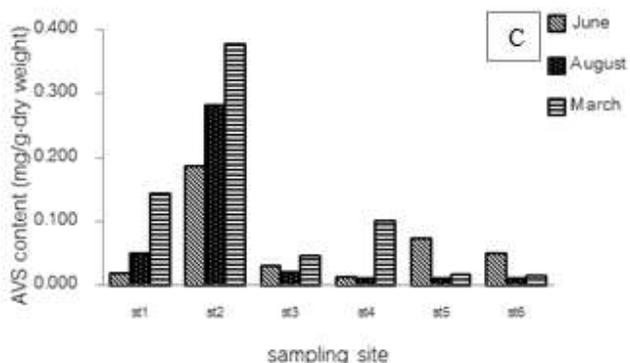


Fig. 3 Total acid volatile sulfides (AVS) average content in sediment layers; 0-3 cm (A), 3-6 cm (B) and > 6 cm (C)

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