Polynuclear Aromatic Hydrocarbon(PAH) and Total Aliphatic Hydrocarbon (TAH) in the Bottom Sediment of the South China Sea, Area I: Gulf of Thailand and East Coast of Peninsular Malaysia

Mohamed Kamil Abdul Rashid

Faculty of Applied Science and Technology, University Putra Malaysia Terengganu
Kuala Terengganu, Malaysia

ABSTRACT

Surface sediment (0-2cm) from 23 station in the Gulf of Thailand and the South China Sea were analysed for Polynuclear Aromatic Hydrocarbon (PAH), and Total Aliphatic Hydrocarbon (TAH). PAH was found to be in the range between 0.7047 mmg/g dry wt. (Stn 70) to 26.6066 mmg/g dry wt. (Stn 52) to 25.5314 mmg/g dry wt. (Stn 41). Long chain aliphatic hydrocarbon (n>20) were found to be dominant species in the most of the sample.

Introduction

Oil introduced into the estuaries, coastal waters and the open sea originates from a diversity of source. Of all the oil reaching the sea, approximately 45% is derived from river runoff, urban runoff, minicipal wastes, and the effluent from nonpetroleum industries. Activities related to oil transportation account for another 33% of the polluting oil (Kennish, 1994). According to Clark (1992), oil input originating from the users of petroleum product far exceeds that from extraction and transport industries which are reponsible for little more than 25% of the total input of oil in the sea.

Among the most widespread chemical contaminant in estuarine and nearshore environments are PAH, a group of ubiquitous compounds commonly occuring in bottom sediments, overlying waters, and biota, especially those in proximity to urban industrialized areas. PAH enter estuarine and nearshore marine environments via several routes, most notably sewage and industrial effluents,oil spills, creosote oil, combustion od fossil fuels, and forest and bush fires (Neff, 1979). Owing to their relative insolubility in waterand strong adsorption to particulated matter, PAH tend to concentrate in bottom sediments.

Law and Zulkifli (1987) have made a study on the distribution of petroleum hydrocarbon in the bottom sediments of the southern paert of the South China Sea and found that the mean concentration in the surface sedimen (0-8cm) was 42.92mg/kg dry wt. This result shows that the hydrocarbon pollution still at its early stage. However, Law and Saili (1988) found that the mean concentration of petroleum hydrocarbon in the surface bottom sediments (0-10cm) in the Sarawak water was 54.04 mg/kg dry wt. Which indicates that the pollution problem is taking place.

Material and Methods

Sampling

Sediment were collected with a Smith McIntyre grab on board the M.V. SEAFDEC in a joint oceanography study between SEAFDEC Thailand and MFRMD Malaysia. The sample were taken during the second cruise in April 1996. Aportion of the surface sediment (0-2cm) was removed with a precleaned stainless steel spatula. The sample were then store in aclean glass bottles wraped in clean plastic bag at -20^{0}C prior to analysis in the laboratory at UPM Terengganu.

Soxhlet Etraction

Wet sediment (10-20 g) was placed in a tared preclean cellulose thimble with 50 g of sodium sulfateas drying agent. The mixture was then spiked with 50 µl recovery standart and extracted with 200 ml CH_2Cl_2 for about 16 -24 hours.

TEL (Total Extractable Lipid)

After the extraction processes, the CH_2Cl_2 was then dried using rotary evaporator. About 1.0 ml of the remaining solvent was then transferred into the preweight teflon caplined vial. The flask was rinsed a few times . The solvent was then dried using nitrogen gas flow. The dried component was then weight to get the TEL.

Separation between TAH and PAH

Before separation , any sulphur presence in the sample was first eliminated using the copper column. Separation of TAH and PAH was done using a silica gel and alumina column. Basically tah was extracted using 30 ml hexane through the column while PAH was extracted using40 ml 50% hexane in CH_2C1_2. Both of the extracts were then dry using rotary evaporator and nitrogen gas flow about 1.0 ml . The sample were then ready for analysis using HP 6890 Series Gas Chromathography equipped with flame ionized detector (FID).

