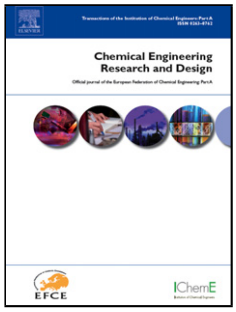

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EFFECT OF SILICA NANOPARTICLES TO PREVENT CALCIUM CARBONATE SCALING USING AN IN-SITU TURBIDIMETRE

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ABSTRACT

Scale minerals in the oil and gas industries are a major concern to reservoir and operations engineering. The main types of oilfield scales found are carbonate and sulfate scales. Calcium carbonate (CaCO3) is a major component of fouling in heat transfer surfaces across different sectors of industry, resulting in additional capital, maintenance and operating costs. Various techniques, including the use of chemical inhibitors, have been used to prevent the formation of scale. In the last decade, there have been considerable advances in the development of chemicals, effective in small concentrations for the control of scale deposits.

The purpose of this study was to investigate the possibilities of utilizing nanoparticles as sacrificial surface for enhancement and control of the nucleation and crystallisation of CaCO3, as a method for fouling mitigation. Here, the turbidity profile of the solution, using a light reflection technique, is used to monitor the process. The outcomes of this study will improve revenues by preventing the unscheduled shutdown of facilities and avoidance of using an excess of scale inhibitors. Silica nanoparticles of different size and surface functional groups were added to the solution. The results showed a reduction in the induction period, consequently indicating improved control over crystallization. Modified silica nanotemplates exhibited the highest reduction in induction time at room temperature. This resulted in preventing scale formation on the wall of the crystallizer. This conclusion is very significant, and further studies are proposed, which will attempt to understand the mechanisms of reactions between the nanoparticles and scaling ions.

KEYWORDS

crystallization, fouling, nucleation, particle, phase change, turbidimeter

1. INTRODUCTION

Scaling refers to the solid particulates that are formed in fluid systems and can be either living (biological scales) and consist of bacteria and fungi or non-living and consist of inorganic salts. Scale can either precipitate from solution or grow on surfaces and is undesirable in most cases. Physically, they are hard and adherent, and cause many problems once they are formed. The sector where the problems caused by scale are most evident is probably the industrial sector. Scaling creates problems by reducing the efficiency of facilities such as heat exchanger, restricting fluid flow through piping and blocking valves.