

**THE NATURE AND CHARACTERISTICS OF SUSPENDED  
PARTICULATE MATTER IN THE GULF WATERS  
AT AL-KHOR, QATAR.**

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**ABSTRACT**

The whitening of the Gulf water at Al-Khor and several other shallow areas is a common phenomenon of the Arabian Gulf. In other areas of the world, like the Bahama Banks, this phenomenon appears to be due to suspended carbonate particles in the water column. At Al-Khor, suspended particulate matter samples were collected and the nature and characteristics of these particulate matter were studied. It was found that the concentration of suspended matter varied between 15 mg and 25 mg/l, and was mainly of calcium carbonate. Particle size analysis showed that most of the particles were in the clay size range. However, the particles tend to flocculate to form aggregates of larger sizes, ( $>8 \mu$ ).

The characteristics of the suspended matter, that is its ability to absorb nutrients, particularly phosphate ions, were investigated. It was found that its capacity was low and may be compared with coarse sand from other areas.

The study is of importance with regard to productivity and pollution studies in the area.

**INTRODUCTION**

Suspended particles in sea water are a major source for bottom sediments. They are also one of the main pathways by which various dissolved ions may be removed from sea water to be incorporated into marine sediments. The nature and characteristics of suspended particles determine to a large extent the type and composition of bottom sediments. However, many other factors affect the removal of dissolved ions from sea water by these particles; temperature, salinity, particle size, concentration of dissolved ion and concentration of suspended particles are among these factors.

In the Arabian Gulf it has been reported that patches of whitening appear occasionally in shallow waters where the depth is less than 10 m. Description of these patches was given (Houbult, 1957), however, no samples were collected in order to investigate the nature and characteristics of the particles forming them. The author, however, compared these patches with those formed in other recent carbonate depositional environments on the Bahama banks and Hawaii. Detailed discussions of these environments are given by Cloud (1965).

Patches of whitening appear frequently around Qatar peninsula, however, observations indicated that at Al-Khor area this phenomenon appears more frequently, almost all the year round. Because of the importance of suspended matter as a possible pollutant remover, and the possibility of setting fish farms in this and similar coastal areas, the present study was introduced in order to investigate the nature and characteristics of the particulate suspended matter in Al-Khor.

## MATERIAL AND METHODS

### A- Samples Collection

Suspended matter samples were collected from Al-Khor area, a narrow shallow water body ca. 50 Km to the north of Doha. It is about 6 Km wide and 12 Km long, with an average depth of 3 m. Waters from the Gulf enter the area through a deep narrow channel to the east. The channel has a maximum depth of 5.5 m (Figure 1 a,b). During high tide, the water level rises about 50 cms.

Water samples were collected from the surface water near the pier in 6 l plastic bottles. Thirty liters of each sample were collected and transported on the same day to the laboratories of the University at Doha.

250 ml of each sample were filtered through pre-weighed membrane filters for total suspended matter content determinations. Sediment was washed with distilled water, until chloride free. The membrane filters were then dried to constant weight.

Suspended matter from 25 l samples was separated by decantation followed by filtration through GFC. The sediment was washed chloride free, then dried at 70 C° for 48 hours. The suspended matter collected was ground very gently in an agate mortar in order to break down aggregates without affecting the particles shape or size. Aliquots of the sediment samples were used for absorption studies.

### B- Methods of Analysis

Particle size analysis was performed on the samples using sedimentation technique (Beltagy, 1969). The carbonate content was determined by acetic acid treatment of the sample, followed by back titration of the excess acid. Phosphate was determined colorimetrically as described by Strickland and Parsons (1972).

