Iraqi Geological Journal 53 (2E), 2020: 107-116
Http://igj-iraq.org ISSN 2414 - 6064

PHYSIO-CHEMICAL PROPERTIES OF TIDAL FLATS SEDIMENTS IN IRAQI COASTLINE, NORTHWEST OF ARABIAN GULF

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Received: 19June 2020; accepted: 12 October 2020

ABSTRACT

The quantitative and qualitative physic-chemical properties considered in more than 15 geographical sites were selected along the Iraqi coastline. The grain size analysis and the EC, pH, TDS, K, Na, Mg, Ca, HCO_3, Cl, SO_4 were estimated in the sediments sample. Three types of soil textures dominate which are sandy clay, sandy clay loam and clay loam were observed in the present study. The results show that the pH value ranges from7.67-8.19, EC (23-68.45 dS/m), TDS (14720-43808 ppm), Na (6388-20746 ppm), K (73.225-211.875ppm), Ca (306.25-537.5 ppm), Mg (675-2475ppm), Cl (6160-18350 ppm), SO_4 (1680-4080 ppm), HCO_3 (93.75-225 ppm), SAR (37.61-107.95). The analytical results for the surface samples presented the impact of both solodization and salinization processes. They are shown from the high values of EC and domination of Na in the exchangeable complex. The ions occur in the following concentration order: Na > Mg > Ca > K and Cl > SO_4 > HCO_3.
Keywords: Mangrove; Physio-chemical; Tidal flat; Iraq; Arabian Gulf

INTRODUCTION

Some properties of the sediment's tidal flats such as sediment dynamics, the biogeochemistry and the physicochemical are dependent on the interactions between chemical, physical and biological properties, including tidal currents, storm waves, sea flows, air contact, ice-scour in the winter and dryness in the summer. Therefore, a better understanding of physic-chemical properties like pH, conductivity, salinity, etc. in the sediments seem to be particularly important issues of research on pollution assessments (Chowdhury et al., 2019).

The distribution of particle size in coastal sediments can give information about the nature and environment of sedimentation processes and their transporting (Rashedi and Siad, 2016; Al-Kaaby and Albadran, 2020). The texture and sediment salinity are the main factors controlling the distribution and ecology of recent fauna (Shareef, 2015).

The sediments textural, amount of anaerobic situation and salinity of the surface layer have a significant effect in then mangrove growing and establishing of seedlings (Shahid, et al., 2004). Sediments salinity can be recognized as a critical factor controlling in survival growth, restoration and zonation in species of mangrove (Semeniuk, 1983; Al-Khalf and Al-Saad, 2019).

The plant establishment success in these lands differs according to variances in the ecological situations (Almulla, 2013). The Coasts of Iraq along the Khor Zubair and Shatt Al-Arab are developing areas. The discharge of water from ships, boats ballast water discharges and the marine action of transporting are important pollutants sources in this part of the Arabian Gulf. Although, industrial, and agricultural dredging additional of pollutant sources in this coastal area. Activities like that along the Iraqi coasts will cause many types of pollutants.

According to Hassan (2018), the relatively high levels of pollution in Kour Al-Zuber tidal flat sediments due to anthropogenic sources such as untreated wastewater and oil spills. The coastal and estuarine sediments typically like a sponge receiving the metals by sorption on the suspended matter and subsequent sedimentation (Abdulnabi et al., 2019; Hassan et al., 2008). Mangrove are salt-tolerant halophytic trees have the potential to planting in intertidal zones (Fig.1). A few studies indicated that planting of mangroves in the coastal land can increase yields of fish species and ma fauna (Al-Nafisi et al., 2009; Bhat et al., 2007).

Fig.1. Some types of mangrove tree

Avicennia marina, commonly known as grey mangrove or white mangrove, is a species of Mangrove tree classified in the plant family Acanthaceae (formerly in the Verbenaceae or Avicenniaceae). As with other mangroves, it occurs in the intertidal zones of estuarine areas (Fig. 1 and Table.1).

