INTERACTION OF HYDRATING CEMENT WITH PETROLEUM INDUSTRY SPACER FLUIDS

Carole Fleming and Tom Dealy

Chevron Petroleum Technology Company and Halliburton Energy Services, Inc.

ABSTRACT

This paper presents the results of a study to examine the interaction between hydrating cement and various spacer fluids used in the petroleum industry. Spacers and chemical flushes are used in oil and gas well cementing operations for several reasons. They are used to separate the drilling fluids from the cement to prevent incompatibility, to aid in removal of the drilling fluid, and to leave all surfaces water-wet to enhance bonding with the cement.

Particular emphasis in this investigation was placed on spacers containing blends of surfactants used with synthetic-based drilling fluids. Synthetic-based systems are being widely used in offshore operations to allow the environmentally accepted discharge of drill cuttings on-site. The surfactants allow the water-based spacers to be compatible with the synthetic-based fluids and invert them to a water-wet condition so cement can bond to any residue that might remain.

This investigation examines (1) the microscopical interaction between the fluids and (2) the compressive strength compatibility of the fluids. The microscopical examinations reveal that some of the spacers appear to increase the formation of ettringite. The two clay-based spacers containing the blend of several surfactants both exhibited large "nests" of ettringite crystals. Three other spacers containing singular surfactants exhibit a notable amount of ettringite, but considerably less than the two with heavy surfactant loading. The pozzolan-based spacer contains the least amount of ettringite and is the only one that does not contain surfactants. Compressive strength determinations show the pozzolan-based spacer (no surfactant) to have the highest compressive strength of the contaminated slurries. The spacers with the heavy surfactant loading are not the ones with the lowest compressive strength however. After curing at 160°F for 120 hours there is virtually no difference between them and uncontaminated cement. The spacer marked clay 2 contains a small amount of retarder and the emulsion-based spacer contains a moderate amount of retarder. This explains the lower compressive strengths for those specimens. The lower compressive strengths of the samples contaminated with the solvent-based spacer may be due to the presence of a mutual solvent in the system which allows the solvent to essentially become part of the cement matrix. More research is needed to examine the possibility of surfactants causing enhanced ettringite formation during cement hydration.