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Original Paper

HYDROCARBON DISTRIBUTION IN SEDIMENTS OF JAKARTA BAY

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ABSTRACT

The analysis of sediments from stations 1, 29, 9, 15, 17 and 25 located in Jakarta Bay were carried out. Sampels were Soxhlet-extracted for 14 hours with methylene chloride : methanol (1:1), followed by saponification using KOH in methanol and benzene. Unsaponification parts were extracted using n-hexanes. Extracted samples were analyzed using gas chromatography with capiler column of SPB-1. From chromatogram results it was noted that the analysis of sea sediment sea from each station in Jakarta Bay indicate the distribution of n-alkanes in the range of C_{14}*-*C_{26} *which were dominated by an even carbon. From the results it is assumed that Jakarta Bay sediment may have natural hydrocarbon sources which may come from either the red or blue algae.*

Keywords : sediments, hydrocarbon petroleum

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INTRODUCTION

The pressure of industrial development and rising populations in coastal zone is resulting in the increase of pollutant loadings to the estuaries. Pathways of anthropogenic hydrocarbons into water bodies are diverse. In addition to oil spills, lakes and estuaries receive chronic inputs from a variety of sources including industrial discharge, marinas, urban-runoff, and atmospheric fallout (1,2).

Hydrocarbon in the marine environments come from natural and antropogenic hydrocarbon. Natural sources are divided into two categories, i.e. biogenic and diagenetic. In the biogenic process, hydrocarbon is formed from the activity of microorganisms with specific metabolisms or biosynthesis. Hydrocarbon that is formed from the biosynthesis process will be released to the sea or sediments by excretion through decomposition of dead organisms. Hydrocarbon from the diagenetic group is formed from the geology process in the sediments. Anthropogenic hydrocarbon comes from human activities i.e gassoline consumption for transportation, oil spills, oil transportation and off shore production. The hydrocarbon species, particularly aromatic hydrocarbon has a letal, sub letal and negatif effect toward sea organisms. About 5 million tones hydrocarbon come from oil production polluted the sea in the world every year (2,3).

Aliphatic hydrocarbons in estuarine and marine environments may be derived from both biogenic and anthropogenic sources. Significant amounts of aliphatic hydrocarbons can be synthesized by many biochemical processes occuring in both terrestrial and marine organisms. These biosynthesized hydrocarbons can be released into the environment by the organisms through metabolic activities or decomposition (2). The composition of aliphatic hydrocarbons found in the marine environment is often complex. Petroleum, in general, contains a complex suite of hydrocarbons with a wide range of boiling points. By contrast, biogenic hydrocarbons generated by biosynthetic pathways usually exhibit relatively simple patterns. Some hydrocarbons indices were thus developed and employed by several researchers in an effort to identify the possible sources of the contaminants (2).

Jakarta Bay is potentially to be polluted with the oil due to high traffic sea transportaion. Unfortunately identification and estimation of polluted oil in the sediments in Jakarta Bay has not been examined yet.

The research has conducted to identify the distribution of petroleum hydrocarbon in sediments sampel from several stations at Jakarta Bay using gas chromatography.

MATERIALS AND METHODS

Location and sampling time. Table 1 showed the location of the stations and sampling time in Jakarta Bay

Table 1. Location and sampling time

Stations	Sampling time	Depth (meters)
1	24 May 2004	3.5
29	26 May 2004	12
9	24 May 2004	3.5
15	26 May 2004	6
17	26 May 2004	9
25	28 May 2004	3

Reagents. dichlorometane, metanol, benzen, n-hexana, KOH, Na_2SO_4, alumina, activated Cu , phytane dan prystane.

Sampling. Surface sediment samples were collected from stations i.e 1, 29, 9, 15, 17 dan 25 from Jakarta Bay which is located in the east, middle, and west side **(Fig 1).** Samples were taken using grab sampler and part of the middle of the grab sampler were taken for the analysis. Samples were wrapped in aluminium foil and dried in atmosphere temperature. After drying the samples were grounded to powder form.

