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Interactions Between Acids and Water-Swelling Elastomers

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Abstract

Achieving successful zonal isolation during well completion is critical to minimize early water production. Recently, oil-swelling packers were used in various carbonate reservoirs, and currently water swelling packers are being investigated for potential field application. Considering future matrix acid treatments of wells completed with water swelling packers is part of this investigation. To the best of the author's knowledge there is no previous work done to fully investigate best practices in stimulating wells completed with water swelling packers.

An earlier investigation by Al-Yami et al.¹ showed that water-swelling elastomers withstood pressures up to 5,000 psi at 190°F after placing the elastomers in brines with salinities up to 200,000 mg/l. CaCl₂ completion fluids at 72 pcf, a common completion fluid, failed to swell the elastomers..

The present study investigates different acids to effectively stimulate wells completed with water swelling packers. Lab testing was done in 3 steps that included swelling the elastomers in low salinity aquifer water, soaking in various acids for 2 hours and finally immersing elastomers in the aquifer water to mimic resumption of water injection after conducting a matrix acid treatment.

Hydrochloric, formic acids and combinations of these two acids resulted in significant reduction in the volume of the swelled coupons. Immersing the coupons after acid exposure in water did not regain their original volume prior to soaking in these acids. Citric and lactic acids slightly reduced the volume of swelled packers from vendors II and III. The elastomers swelled again in water after exposure to these acids. Acetic acid showed the least effect on water swelling elastomers and their size was swelled again after immersing in water. The shape of coupons obtained from vendor III changed almost in all acids examined. The change in shape will definitely impact the ability of this type of packer to isolate various zones.

Introduction

The best well completion is the lowest cost one that meets the demands for the well during its well life. There are different aspects that need to be considered when designing completion such as reservoir consideration (producing rate, multiple reservoirs, etc.) and mechanical consideration (safety, anticipating all operating conditions, etc.). We can have vertical, horizontal wells with openhole, or perforated casing completion.^{2,3}

Production packers play an important role in completing various wells and they are used for the following cases:¹

- Isolation of casing leaks,
- Artificial lift installation,
- Protection of casing from pressure and corrosive fluids from well or stimulating operations,
- In combination with subsurface safety valves, and
- For holding kill fluids in casing annulus.

They can be classified either as retrievable or permanent type. Some types of retrievable packers are:²

- Compression packers: suited for low pressure cases where the pressure above packers exceeds tubing pressure below it. Tubing weight is applied down to expand the packing element. To release, tubing weight is picked up to remove slips from behind the slips.
- Tension-set packers: suited for injection wells or stimulation operations where pressure below packers exceeds tubing above it. In this case, tubing weight is picked up to release packer.
- Mechanical-set packers: suited for higher pressure cases. The setting mechanism is tubing rotation.
- Hydraulic-set packers: wellbore fluid pressure acts on a piston-cylinder as a part of the setting mechanism.