Frictional Strength between Casing and Cement under Confining Pressure

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ABSTRACT

Push-out tests were performed on specimens made of cement and steel rod. These specimens were simulated a part of interface of methane hydrate production well. From the results of push-out test, frictional strength was considered for the dependences of the roughness of steel rod and effective confining pressure.

KEY WORDS: Push-out test; interface; cement; frictional strength; surface roughness; effective confining pressure.

INTRODUCTION

Methane Hydrate (MH) is considered to be one of the potential energy resource in the near future (Makogon, 1982; Kvenvolden, 1988; Kvenvolden et al., 1993; Boswell et al., 2011). In the project of methane gas extraction from the MH bearing sand sediment in marine sediments, a production well is drilled into the sea floor from a marine platform. The depressurization method has been proposed as a method of extracting methane gas (Yamamoto, 2009). This method is most effective technique in terms of gas productivity and economical efficiency. In this method, depressurization is initiated by discharge of water from the production well and then decrease of lowering water head level. The pressure gradually decrease from the neighborhood of well to surrounding layers and MH dissociation occurs. It is predicted that the sediment deformation and consolidation occurs due to MH dissociation and increases of effective stress during depressurizing operation. Consolidation and deformation of seabed ground wreck negative friction on the production well. As a result, that may cause the shear failure, tension failure and gap of interface. These failures lead to the buckling of the well and flow channel initiation, eventually, it may cause the problem such as gas leakage and depressurization impediment. Therefore, in order to prevent these problems, it is necessary to understand the frictional strength of the interface between the well and strata.

The production well has three types of interface as shown in fig.1. Those are between the casing and cement, the casing and sediment, and the cement and sediment. In the laboratory experiment, Karasawa et al. (2007) conducted to measure bond strength between the casing and cement under the no effective confining pressure condition. And they said shear strength and about the effect on the adhesion strength due to the additive amount of muddy water. However, the frictional strength of the interface under high confining pressure has not been cleared. In this study, specimens were made to simulate the interface between the casing and cement using steel rod and cement, and push-out test was carried out on these specimens under the different effective confining pressure. In addition, different conditions of roughness of steel were also considered.

PUSH-OUT TEST UNDER ATOMOSPHERIC PRESSURE

Preparation of Specimens

In order to simulate the interface between the casing and cement, specimens were made using steel rod and cement. Fig.2 shows