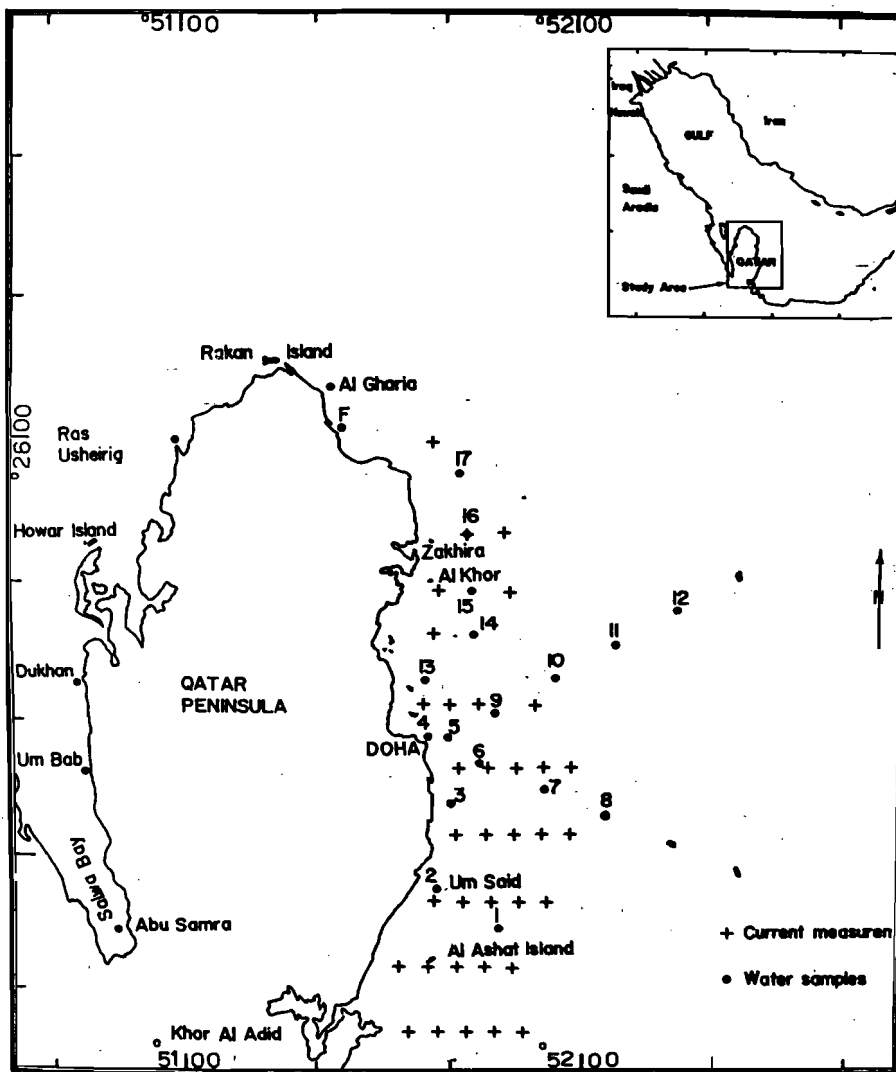


Fig. 1 a. Study area and locations of sampling stations.



Fig. 1 b. Aerial photograph of Al-Khor area.

Absorption experiments were carried out on the suspended matter samples using trace element free sea water as described by El-Sayed, (1977).

## RESULTS AND DISCUSSIONS

The suspended matter content of the waters varied between 15 mg and 25 mg/l (an average of 21 mg/l). Higher concentrations were observed at noon, while lower values accompanied high water in the area. Physical and chemical parameters of the water in terms of temperature, salinity, pH and oxygen content of the surface and bottom waters were almost constant during the presence and absence of the whitenings which pointed to the absence of turbulence and bottom disturbance (Table 1).

Particle size analysis performed on three suspended matter samples showed that most of the particles were in the clay size range i.e. smaller than  $2 \mu$  (Table 2). However, in salt water, particles tend to flocculate forming aggregates of larger sizes. At the normal salinity observed in the area (ca. 43 ‰) these aggregates had a diameter greater than  $8 \mu$ . Because of the shallowness of the area, and the high settling rates of the particles acquired by flocculation, suspended particles are quickly removed from the water column, and high sedimentation rates occur in the area. This is indicated by the oxidizing state present in the upper 10 cm of the bottom sediments; below this level, reducing conditions prevail, and  $H_2S$  and organic rich sediments are observed.