Table1. Scientific classification of mangrove trees

Kingdom	Clade	Clade	Clade	Clade	Order	Family	Genus	Species
Plantae	Tracheophytes	Angiosperms	Eudicots	Asterids	Lamiales	Acanthaceae	Avicennia	A. marina

How can be planting mangrove? can be useful in Iraqi coastal? These areas are exposed to continuous erosion operations, which causes the loss of coastal lands (Khalifa, 2019). The marine resources and coastal are major importance to Iraq, so that any coastal improvement plants will may enhance the economic and ecological sustainability of that resources, so mangrove plantations is useful because of its portability stabilized a significant amount of naturally accreted coastal land (Uddin et al., 2019. Almulla (2013) shown that few locations have good chance for mangrove plantation along Kuwait Bay. Mangrove growth may have affected by other soil Physic-chemical parameters that are soil grain size, salinity, redox potential, pH, organic carbon and temperature could also influence the rate and abundance of species distributed in them (Almulla, 2013; Almulla et al., 2013; McLusky & Elliott, 1981). The sediments structure additionally assumes a significant job in the circulation of the creatures that live in or on them (Atobatele et al., 2005; Khan, et al., 2001). In this study the physical and chemical properties was surveyed to determine the environmental characteristics in the region in order to find the suitability of cultivation in the Iraqi coasts.

MATERIALS AND METHODS

Sampling and Sites

Samples of surface sediments were collected in summer 2015 from 15 representative points duplicates for each site, throughout the Iraqi tidal flats on the North West Arabian Gulf (Fig. 2). GPS and other devices have been used for sampling. The sediments put in bags of polyethylene. In the laboratory, the sediments air dried than sieved through 200 µm of stainless steel. The samples were ready for analysis. The areas which the studied sediment samples were taken are not cultivated with mangroves.

Analytical Methods

The sediment samples were analyzed for grin size analytical (sand, silt and clay) using pipette method as described in Black (1965). Soil texture calculator use this online tool to calculate a single point texture class based on percent sand, silt, and clay (USDA).

