ACACIA

Acid Alteration of Cement and Interface

OBJECTIVES

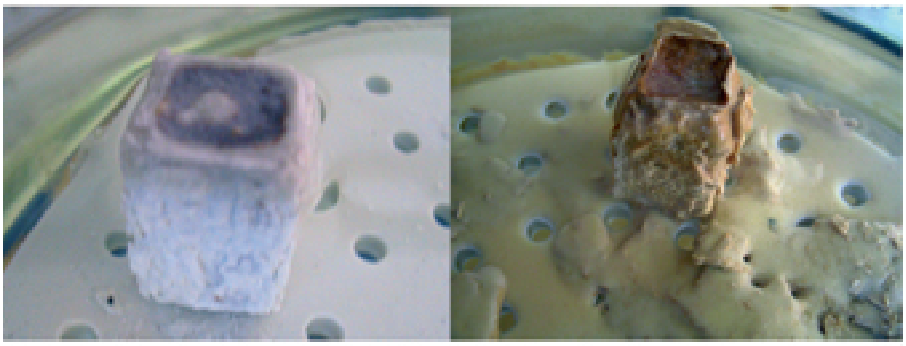
The main objective of these studies is, first of all, to characterize and understand the chemical degradation of different materials (cement-based materials) in contact with acid gas mixtures. For the materials exhibiting the best durability, the tightness of cement/casing interface and cement/formation interface will be measured.

PROGRAM

■ **Phase 1**

We will study the aging of cement-based materials in a fluid corresponding to reservoir conditions *i.e.* 16 mol% H_2S and 2 mol% CO_2 plus associated gas in the presence of reservoir brine (65-70 g/L NaCl) at 700 bar and 97°C under agitation, i.e. wet gas, in order to study

Aging in H_2SO_4 for 110 days



Low permeability cement — Reference cement the chemical durability of such materials and be able to select one or two of the best materials for this application. Chemical reactions occurring between mineral phases contained in a cement and hydrogen sulfide are very poorly documented in literature. It is important to study these chemical reactions because they may lead to end products that are damaging to the cement matrix, especially when a water phase is present (water saturation in cement pores and/or water phase in the gas). Different types of materials will be selected and studied (class G as reference, two new-based formulations, one of them based on very-low-perm materials to be decided between participants). The duration and the number of samples need to be defined as a function of the kinetics of the chemical reactions. Since the alteration products of one such material may have effects on the degradation reactions of the others, the three materials will be aged alone and sampled as a function of material stability for a maximum total duration of 18 months. The same cement samples will be aged under the same pressure and temperature conditions but in lime solution in order to compare aging effects.

Plugging materials will be cured and stored at controlled pressure and temperature in aging cells. Set cement evolution versus time can then be quantified mainly by measuring physical properties, *i.e.* permeability, mechanical properties, porosity. The structures of the cements will be observed by X-ray diffraction (XRD), NMR (in collaboration with ESPCI) , porosity measurement, and scanning electron microscopy (SEM).

■ Phase 2

Accelerated leaching could be performed in a 3 1/2" diameter cell where different configurations could be implemented: cylindrical cement sample (full cement diameter), casing with cement inside, cement annulus/rock formation. Leaching will be performed letting the wet gas flow through the samples for a period of no more than 6 months to evaluate the sealing capability of the cement (quality of adherence and tightness) at the interface, *i.e.* casing/cement or cement/rock (permeable formation or cap rock). The parameters will be: steels (T95 [production casing] and CRA-110 [production liner]), cements (one or two of the best materials selected in phase 1), rock formation (type, saturations, etc.). Both cement and casing alterations will be quantified including, for the casing, specific corrosion characteristics (surface characterization, X-ray, etc.). The alteration of cements will be characterized as a function of depth of penetration.

DELIVERABLES

Evaluation of the mechanisms of degradation of cement and cement interfaces at high H_2S concentrations.

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