Extraction. Approximately 40 g of dry sediments were Soxhlet-extracted for 14 hours with methylene chloride : methanol (1:1).

Saponification reactions. Saponification reactions were carried out to remove the fatty acid and ester. The saponification reaction was done for 2 hours by using 25 ml of 0,5N KOH in methanol and benzene (1:1) and 25 ml of water.

Extraction and fractionation. Extraction process was done in separating funnel by using 25 ml of n-hexane two times. Sodium sulfat anhydrous was used to remove the water. Extract were vacuum evaporated to near dryness, desulphurized with activated copper and fractionated by activated alumina column chromatography (22 cm length, 0.5 mm inner diameter), and eluted with 45 ml of n-hexane. The eluate were evaporated until 1 ml and ready to inject using gas chromatography.

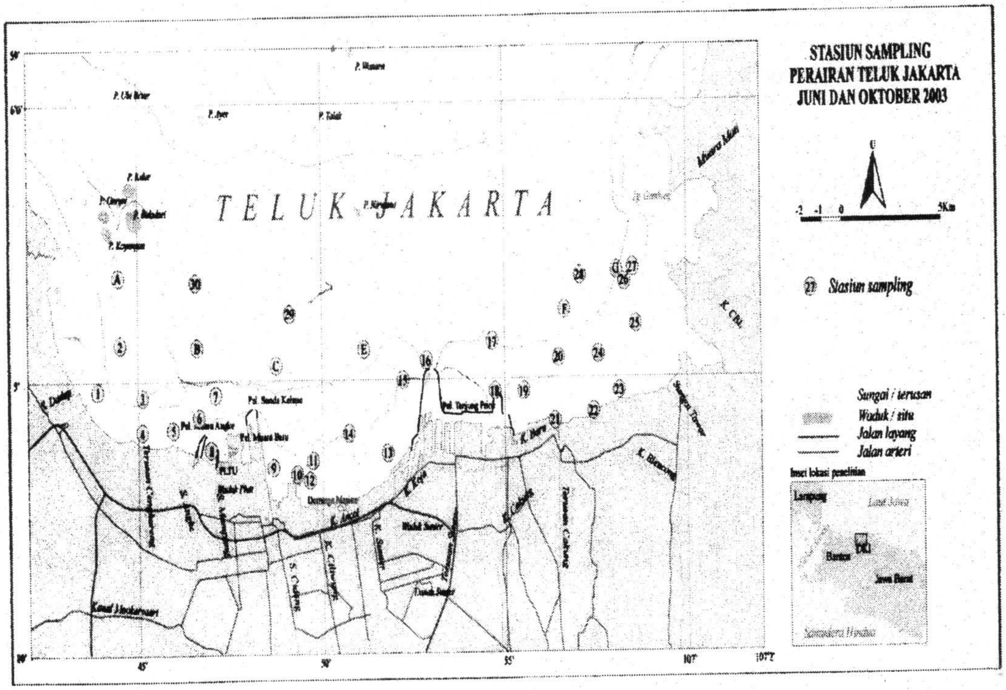

Fig 1. Sampling map location of Jakarta Bay

Determination of hydrocarbon distribution.

Hydrocarbon distributions were determined by cappilary gas chromatography with SPB-1 (60 m x 0.25 mm internal diameter). Nitrogen gas was used as the carrier gas, and injection temperature at 200°C. The oven temperature was programmed from 50°C at 3°C/minute, and detector temperature was 250°C.

