MECHANICAL CONTROL OF ANNULAR GAS FLOW,  
A CASE STUDY AND WAY FORWARD ANALYSIS

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ABSTRACT

Annular gas flow during and after cementing is a frequent problem in areas where oil and gas producing reservoirs are young and shallow gas formations are present. Areas considered potentially severe include the Gulf of Mexico, South China Sea, Indonesia, Malaysia, and areas where Miocene aged formations produce oil and gas.

Annular gas flow may result in moderate to severe problems such as Sustained Casing Pressure (SCP), loss of well control, blowouts etc.

In one Indonesian field over a two-year, 150 well drilling period, shallow gas flow combined with sand characterized by poor compressive strengths resulted in numerous wells with SCP, three rig evacuations and two rig fires. A mechanical solution using a casing annulus packer (CAP) and port collar (PC) was implemented to seal the annulus above the gas source immediately after “bumping” the cement wiper plug on the surface casing primary job and providing a second stage cementing option in cases of poor displacement or losses or possible gas influx during the primary job.

To date, 220 casing completions with CAP and PC have been achieved in this field with no severe problems. Based on prior experiences and costs associated with remediation of a well with annular gas flow, the mechanical control technique has effectively reduced the overall well costs in addition to drastically improving HSE issues.

BACKGROUND

Problems associated with shallow gas flow can be minor such as SCP or severe to the extent of rig evacuation and fire. The Gulf of Mexico is known to have over 8,000 wells with SCP1,2 and a recent AADE3 paper presented a Gulf of Mexico case where a prior drilling program resulted in a rig fire. Corrections to the drilling program for three additional wells successfully utilized the mechanical technique presented in this case study. Another IADC/SPE4 paper presented a similar case study in Gulf of Thailand wells.

Numerous research projects such as presented in SPE5,6 papers attempted to understand the physics behind annular gas migration in order to better address a means to control the problem. In many wells such as the case study presented in this paper, background gas during the drilling operations is low even when drilling with light weight (1.1 sg) water based mud but gas flow increased during the cement displacement process to a level of having continued flow on the annulus after plug displacement, even with 1.50 sg cement.

Care must be exercised in eliminating the annular pressure as actions such as topping the annulus with a cement plug may only disguise the real problem of continued down hole annular flow which can pressure charge formations up hole and present extremely severe problems with future infill drilling or exploration.

Theoretical causes of gas flow through the cement column are generally accepted as a result of gel strength development in the cement column being irregular and thus fluid loss from the slurry reduces hydrostatic pressure below the gelled regions as depicted in Figure 1. If such hydrostatic pressure