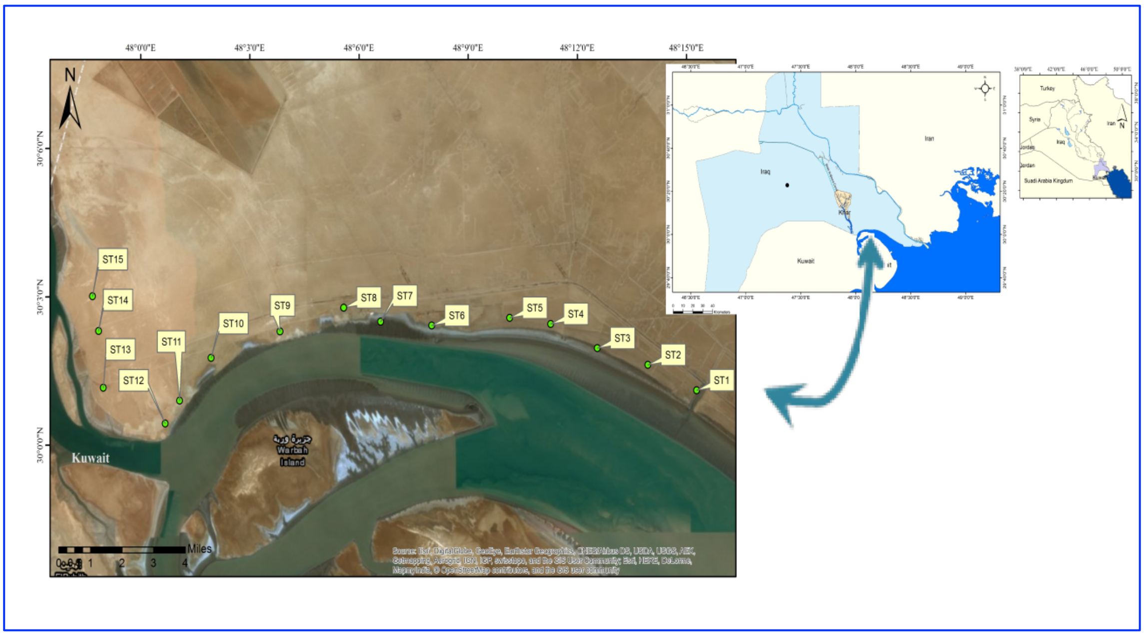

Fig. 2. Sampling station in the study area

Soil: water ratio (1:2) extraction used to measure pH, Electrical Conductivity (EC) they measured as soon as the extracts are prepared, using EC and pH WTW (Multi -meter 3410 Set C, Germany). In this extraction selected cation like Potassium (K), Sodium (Na). They determined by using flame photometer (JENWAY PEP7). Calcium (Ca), Magnesium (Mg) titrated with 0.01N Na_2EDTA, and some of anion such as Chloride (Cl) determined by titration with 0.01N $AgNO_3$. Sulphate (SO_4) is determined by double- beam spectrophotometer (UV-Vis) type (Japan, PC, Shimadzu1800) using turbidity method. Bicarbonate (HCO_3) determined in the same soil extract by titration with 0.01 N H_2SO_4. The techniques and methods followed for analysis and interpretation were according to the standard procedures (Sparks et al., 1996). Sodium Adsorption Ratio (SAR), the cation in meq/l unit was calculated as to the following equation.

$$SAR = \frac{(Na^{+})}{\sqrt{\frac{(Ca^{2+}) + (Mg^{2+})}{2}}} \qquad (1)$$

The importance of calculating the SAR is due to its effect on the movement of water in the soil and washing operations in addition to the sodicity risks and it gives an idea of the exchanged sodium concentration. (Klopp et al., 2020; Awadh and Ahmed, 2013). The mean, Standard deviation (SD), Standard error (SE) and one–sample T test were analyzed statistically using SPSS software V.20 (Table 2).

Table 2. Statistical analysis, one sampled T test

One sample T test statistics	Mean	Std. deviation	Std. error mean	t	Sig. (2 tailed)
Na mg/l	13946.31	4207.61	1086.40	12.837	.000
K mg/l	133.25	42.69	11.02	12.090	.000
Ca mg/l	405.42	78.38	20.24	20.033	.000
Mg mg/l	1310.00	526.43	135.92	9.638	.000
HCO_3 mg/l	140.18	36.13	9.33	15.026	.000
Cl mg/l	12037.67	3573.13	922.58	13.048	.000
SO_4 mg/l	2598.40	683.14	176.39	14.731	.000
SAR	76.73	18.43	4.16	14.581	.000
SO_4/Cl	0.23	0.09	0.02	9.562	.000
%sand	46.93	12.96	3.35	14.020	.000
%Silt	15.57	7.66	1.98	7.876	.000
%Clay	37.50	10.21	2.64	14.228	.000
PH	7.88	0.16	0.04	196.001	.000
EC dS/m	43.94	12.11	3.13	14.053	.000
TDS ppm	28121.60	7750.13	2001.07	14.053	.000

RESULTS AND DISCUSSION

Analysis of Particle Size

Texture of 15 sediment samples were analyzed. Three types of soil textures dominate; they are sandy clay loam; clay loam and sandy clay were observed in the present study. As displayed in Fig. 3 and Table 3. The sand is ranged from 21.63% in station 4 to 75.85% in station 12. The silt ranges from 3.40% in station 11 to 26.95% in station 8 while clay is ranged from 19.82% in station 12 to 64.27% in station 4. The sediment samples have varied textures. Muttashar et al. (2010) noted that the sediments coast in Khor-Abdullah, have great clay ratios (65-85%). Shareef et al. (2015) noted that the soil texture for Khor Shitana, Umm Qaser, Khor Al-Zubair and Al-Faw are sandy silt, clayey silt, silt, sandy silt and mud.

