NESR Introduces a CO_2-Resistant Cement System in the Middle East

INTRODUCTION

One of the major national oil companies in the Middle East is expanding its carbon capture program to enhance oil production, reduce its CO_2 emissions and overall environmental impact. Carbon capture and storage wells and enhanced oil recovery CO_2 injection wells are becoming more frequent in the Middle East to serve environmental objectives.

A candidate well was chosen from among many wells to be drilled in the next 5 years. NESR conducted a field trial of newly developed CO_2-Resistant Cement System on the selected well. The Client required a cement system that resists cement degradation when exposed to CO_2-rich environments.

CHALLENGES

A conventional Portland Cement System degrades rapidly in wet supercritical CO_2 and water saturated with CO_2 under downhole conditions.

CO_2 infused water reacts with the cement matrix to form carbonic acid which reacts with C-S-H gel and Calcium Hydroxide to form Calcium Carbonate. This will lead to increased compressive strength and lower permeability of set cement. Later, the Calcium Carbonate reacts with formation water, allowing more dissolution process that results in more Carbonic Acid with the process continuing until it results in cement sheath failure.

Such degradation compromises the well integrity; raising serious concerns of dangerous gases leaking from the reservoir to the surface and at the same time leading to economic loss and reduction of CO_2 injection/storage efficiency. To mitigate this, a specially engineered cement system is required to ensure long-term well integrity.

PROPOSED SOLUTION

NESR's CO_2-Resistant Cement System is the latest wellbore isolation technology for CO_2 geological storage, which provides an enduring solution for zonal isolation during CO_2 injection and storage.
CO_2-Resistant Cement System features densities ranging from 15.8 lbm/gal to 16.7 lbm/gal. The mechanisms in the 15.8 lbm/gal cement system are the conventional dissolution/carbonation processes while the 16.7 lbm/gal cement system shows an additional healing mechanism. Consequently, the degradation seems to stabilize after 30 days of CO_2 exposure.

CO_2-Resistant Cement System can be incorporated into standard primary cementing operations for zonal isolation of new CO_2 injection wells.

DESIGN, EXECUTION AND EVALUATION

After extensive laboratory testing and prequalification, a high potential well was selected as a trial candidate well for the CO_2-Resistant Cement System. In Nov. 2019, the field trial was performed in a 7-in liner, set at ~11,200 ft MD, with a maximum deviation of 42 degrees.

The job design was simulated to ensure optimized mud displacement efficiency. The CO_2-Resistant Cement System was batch mixed to ensure proper quality control and homogeneity of the slurry. The cement job was executed successfully as per the design of service.

Cement Bond Log (CBL) conducted across the 7-in liner showed excellent bond strength between both cement to formation and cement to casing.The trial job was considered a comprehensive success by the Client. The CO_2-Resistant Cement System was subsequently approved to be pumped in all future high-profile water and gas injector wells, and critical oil and gas wells to be drilled in surrounding fields.