RESULTS AND DISCUSSION

Determination of n-alkanes distribution

Prystane and phytane which confirm the petroleum related origin of the n-alkanes is given in **(Fig 2).**

The chromatographic patterns of the aliphatic hydrocarbons in the sediments of Jakarta bay were quite variable. Station 1 showed the distribution of n-alkanes from C_8 up to C26 with the exeption of n-alkanes that has C19, C21, and C25. The n-alkanes with chain lengths ranging from C15-C26 showed the domination alkanes with even carbon number towards alkanes with odd atom carbon **(Fig3).**

Station 29 showed the distribution of n-alkanes from C_8-C_{10} and C_{14}-C_{24}. At this range, alkanes with even carbon number inclined towards alkanes with odd carbon number. The chromatogram of n-alkanes with has an atom carbon of C_{19}, C_{21} and C_{23} was low **(Fig 4)**.

showed the distribution of n-alkanes from C_8-C_{10} and C_{15}-C_{26}. of station 9, the intensity of peak C_{17}, C_{21} dan C_{25} was low in the sample. The dominance of the n-alkanes with even carbon number towards an odd carbon number is in the range of C_{15}-C_{26}. **(Fig 5).**

Station 15 showed the distribution of n-alkanes from C_8-C_{10} and C_{15}-C_{26} with the exception of C_{21} and C_{25} . The dominance of the n-alkanes with even carbon number. towards an odd carbon number ranged of C_{15}-C_{26} **(Fig 6)**.

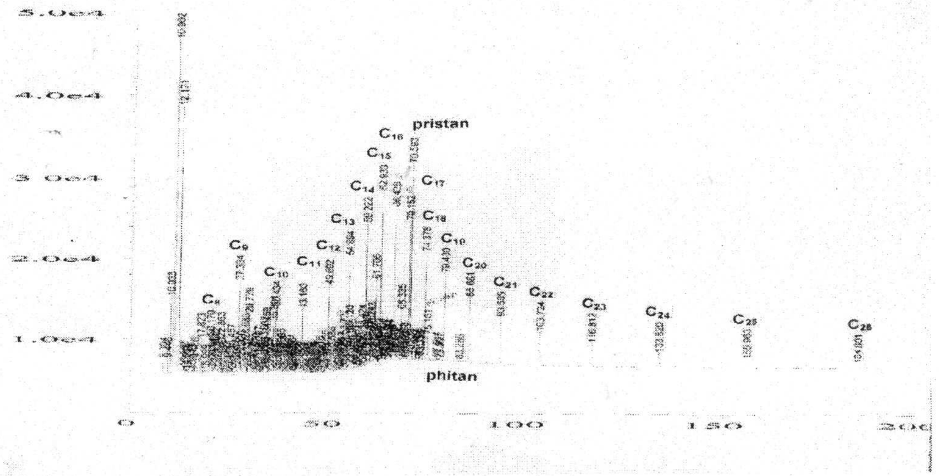

Fig 2. Chromatogram standard of pristan and phitan

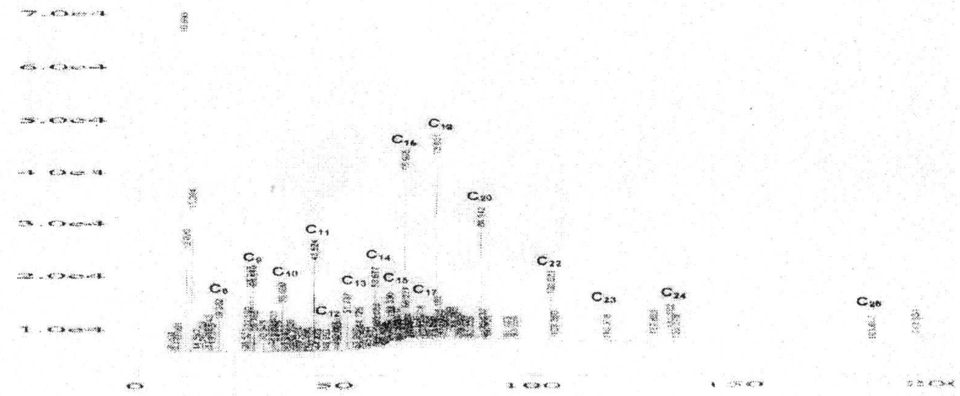

Fig 3. Chromatogram of n-alkanes from station 1

Station 17 has distribution of n-alkanes ranging from C_8-C_{10} dan C_{14}-C_{26}, but the peak intensity of C_{15}, C_{17}, C_{21} and C_{25} are too low. The dominance of the n-alkanes with even carbon number towards an odd carbon number ranged of C_{14}-C_{26} . The chromatogram could be seen in **(Fig 7).**

