Iranian Journal of Engineering Geology
Spring 2021, Vol.14, No.1

Geological Engineering Studies of Marine Sediments, Northwestern Persian Gulf

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Abstract

Having knowledge about geological and engineering properties of marine sediments, is very important to perform stability analysis of offshore structures. In this paper, the geological engineering characteristics of marine sediments (from seabed to a maximum depth about 30 meters below seabed) was investigated in three oil and gas fields located in the northwestern Persian Gulf. In the first step, geotechnical database of study area was developed based on studies carried out by marine geotechnical labs and oil companies in Persian Gulf. Then, the distribution of physical and mechanical properties of marine sediments with depth and also their relation to the other parameters were studied and some graphs and geological/geotechnical profiles were drawn. The results showed that the physical and mechanical characteristics of these sites are influenced by the distance from the Iranian coast, water depth and distance from Arvand Rud river delta. Generally, from siteI to siteIII, the grains size, and liquid limit of fine-grained and strength of subseafloor sediments were increased. The thickness of soft sediments was decreased from siteI to siteIII. By evaluating the percent of carbonate content, it was found that with distance from the coast, the percent of carbonate content in subseafloor sediments were decreased. So, the least amount of carbonate content was observed in site III. According to the result of PI versus PL/LL graph, Illite is the most abundant clay mineral in the study area.

Keywords: *Persian Gulf, Marine Engineering Geology, Subseafloor sediments.*

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Extended Abstract:

1. Introduction

General knowledge about geological conditions of installation site of marine structure and its surrounding area, can helps offshore geotechnical engineers to gain a general view of potential hazard and also performing a better interpretation the result of engineering tests, studies and analysis. The investigation of physical and mechanical properties of subseafloor sediments can be used for construction a geological engineering model that can show the spatial uniformity of seabed properties across the study area. The purpose of this paper is to study geological engineering conditions of subseafloor sediments in three oil and gas fields in northwestern Persian Gulf.

2. Materials and methods

In order to study the geological engineering properties of subseafloor sediments in three oil and gas fields in northwestern Persian Gulf, geotechnical and geological data and information were gathered and organized into a database. The maximum depth of offshore boreholes in this study is about 30 m. below the seabed. The physical and mechanical parameters which studied in this paper include sediment type, moisture content, submerged unit weight, porosity, carbonate content, internal friction angle, shear strength, and Atterberg limits. Physical and mechanical properties of subseafloor sediments have been studied from shallow water depth area near coastline towards deeper part near the Arvand Rud river delta.

3. Result

The abundance and lateral/vertical distribution of sediments were studied in two groups of fine grained and coarse grained sediments. The particle size of the sediments was increased from siteI to siteIII. The majority of sediments in study area included: silty clay (siteI), clay and sand (siteII) and silty sand (siteIII). The distribution of moisture content, submerged unit weight, porosity and carbonate content with depth for sitesI, II and III were investigated. A detailed assessment of the data reveals that average moisture content and porosity in the siteI is greater than other sites. The siteI has the highest moisture content and lowest submerged unit weight (8 KN/m2). The highest average of submerged unit weight was observed at siteIII (9.2 KN/m2). Carbonate content is generally decreasing from siteI to siteIII. The minimum amount of carbonate content were observed at siteIII. The plasticity of sediments were increased from siteI to siteIII. The most common mineral at all three sites is Illite. Small amounts of Kaolinite and Halloysite have also been identified at these sites. Montmorillonite is indicated in very small amounts at siteIII.

The thickness of soft sediments is decreasing from siteI to siteIII. The average values of undrained shear strength in study area is about 33 KPa at siteI, 85 KPa at siteII, and 200 KPa at siteIII,. Also the average values of the internal friction angle from siteI to siteIII have indicated about 20, 25 and 33 degrees, respectively. Based on geological and geotechnical information, the geological engineering model of study area was prepared and variation of sediment type and strength along siteI, II and III was indicated.

4. Conclusion

In this research, the physical and mechanical properties of subseafloor sediments in three oil and gas fields (siteI, siteII and siteIII) in northwestern Persian Gulf was investigated and geological engineering model of study area was prepared. Based on analysis carried out in this paper, the following results were obtained.

- The grain size of sediments is increasing from siteI to siteIII. The majority of sediments in study area include: silty clay (siteI), clay and sand (siteII) and silty sand (siteIII).
- The thickness of soft/loose sediments is decreasing from siteI to siteIII. The majority of sediment undrained shear strength values in study area are less than: 50 kPa at siteI, 280 kPa at siteII and 475 kPa at siteIII, up to about 30 m beneath the seabed. Also the average values of the internal friction angle from siteI to siteIII have indicated about 20, 25 and 33 degrees, respectively.
- The most common mineral in study area is Illite. Small amounts of Kaolinite and Halloysite have also been identified at these sites. Montmorillonite is indicated in very small amounts at siteIII.
- Carbonate content is generally decreasing from siteI to siteIII. The minimum amount of carbonate content have observed near Arvand Rud river delta.
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