Result and Discussion

Due to equipment problem and the time constraint, only portion of the samples colleted during the second cruise were able to be analysed yet. The samples selected were those along the coastal zone of the Gulf of Thailand and the East coast of peninsular Malaysia. The concentration of TAH and PAH are shown in Table 1 and 2, respectively. TAH was found to be in the range between 2.1819 µg/g dry wt. (Stn.52) to 25.5314 µg/g dry wt. (Stn. 41). As a whole higher concentration of TAH was found in samples from the Gulf of Thailand if compare to those in the South China Sea. Station 39 shows the highest concentration of TAH followed by Station 41, Station 31 and Station 1 respectively. All of these stations were situated in the Gulf of Thailand. Long chain aliphatic hydrocarbon (n>20) were found to be the dominant species in most of the samples analysed which was dominanted by C28 compound, C24 and C30 respectively.

PAH was found to be in the range between 0.07047 µmg/g dry wt. (Stn. 70) to 26.6066 µg/g dry wt.(Stn. 1). As a whole the concentration of PAH shows the same trend as TAH where higher concentration was found in samples from the Gulf of Thailand especially in Station 1 (26.6066 µg/g dry wt) followed by Station 10 (21.7853 µg/g dry wt.) and Station 31 (14.1442 µg/g dry wt.) respectively. Compound containing the benzene rings were found to be dominant in most of the samples. These compounds such as Benzo(a)anthracene, Benzo(b)flouranthene, Benzo(k)flouranthene, Benzo(a)pyrene and Benzo(ghi)perylene were found to be high in concentration especially in samples from the Gulf of Thailand.

Conclusion

From these prelimenary result, there was a contrast different between the distributions of TAH and PAH in the coastal surface sediment of the Gulf of Thailand and the South China Sea. Higher concentrations of both these compounds were seen in samples from Gulf of Thailand. These result could be attributed to the higher concentration of population and higher human activities around the Gulf of Thailand. The physical conditions of the Gulf area such as its closed system with lack of mixing may also be considered.

Table 1. Concentration of TAH in the surface bottom sediment of the Gulf of Thailand and East Coast of Peninsular Malaysia

Concentration of TAH μg/g dry wt. with station

No.	Species	1	9	10	16	17	18	23	24	30	31	39	40	41	52	61	62	64	70	71	76	77	80	81	Total
1	C12																								
2	C14															0.046			0.022					0.029	**0.097**
3	C16	0.817	0.304	0.560	0.487	0.385	0.487								0.232	0.039	0.285	0.420				0.338			**4.351**
4	C17	0.295	0.097	0.169	0.109		0.209	0.093				0.134	1.140		0.050	0.056	0.046	0.064	0.058	0.081	0.065	0.100	0.074	0.089	**2.926**
5	C18	0.426	0.102	0.221	0.230	0.115	0.158	0.100	0.180	0.155	0.171	0.151	0.142	0.229	0.055	0.057	0.112	0.107	0.069	0.028	0.022	0.102	0.012	0.067	**3.009**
6	C20	0.633	0.279	0.313	0.354	0.156	0.450	0.138		0.198	0.283	0.248	1.250	0.323	0.099	0.086	0.109	0.243	0.126	0.209	0.298	0.116	0.037	0.116	**6.063**
7	C21	1.269	0.562	1.077	0.904	0.700	1.501	0.606	0.132	1.468	1.996	1.682	1.075	1.500	0.101	0.276	1.198	0.637	0.352	0.515	0.506	0.316	0.379	0.387	**19.138**
8	C22	1.968	1.030	2.303	1.949	1.083	2.803	1.297	0.303	2.429	3.099	3.424	2.410	3.216	0.214	0.591	0.427	0.998	0.737	1.075	1.040	0.498	0.802	0.586	**34.279**
9	C24	3.559	1.608	3.952	3.564	1.591	3.773	2.286	0.697	4.104	4.668	6.130	4.482	5.790	0.406	1.074	0.715	1.585	1.177	1.754	1.797	0.963	1.616	0.919	**58.209**
10	C28	4.812	1.769	4.056	4.513	1.523	3.511	2.102	1.083	4.102	4.316	6.838	4.469	6.309	0.539	1.059	0.672	1.399	1.416	1.915	1.913	1.169	2.237	0.824	**62.545**
11	C30	4.174	1.602	3.453	3.845	1.190	2.592	1.605	0.998	3.305	3.326	5.539	3.647	5.598	0.401	0.834	0.471	0.873	1.035	1.696	1.555	0.842	1.933	0.564	**51.074**
12	C32	1.143	0.701	1.624	1.030	0.426	0.901	0.690	0.388	1.454	1.274	1.846	1.629	2.568	0.086	0.302	0.145	0.265	0.232	0.709	0.535	0.177	0.489	0.119	**18.729**
	Total	**19.094**	**8.053**	**17.727**	**16.984**	**7.167**	**16.384**	**8.916**	**3.782**	**17.214**	**19.132**	**25.991**	**20.244**	**25.531**	**2.182**	**4.420**	**4.179**	**6.589**	**5.223**	**7.981**	**7.731**	**4.621**	**7.579**	**3.698**	**260.42**