The distribution of n-alkanes from station 25 is presented in **(Fig 8)**. The distribution of n-alkanes is ranging from C_{15}-C_{26} . At this station the peak intensity of C_{21} dan C_{25} were low. The dominance of the n-alkanes with even carbon number towards an odd carbon number is in the range of C_{15}-C_{26}. The above data showed that distribution of n-alkanes was dominated with small molecular weight (less than C_{23}) therefore it is indicated that there are some organic material that come

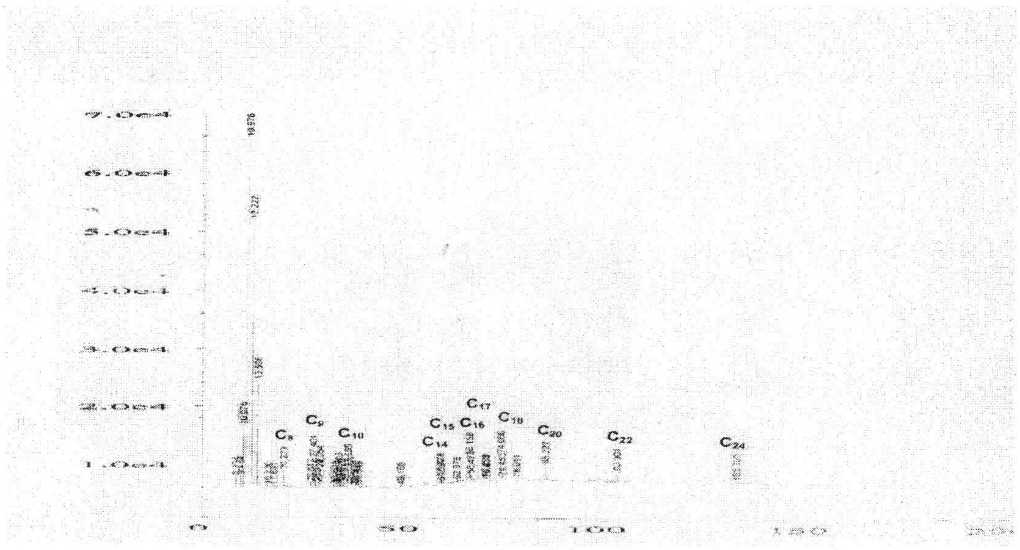

Fig 4. Chromatogram of n-alkanes from station 29

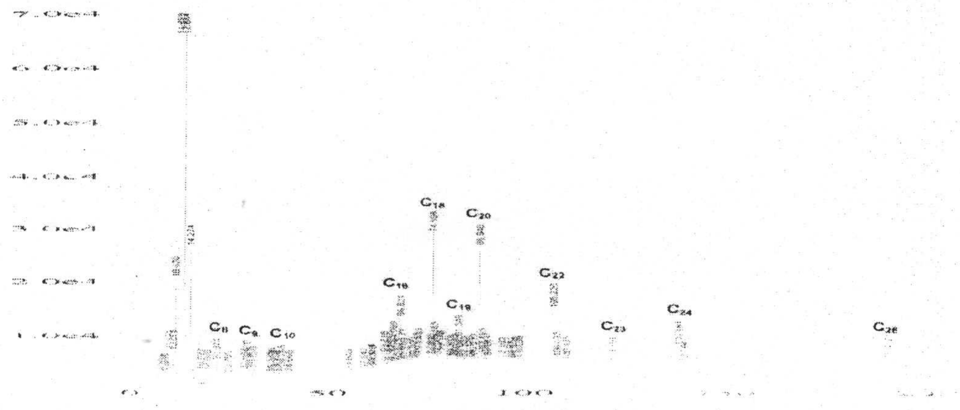

Fig5. Chromatogram of n-alkanes from station 9

from algae and some from zooplankton, bacteria, fungi and fish (1). Petroleum and fuels have n-alkanes distribution in the range of C_6-C_{12} and C_{10}-C_{28}, respectively. The presence of longer chain more than C_{28} alkanes is evidence that there are such compounds characteristic of higher plant wax (5).In unpolluted areas hydrocarbons associated with marine sediment are often a mixture of algal and other marine remains, and terrigenous plants. The distribution of hydrocarbons in aquatic sediment, especially the top 0-20 cm, generaly shows that most organic matter present in the samples has identifiable sources. The predominance of low molecular weight (smaller that C_{23} n-alkanes and fatty acid in gas chromatograms is indicative of organic matter derive mainly from algae and partially from zooplankton, bacteria, fungi and fish. However a predominance of high molecular weight (larger than C_{23}) is generally considered to be indicative of organic matter originating

