Chemical-Physical Mechanism of Marine Sediments

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Abstract. The target material of this study is the marine depositions from Eastern Seas of Zhejiang. The comprehensive experiments were implemented to discover the chemical-physical mechanism and the micro-fabric of the target material. The results of this study will help many maritime explorations such as geophysical prospection, coastal reinforcement, resource exploitation as well as marine structure establishment.

1. Introduction
The sediments in Zhoushan coast from eastern seas of China are the complicated ones as for the storage, the physics, chemical, the chemistry as well as the biologics [1,2]. Under the influence of tidal current, ocean current and seabed denudation, the dynamic evolution characteristics of marine sediments in the eastern Zhejiang sea area are remarkable[3]. Mastering the main physical and chemical mechanisms of Marine sediments is of guiding significance for the study of seabed geological movement, Marine biological distribution, Marine environmental evolution and Marine energy development in eastern Zhejiang [4].

2. Physical and chemical properties of seawater
The physical and chemical properties of seawater have a large impact on the performance of marine sediments. The eastern Zhejiang sea is located at the mouth of the Yangtze River, and the closer it is to the seabed sedimentary layer, the greater the net adsorption between the soil suspended matter in the ocean current [5-6]. The salt content of each 1kg of sea water reaches 11.2g, which can cause sudden flocculation of particles.

The ocean current environment at the sampling sites is generally weak alkaline and the content of sodium salt is relatively high, which results in the marine sediments in this area having a significant micro-structure. If the external environment is abnormally disturbed, the microstructures of marine sediments will be destroyed and their physical and chemical properties will also undergo changes.

3. Chemical properties of marine sediments
The pH value of Marine sediments in the eastern Zhejiang sea area was between 7.35 and 8.36, the content of organic matter is high and the content of humic acid is 0.75%. It is an alkaline marine organic soil. The total salt content of marine sediments is as high as 11.2%, and the marine properties are remarkable. X-ray diffraction analysis of the microscopic mineral phase of marine sediments shows that: marine sediments generally belong to quartz ore facies (SiO₂), accompanied by the main
mixing phases are calcium carbonate (CaCO₃), sodium chloride (NaCl), and contains trace amounts of radioactive material. Affected by ocean current transport and seafloor temperature and pressure changes, the extremely trace elements Al and Mg often form silicate minerals.

4. **Hydrological properties of marine sediments**
The appearance of marine sediments is gray-black, with a fishy odor and delicate particles. Marine organism residues are commonly found in the samples. According to the investigation, it can be concluded that the plastic limit of the marine sediments is 32.3%, the liquid limit is more than 40%, and it has the characteristics of high moisture content, high liquid limit, high plastic limit and so on. At the same time, the liquid index of marine sediments in this area is up to 4.5, which has all the hydrological characteristics of marine flow mud.

According to the experimental results, the relative mass ratio of the liquid phase to the solid phase of marine sediments in the natural state is more than 50%. It can be seen that the key to the utilization of this kind of material is the control of its liquid phase, which includes not only the drainage consolidation, but also the liquid phase control. It also includes the spatial and temporal allocation of the hydrologic environment in the domain.

5. **Physical properties of marine sediments**
Marine sediments in the natural state are shown in Figure 1, and a large number of living and remnant marine organisms can be identified by naked eye.

The specific gravity bottle method is used to test the specific gravity of marine sediments. Because of the rich content of soluble salts, organic matter and hydrophilic colloidal particles in marine medium, kerosene is used instead of pure water. The specific gravity of marine sediments was 2.71, while the natural density of marine sediments was only 1.11 g/cm³.

6. **Granular structure of marine sediments**
The natural marine sediments taken at the site were tested by laser particle size analyzer and the particle size structure was analyzed. The results showed that the natural marine sediments in the eastern Zhejiang sea have extremely fine particle sizes, and most of the particle sizes are in the range of 10-20μm. Part of the soil particle size is even less than 1μm, which is a chemically active silicate particle. In addition, the content of clay with particle size less than 0.005mm is 34%. It is obvious that the key to engineering utilization is to control the fine-grained marine sediment particles, and accelerate the discharge of liquid phase in the micro-pores to promote solidification.

7. **Microstructure of marine sediments**
The microscopic physical morphology of wet marine sediments was tested by environmental scanning electron microscopy. A typical SEM image is shown in Figure 2. It can be seen that the marine characteristics of natural sediments are remarkable, and the needle-like and crumbly water-soluble salts are intertwined with the colloidal rubber particles. The flaky quartz mineral is surrounded by
acicular calcium carbonate granules, and the outermost layer is adhered by the debris of the marine sodium chloride substance. The micro-pore development of the micro-scale, which can be filled by a marine component with very unstable properties at any time, can weaken the water permeability of the sediment.

Figure 2. SEM image of marine sediment

8. Conclusion
The density of natural marine sediments in the eastern Zhejiang sea is extremely low; the sodium salt content in sediments is generally high and the microstructure is significant. The sediment belongs to the alkaline quartz mineral phase, and the liquid limit and plastic limit are high. Most of the fine particles contained in marine sediments are chemically active silicate particles with a particle size of less than 1μm. The microscopic pores thus formed are abnormally developed, and there are many marine debris in the pores, which makes the permeability of natural marine sediments extremely weak.

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