ABSTRACT

For a well in Indonesia, a completion packer was set above top of cement in a 3 ½ in monobore production string. Following the Operator’s operating procedure, the packer was pressure tested after the cement placement. Three days after the cementing job, the packer was tested again. These tests contributed to damage the cement sheath integrity, including the generation of a microannulus. This was validated by cement stress analysis. This analysis evaluates the stresses applied to the cement sheath, and the result showed a failure in traction and the existence of a microannulus due to these pressure tests. With packer failure, the flow paths that are created could cause the hydrocarbons to migrate to the surface or to be trapped below the wellhead, leading to a pressure buildup.

Therefore, self-healing cement was proposed to fill the gap and give a contingency barrier to the well integrity. This self-healing cement system is based on a responsive material with intrinsic self-healing properties automatically activated upon hydrocarbon exposure that rapidly seals the hydrocarbon path. The system has properties equivalent to conventional cement systems and requires no modifications to standard surface equipment. Within hours, the downhole well integrity is restored, thereby reducing the health, safety, and environmental risks plus the extra costs associated with remediation of these problems, including loss of production.

The self-healing cement system was successfully pumped in the 3 ½ in monobore production string. This was the first application of self-healing cement in Indonesia, and it was successful in achieving zonal isolation, even in the case of a packer failure and cement sheath traction failure due to pressure tests performed on the well after the cement had set.

INTRODUCTION

The SAPI area is one of a gas field development area in Kalimantan, Indonesia. It is located in east part of the Kalimantan Island. The exploration started in 2000, and development has been start since 2006. This area is one of the main sources of gas production in Kalimantan to date. The well type in the SAPI area is a monobore well type Figure 1. It uses a 3 ½ inch monobore completion string with a single monobore packer. The completion string is cemented to right below the monobore packer.

CHALLENGES AND PROBLEM ANALYSIS

Monobore packer is the secondary barrier after cement sheath integrity. The packer is set right after cementing job is done. To ensure the packer is properly set, pressure test should be taken right after the cementing job and then re-test the packer after 3 days of cement is hard set. Validated by cement sheath stress analysis software, this pressure testing of hard cement could increase the possibility of the cement sheath crack and generate a microannulus Figure 2.

Loss of cement sheath integrity could give a path for unwanted hydrocarbon gas to flow. Furthermore if the monobore packer fails, this path will lead to a serious problem if the gas flows up to surface. Self-healing cement (SHC) was decided to be used to mitigate this issue.

SELF-HEALING CEMENT

The self-healing cement (SHC) system is a responsive material that the repair is initiated when hydrocarbon fluid originating from the formation comes into contact with the SHC additive. This is a