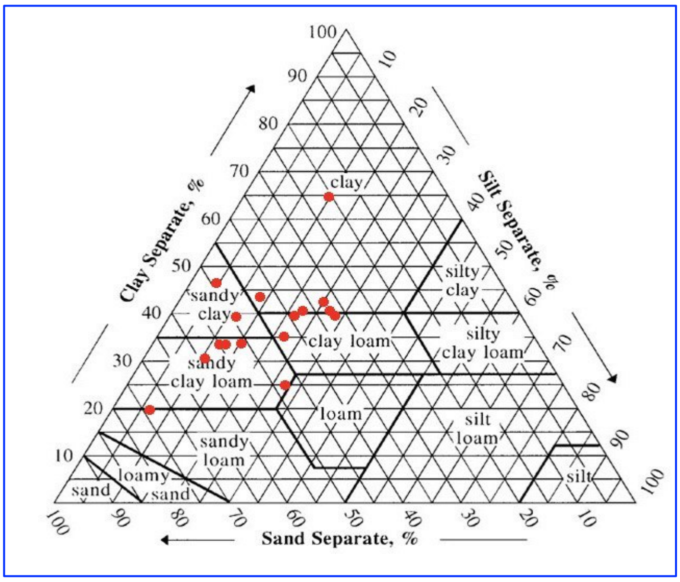

Fig 3. Distribution of sediment samples texture in textural triangle

Table 3. Textural classes for selected sediments samples

Soil samples	Sand%	Silt%	Clay%	Soil Texture Class
St1	44.06	21.28	34.66	Sandy Clay loam
St2	33.48	24.48	42.04	Clay loam
St3	38.00	21.84	40.16	Clay loam
St4	21.63	14.09	64.27	Clay
St5	50.25	11.00	38.75	Sandy clay
St6	52.17	14.67	33.16	Sandy clay
St7	40.02	21.00	38.98	Clay loam
St8	33.68	26.95	39.37	Clay loam
St9	48.93	26.70	24.37	Sandy clay loam
St10	60.14	9.85	30.01	Sandy clay loam
St11	50.40	3.40	46.20	Sandy clay
St12	75.85	4.33	19.82	Sandy loam
St13	44.26	12.38	43.36	Sandy clay
St14	54.94	11.09	33.97	Sandy clay
St15	56.08	10.52	33.40	Sandy clay

Al-Shahwan et al. (2009) showed that the recent sediments coastal of Khor Abdullah and Khor Al-Zubair are mainly composed of silt and mud. Abas et al.(2019); Al-Kaaby and Albadran (2020) concluded that the type of sand sediments Northwest of the Arabian Gulf is within the river environments and it was brought from the river (Shatt Al Arab) by tide currents during the declining of the sea-level. Both marine and terrestrial interaction processes give the coastal sediments their textural, and the main characteristics of the coastal sediment's precipitates (Pickrill, 1986; Al-Jaberi and Mahdi, 2020).

Physical-Chemical Properties of Sediments

The pH and EC were analyzed in the sediment samples. The results in Fig.4. noted that pH ranges between 7.67 and 8.19, it is neutral to slight alkaline, maximum pH value was recorded in coastal sediment and lower value was registered in sediments close to the river mouth. The high values of pH are indicative of the sediments rich with carbonate. which depend on the calcium carbonates concentration (Awadh and Ahmed, 2013; Awadh, and Abdul Al-Qhani, 2014). The higher values may be due to shallow water levels which causes more salinity and high pH, consequently because the levels of carbonates and bicarbonates (Al-Kazaeh et al., 2008). These results agree with Al-Kazaeh (2005), he found the pH ranges between 7.7 and 8.3 in the sediment samples which collected from tidal flats. The Shatt Al-

Arab river and North West Arabian Gulf. EC level is one of the important factors which has been taken into consideration in a range research conducted on the mangrove.

