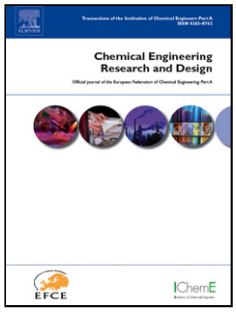

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Authors: Dimitrios Georgios Hatzignatiou, Nils H. Giske

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Sodium Silicate Gelants for Water Management in Naturally Fractured Hydrocarbon Carbonate Formations

Dimitrios Georgios Hatzignatiou

University of Houston (UH) and Nils H. Giske, International Research Institute of Stavanger (IRIS)

Highlights

- Silicate-based gelants evaluated for isolating high conductivity conduits.
- Gelant filtration and gelation; gel strength, shrinkage and dissolution tested.
- Gelant injectivity into porous matrix affects the degree of formation damage.
- Gelation and gel type depend on silicate, activator, and temperature.
- Gels dissolution is affected by temperature and alkaline fluid strength.

Abstract

Two commercially available, water-soluble, environmentally friendly, sodium silicate gelant systems (Silicate A and Silicate B) are screened and evaluated for water management applications in naturally fractured carbonate (NFC) reservoirs. The gelant impact on oil production and the ability to reverse poorly deployed gel treatments through gel dissolution are also investigated.

Several bulk- and core-based tests are engaged, with the two investigated water-soluble silicate gelant chemicals having undergone a thorough and careful investigation of their filterability, injectivity, gelation time, gel strength, and gel shrinkage. The activators used for gel formation are system dependent and included NaCl, HCl, HNO_3, HCOOH, and urea. Gelation is mainly controlled by the activator type and concentration, silicate concentration and temperature. Formed gel strength can be improved by increasing the injected silicate concentration but in Silicate B experiments, gelation difficulties are experienced for concentrations exceeding ~7 wt%.

Filterability of Silicate B is significantly better than that of Silicate A. Fractured core tests using Silicate A gelant revealed that the average core permeability is reduced by three orders of magnitude from prior- to post-gelation conditions. Silicate B gelants exhibited gelling “difficulties” and formed gels displayed a lower strength compared to Silicate A gels. Unsuccessfully deployed gels may be reversed through dissolution with alkaline fluids (NaOH or KOH); gel dissolution rate is a function of the alkaline fluid concentration and type of process followed.

Overall, Silicate A outperforms Silicate B and shows promising properties for its potential utilization in field applications to control injected water in NFC formations.

Keywords: Sodium silicates: gels, oil and gas, water management; naturally fractured; carbonate formations

Nomenclature

A	=	Area (cm^2)
df	=	Degrees of freedom
k	=	Permeability (mD)
H	=	Hypothesis
M	=	Molarity (mol/l)
L	=	Length (cm)
t	=	Time (s, hrs or days)
p	=	Pressure (bar)
q	=	Flow rate (ml/min)