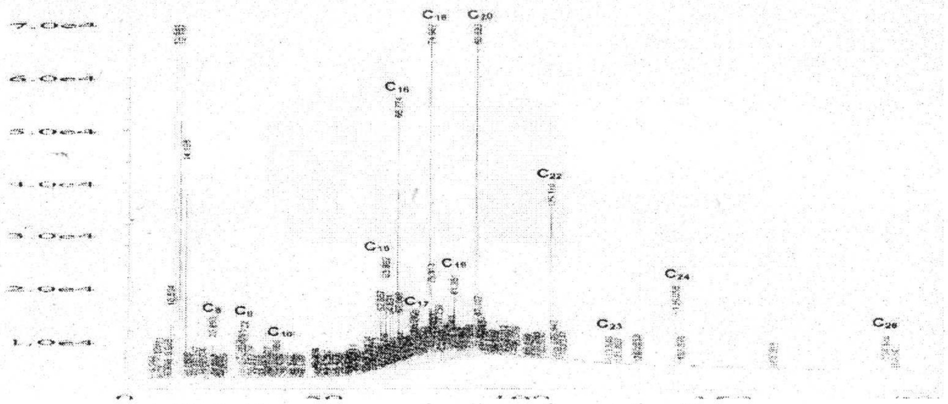

Fig6. Chromatogram of n-alkanes from station 15

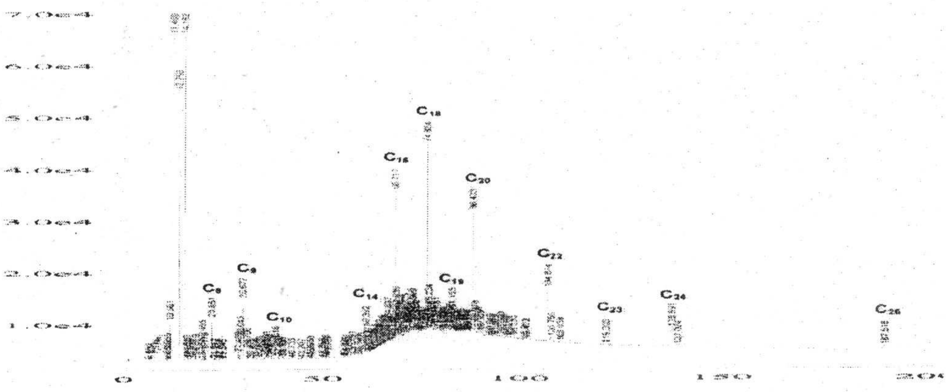

Fig 7. Chromatogram of n-alkanes from station 17

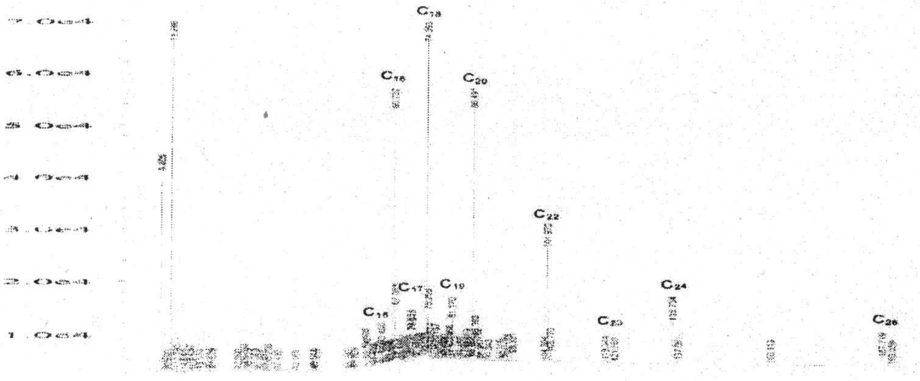

Fig 8. Chromatogram of n-alkanes from station 25

alkanes and fatty acid in gas chromatograms is indicative of organic matter derive mainly from algae and partially from zooplankton, bacteria, fungi and fish. However a predominance of high molecular weight (larger than C_{23}) is generally considered to be indicative of organic matter originating from land and aquatic plants (1) .

The chromatography gas results from all stations in general showed that the distribution of n-alkanes is in the range of C_{14}-C_{26} with the domination of alkanes with even carbon number towards alkanes with odd atom carbon. The source of n-alkanes may come from any other sources, one of them is cyanobacteria which has n-alkanes distribution in the range of C_{14}-C_{19}. On the other hand, the distribution of n-alkanes in the cyanobacteria was not dominated by an even carbon number. The distribution of n-alkanes in the range of C_{15}-C_{24} was obtained from red algae (*Rhodophyte*) with dominance of alkanes with even number (7), whilst the distribution of n-alkanes up to C_{20} was obtained from several blue algae species (*Cyanophyte*). It would seem logical to expect that a direct input from marine plankton is a more likely source of even carbon n-alkanes. It is suggested that sediments sample have hydrocarbon sources that come from red algae or blue algae. This data is strongly supported by the results of CHARLES, 1965 (8), that reported the domination of an odd carbon number alkanes were very low towards an even carbon alkanes in sea organisms. Furthermore it was stated that the presence of new sediments that have constituents of sea organisms has small n-alkanes distribution with the domination of odd carbon alkanes.