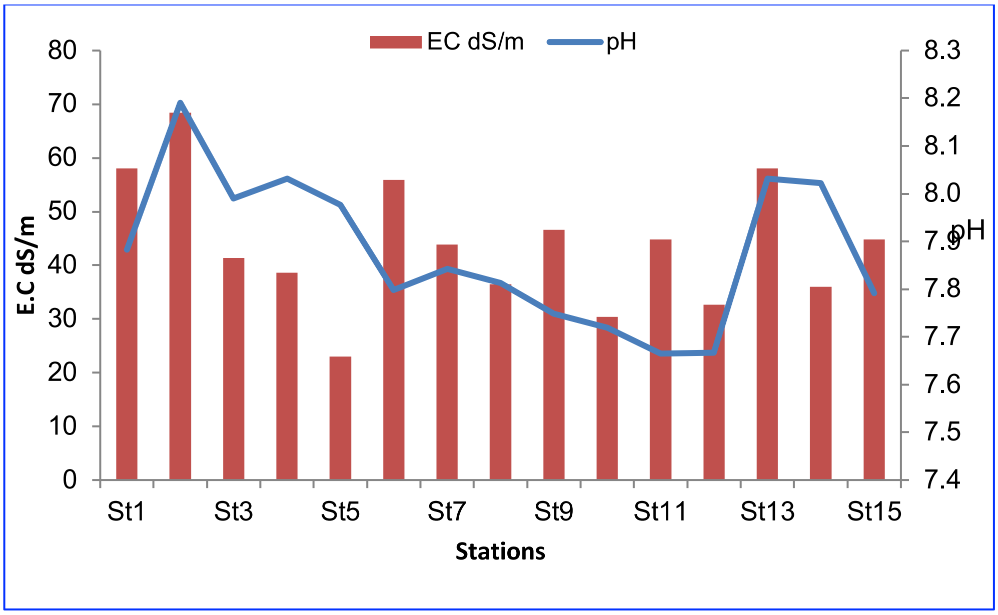

Fig. 4. Distribution of the EC and pH values in the sediment samples

Anions and Cations

Potassium, sodium, magnesium, calcium, bicarbonate, chloride and sulfate. There was a significant varied between stations. Sodium ranged from 6388 in St8 to 20746 mg/l in St6, Potassium concentration 73.225 in St3 to 211.875 mg/l in St13. Calcium reaches to 306.25 in St10 to 537.5 mg/l in St2. Magnesium extends to 675 in St5 to 2475 mg/l in St13. Chloride varies from 6160 in St8 to 18350 mg/l in station St13. Sulfate differs from 1680 in St12 to 4080 mg/l in St3 and bicarbonate ranged from 93.75 in St4 to 225 mg/l in St1. The values of SAR ranged between the highest value (107.95) in St1 and the lowest value (37.61) for St8 (Table 4).

The analytical results for the surface samples are presented the impact of both solodization and salinization processes. They are shown from the high values of EC, domination of Na in the exchangeable complex and the value of SAR. The ions occur in the following concentration order:

Na > Mg > Ca > K and Cl > SO_4 > HCO_3. The salts rising in the sediments correlated to the common action of tidal flat, the similar proportions of the ions in the sediment and seawater are due to seawater action (Gomes et al., 2016; Al-Khalf and Al-Saad, 2019). The SO_4/Cl indicated that chlorite dominate mineral (Table 4). Monograph can grow in different environments and sediment with extended range of chemical and physical properties.

Table 4. Chemical parameters of sediment samples

Stations	Na	K	Ca	Mg	HCO_3	Cl	SO_4	SAR	SO_4/Cl
	mg/l								
St1	18885.88	144.08	481.25	1100.00	225.00	15750	2064	107.95	0.13
St2	19309.43	201.71	537.50	1450.00	151.25	16375	2928	97.69	0.18
St3	11384.45	73.23	356.25	875.00	141.50	8750	4080	73.49	0.47
St4	13161.18	106.79	356.25	712.50	93.75	10500	2448	92.11	0.23
St5	10109.75	76.28	412.50	675.00	142.50	8000	2784	70.90	0.35
St6	20746.50	113.57	537.50	1412.50	193.75	17250	3408	106.09	0.20
St7	16119.23	130.52	343.75	1012.50	163.75	13250	2496	98.35	0.19
St8	6388.50	101.70	368.75	1087.50	103.75	6160	1920	37.61	0.31
St9	12193.65	118.65	387.50	1025.00	106.25	10625	1728	73.24	0.16
St10	11002.85	123.74	306.25	1087.50	93.75	9125	3264	65.73	0.36
St11	13086.75	203.40	375.00	1000.00	156.25	11105	2256	79.64	0.20
St12	10258.60	127.13	381.25	2062.50	137.50	10625	1680	45.65	0.16
St13	20076.68	211.88	537.50	2475.00	143.75	18350	3264	80.85	0.18
St14	13086.75	120.35	343.75	1762.50	125.00	12125	2256	62.82	0.19
St15	13384.45	145.77	356.25	1912.50	125.00	12575	2400	61.83	0.19
Al-Mmulla (2013)	5475-19890		333-1411	773-2056	17-211	14387-34782		29-217	