Table 2. Concentration of PAH in the surface bottom sediment of the Gulf of Thailand and East Coast of Peninsular Malaysia

Concentration of PAH μg/g dry wt. with station

No.	Species	1	9	10	16	17	18	23	24	30	31	39	40	41	52	61	62	64	70	71	76	77	80	81	Total
1	Naphthalene																								**0.000**
2	Acenaphthlene															0.233									**0.233**
3	Acenaphthne																					0.459			**0.459**
4	Flourene																					0.073			**0.073**
5	Phenantherene										0.322					0.100						0.076			**0.498**
6	Anthracene						0.291	0.210	0.257	0.313	0.422	0.324	0.354	0.435	0.140	0.186	0.117	0.259	0.063	0.160	0.147	0.144	0.107	0.106	**4.035**
7	Flouranthene						0.208	0.237	0.420	1.024	0.223	0.328	0.410	0.537	0.083	0.125	0.085	0.210	0.090	0.221	0.718	0.144	0.096	0.165	**5.323**
8	Pyrene	1.227		3.602	1.604		1.057	0.519	0.277	0.846	1.243	0.385	0.756	1.158	0.300	0.483	0.193	0.724	0.028	0.392	0.421	0.246	0.331	0.146	**15.937**
9	Benzo(a)anthracene	7.012	2.268	4.809	1.909	0.236	0.502	0.347	0.113	0.387	0.554	0.821	0.306	0.890	0.033		0.040	0.098		0.139	0.137	0.027			**20.626**
10	Chyrsene		1.386				0.236	0.163		0.242	0.386	0.331	0.295	0.462	0.064	0.115	0.070	0.146		0.101	0.089	0.077	0.086	0.082	**4.293**
11	Benzo(b)Flouranthene					0.315	0.208	4.432		7.844	6.627	4.874	4.332	0.354	1.172	1.390	1.170	0.109		0.084	0.075	0.868	1.133		**34.985**
12	Benzo(k)Flouranthene		2.931				0.280	0.291	1.740	0.426	0.521	0.355	0.235	0.651	0.089	0.105	0.102	0.192	0.392	0.134	0.120	0.086	0.084	0.648	**9.379**
13	Benzo(a)pyrene	11.363		7.903	3.554	0.314	0.384	0.342	0.209	0.657	0.535	0.542	0.429	0.541	0.119	0.142	0.159	0.269		0.151	0.165	0.152	0.083	0.110	**28.123**
14	Indeno[1.2.3-cd]pyrene	4.332	1.197	3.126	1.508	1.161	1.838	0.073	0.533	0.151	2.023	1.681	1.563	0.325	0.026	0.468	0.574	0.127	0.087	0.056	0.050	0.364	0.383	0.156	**21.802**
15	Dibenz[a,h]anthracene					0.238								0.476	0.119					0.115	0.150				**1.097**
16	Benzo[ghi]perylene	2.672		2.345			1.277	1.120	0.336		1.287	1.099	1.048	2.751	0.439	0.290	0.406	0.680	0.045	0.695	0.487	0.257	0.245	0.099	**17.579**
	Total	**26.607**	**7.782**	**21.785**	**8.575**	**2.265**	**6.280**	**7.733**	**3.886**	**11.888**	**14.144**	**10.741**	**9.728**	**8.543**	**2.582**	**3.635**	**2.915**	**2.812**	**0.705**	**2.247**	**2.557**	**2.970**	**2.549**	**1.511**	**164.440**

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