As examples predominance of even number n-paraffins in the range from C_{13}-C_{31} was observed in several sediment samples from the Arabian Gulf. AL-SAAD (1) reported that one sediment section of a core sample taken from the Black Sea which or exhibits, a maximum peak of C_{18} n-alkanes with a strong even to odd predominance. It is suggested that a transformation of fatty acids into saturated n-alkanes might have given rise to this phenomenon. Most all natural fatty acids have an even carbon number because these acids were biosynthesized from the asetil group that has two carbon atoms in the asetil coenzym. This might explain that an even carbon alkanes may originate from marine plankton (4).

One difficulty with the analysis of subtidal (less than 10 m depth) hydrocarbon data is distinguishing oil spill hydrocarbon from other sources both natural and anthropogenic (6). The analysis indicated that several weeks before the field sampling in the beginning of May 2004 a biogenic input possibly originating from red algae and blue algae due to the harmful algae bloom or red tide happened in Jakarta Bay.

Comparing of all the chromatogram it is seen that the distribution of n-alkanes is almost similar to each other. Therefore, it is assumed that the source of the hydrocarbon from all stations is similar. Station 29 was assumed as a control, because the location further away from the sampling location. From the results it is indicated that station 29 has the same distribution of n-alkanes as the other stations except that the intensity of the peak in station 29 is lower than the others.

CONCLUSION

From the results of this study it is concluded that distribution of n-alkanes could be determined from C_{14}-C_{26} with domination of an even carbon number in every stations in Jakarta Gulf. The analysis using gas chromatography indicated that sediments contains natural hydrocarbon which is assumed to be red algae (*Rhodophyte*) or blue algae (*Cyanophyte).*

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