Chemical analysis showed that the suspended particles were mainly carbonates (average 93 ‰). These carbonates are likely to be deposited from the water. The high concentration of suspended matter in the area accompanying high water temperatures at noon, and stable stratification of the water column indicates that suspended particles have been chemically separated from the water itself; probably due to the escape of  $CO_2$  from the water due to high temperature and or high photosynthesis rate at this time.

The characteristics of suspended particulate matter from the area, as to its capacity to absorb phosphate ions shows that it has a very low capacity - less than 0.1 mg/gm (Figure 2). This may be compared with sands from other areas. The amount of phosphate ions absorbed increases with phosphate ion concentration in the sea water, and the amount of suspended matter present in the water (Figures 3 and 4). Salinity has very little effect on the amount of phosphate removed by the suspended matter (Figure 5).

TABLE 1  
SUSPENDED MATTER CONTENT AND OTHER OCEANOGRAPHIC PARAMETERS AT AL-KHOR

Date & Time	Wt. of suspended matter in mg/l	Water temperature		Salinity ppt		Oxygen ppm		pH	
		surface	bottom	surface	bottom	surface	bottom	surface	bottom
Dec.									
7 AM*	3.0	18.3	18.3	42.8	42.8	6.13	6.10	8.10	8.10
9 AM*	5.0	19.5	19.4	42.8	42.8	6.31	6.28	8.20	8.20
11 AM*	19.0	22.0	21.5	42.9	42.9	5.22	5.22	8.30	8.30
1 PM†	20.0	23.7	23.2	43.0	43.0	4.31	4.31	8.35	8.35
3 PM†	22.0	24.5	24.3	43.0	43.0	5.64	5.64	8.35	8.35
May.									
6 AM*	7.0	20.0	19.8	43.2	43.2	5.95	5.95	8.15	8.15
8 AM*	8.0	22.0	21.7	43.2	43.2	6.10	6.10	8.20	8.20
10 AM*	15.0	23.4	23.4	43.3	43.3	5.60	5.60	8.25	8.25
12 Noon†	22.0	24.7	24.6	43.3	43.3	4.80	4.80	8.25	8.25
2 PM†	23.0	17.0	26.9	43.3	43.3	4.70	4.70	8.25	8.25
4 PM†	25.0	27.0	26.9	43.3	43.3	5.40	5.40	8.25	8.25

\* High tide  
+ Low tide

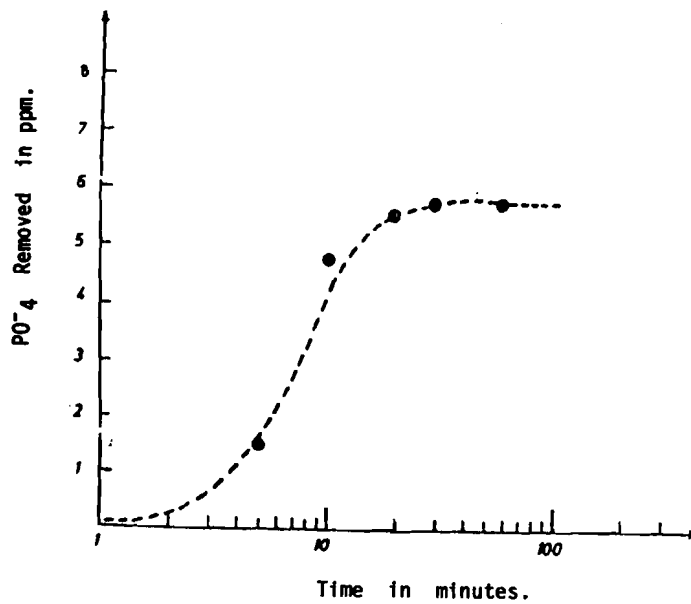


Fig. 2. Variation of the amount of phosphate absorbed with time.

