The Use of a pH-Triggered Polymer Gelant to Seal Cement Fractures in Wells

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Introduction

• Existing wells which leak “behind pipe” allow fluids to migrate from one formation to another through a pathway along the cement/earth interface or within that cement.
• Leakage pathways too narrow to be readily repaired with traditional oilfield cement are nevertheless wide enough to allow significant leakage rates.

Key Findings

1. The reactive polymer solution enters the cement fracture flushing the alkaline brine that was originally in the fracture.
2. Subsequent polymer gelation injection allows formation of the calcium-free yield-stress gel on the fracture surface.
3. The core is shut in for various durations to allow polymer to react with the cement and to form flow-blocking gel.
4. DI water/acidic brine is used as holdback fluid and pumped at constant flow rate for a steady pressure buildup.
5. The maximum pressure before holdback fluid breakthrough is recorded and translated as holdback pressure gradient to determine the resistance of gel.

Methodology

1. The cement fracture is pre-soaked with a small bank of chelating agent to remove Ca++ from a thin layer of cement.
2. Neutralization reaction between polymer solution and cement surface causing the pH to increase.
3. The pH increase initiates the swelling of microgel resulting in the thickening of the gel.

Results

• The holdback pressure gradient greatly improved for pre-treated cement due to the removal of Ca++.
• Sodium Triphosphate (Na$_5$P$_3$O$_10$) pre-treatment has been proven to have the best performance in both polymer injectivity and pressure holdback.

Conclusions

• pH-trigger polymer gelant has desirable yield stress in holding back pressure and is effective at stopping leaks in cement fractures.
• Chelating agent pre-treatment can successfully remove calcium cations and inhibit the unstable gel formed by Ca-polymer syneresis.
• Results from various shut-in time implies that Na$_5$P$_3$O$_10$ reaction and gel development reach completion around 2-weeks time and continues to mature/dehydrate forming a strong gel.
• The calcium removal happens quickly and effectively with pre-treatment time as short as 10 minutes.

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