there is about 70 to 84 different species of mangroves worldwide but only two species may be found in the Arabian Gulf (Alongi, 2009). That is possibly due to its extreme conditions increasing of seawater hyper salinity and temperature during the last three decades in the northwestern Arabian Gulf (Almahasheer, 2018). Rhizophora mucronata and Avicennia marina can be found In Iran and other three species (Van Lavieren et al., 2011), but only Avicennia marina of mangroves species can be seen on the Arabian side Abu Dhabi, UAE, and in few Arabian gulf countries (Almahasheer, 2018; Burt, 2014).

Mangroves are one of the few ecosystems of woodland that live in hot-arid climates. They can survive extreme conditions of high solar radiation, low precipitation, hyper salinity and wide temperature fluctuations.in arid climates could help sustain their valuable ecosystem services (Adame, 2020 and Awadh and Ahmad, 2012). Natural healthy ecosystems coastal, like marshlands of saltwater, mangrove forests, and seagrass meadows provide a vast array of important co-benefits to coastal communities around the world, including throughout the Arabian Peninsula. These benefits include ecosystem services such as a rich cultural heritage, the protection of shorelines from storms erosion or sea-level rise food from fisheries, maintenance of water quality and landscape beauty for recreation and ecotourism (Almahasheer, 2018).

Chaikaew and Chavanich (2017) found that the 6.95 > pH < 8.01 and 1.88> E.C < 5.28 dS/m are good properties to grow Monograph in wetland soils in part of the upper northeastern Gulf of Thailand, while Almulla (2013) in his study in Kuwait coast indicated that the sediments position suitability range between highly to moderately suitable, depending on the certain location boundaries, the highly suitable with sediment, on the other hand 53.4> E.C < 87.1 dS/m, that a high value of EC compared with other studies show that the suitable EC is no more than 7 dS/m, but Kuwait still does not have mangrove forests on its coast. Al-Kazaeh et al., (2008) have reported EC of 27 to 88 dS/m in sediments samples collected from the same zone Iraq tidal flat. Unfortunately, these values are higher than the values that allow to grow mangrove. Several studies have indicated that EC values more than 7 dS/m cause decreasing mangrove plantation.

A comparison of the results of Al-Mulla (2013) show that the physical and chemical properties of the Kuwait coastline like those of the Iraqi coast. Also, the climate and weather conditions for the region are similar, therefore there is a great chance to cultivate the Mangrove in the Iraqi coasts with choosing areas far from pollution and can be managed easily. Sediment samples in this study have various textures sorting as sandy clay and clay loam sediments. That is good point because mangrove forest has negative correlation for sand, and a positive relationship for clay, and a neutral correlation with silt (Chowdhury et al., 2019). According to Almulla (2013), the fine textured soils are better than the muddy clay loam in plantations mangrove, mangrove can be developed sediment deposition since the aerial root system of mangroves is rapid. It is possible that the reason hindering the growth of the mangrove plant in Iraqi coastal lands is the high salinity. should try to cultivate it on Shatt Al-Arab River zone., which is more suitable for its growth.

CONCLUSIONS AND RECOMMENDATIONS

plantation of mangrove on the Iraqi coast is so important for several reasons:

first to prevent the land from eroding, second to stabilize the new environment, third as mangrove can filter inland water when it flows to the seawater and working as elementary habitat for deferent kinds.

According to the founding result, mangrove can plantations in this area, even with insensitive climatic circumstances. Mangrove plantations can successful with suitable management in some zone on the Iraqi coast and, by using salinity tolerant mangrove species.

ACKNOWLEDGMENTS

The authors are grateful to the Editor in Chief Prof. Dr. Salih M. Awadh, the Secretary of Journal Mr. Samir R. Hijab and the Technical Editor Dr. Heba S. Al-Mimar for their great efforts and valuable comments.

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