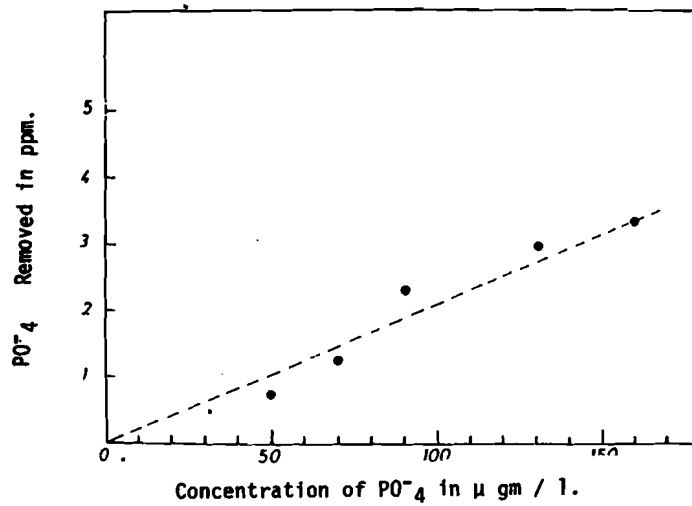


Fig. 3. Effect of the phosphate ion concentration in sea water on the amount of phosphate removed by suspended particles.

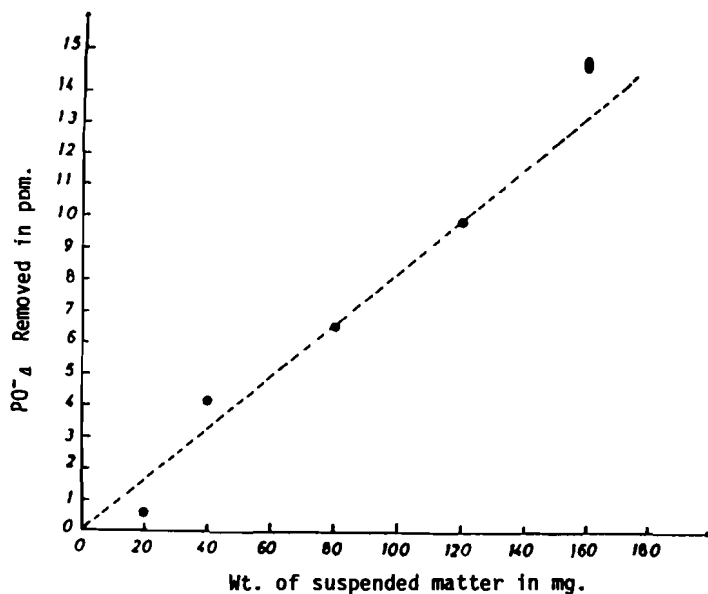


Fig. 4. Effect of suspended particulate matter concentration on the amount of phosphate removed from sea water.

TABLE 2  
PARTICLE SIZE ANALYSIS OF THREE SUSPENDED MATTER  
SAMPLES FROM AL-KHOR Wt. %

Particle size range:	Sample No. 1	Sample No. 2	Sample No. 3
> 16 $\mu$	1.6	2.0	0.0
8-16 $\mu$	3.0	1.0	0.0
4- 8 $\mu$	6.0	6.0	3.0
2- 4 $\mu$	6.0	11.0	3.0
< 2 $\mu$	84.0	80.0	94.0



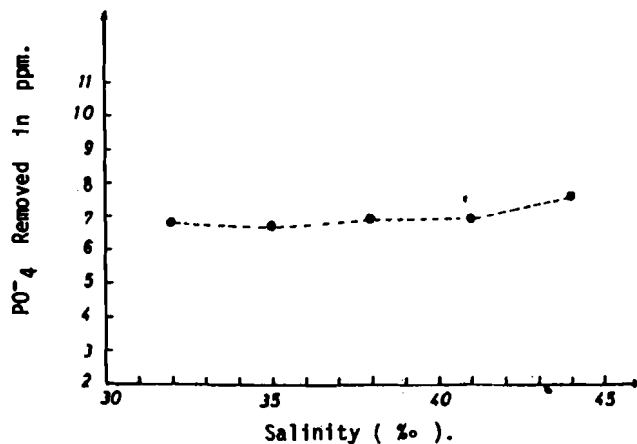


Fig. 5. Effect of salinity on phosphate absorption from sea water.

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