

White Paper

The Benefits of Utilising Tendeka Water Swells in Injector Wells

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Introduction

Injection of water is a common and economical method of increasing oil production in a neighbouring well. If the well has not been completed effectively, injector wells can inadvertently lead to flooding of the production well via flood zones, generating communication and crossflow between the reservoir layers. This can in turn increase the water cut of the produced oil reducing production.

In order to combat thief zones, for pressure stabilisation of both wells and to prevent crossflow, zonal isolation is utilised. Swellable products can be placed to shut off thief zones and/or fractures in the formation identified during underbalanced drilling. The ability to shut off zones to target specific injection zones can be of great benefit to prevent thief zones and formation collapse due to the forcible pressures seen through bullhead injection. Particularly in mature fields, the possibility of thief zones is increased and zonal isolation should be considered.

Swellable elastomers are designed to absorb fluid from the wellbore into the rubber causing the rubber to increase in diameter and seal against the wellbore or the casing. After contact, the elastomer continues to swell generating an internal seal line pressure between the elastomer and borehole wall.

Technological advances in Swellable elastomers design has seen the increase of robust, reliable and predictable high performing products available on the market for multiple environments and swelling mechanisms. Swellable elastomers have been designed as a cost-effective alternative method of zonal isolation when compared to mechanical alternatives. Tendeka has performed extensive elastomer development and testing to offer an elastomer with improved strength and chemical resilience to be utilised in water injector wells and to be compatible with any injected fluid.

World's First Swellable Packer Installation

The first installation of swellable elastomer technology worldwide was in 2002, utilising a Tendeka water swell packer in a water injector well in the Middle East. The well had been stimulated several times which resulted in increased water communication to the production well, reducing oil production to less than 10% of the original

value prior to stimulation. Figure 1 presents the drop in oil production after stimulation occurred in the well.

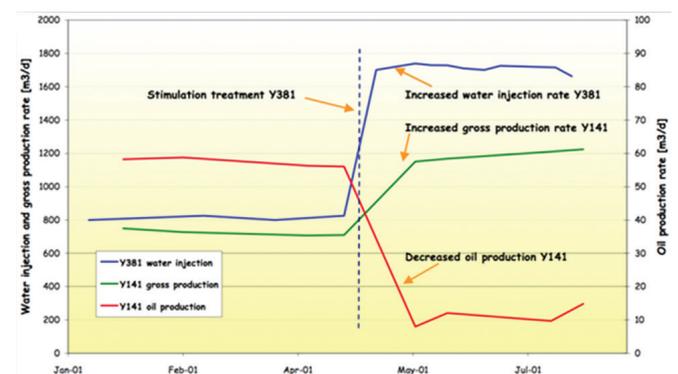


Figure 1 - Oil production rate before and after stimulation

A production log was run and the thief zone was identified at 1,880m. Well intervention was conducted and swellable packers, 10 joints of 13ft seal of rubber was run to the required depth and allowed to swell against the formation.

After installation of the water swellable packer it was seen that the water injection rate had decreased and the conduit between the two wells had been shut off (figure 2). Oil production was increased and sustained at over 100 m3/d.



Figure 2 - Water injection rate before and after swellable packer installation

Overview of Water Swell Technology

SAP (super absorbent polymer) water swell compounds are the most commonly available water swellable elastomer. These compounds swell by the process of water absorbing into the SAP material and increasing in size. The rate of this process is dependent on both temperature and salinity. These compounds although show fast swell at low temperatures, can experience limited swell in saline solutions and can be significantly affected by exposure to acid and breaker systems.

Tendeka's proprietary osmotic swells provide an alternative to SAP swells. Swelling by the process of osmosis is dependant on temperature and salinity. At lower temperatures the rate of swell for osmotic swells can be slower than that of SAP but it maintains a superior performance in saline solutions and has high internal osmotic pressures resulting in higher pressure holding capability.

Tendeka developed a water swell compound to reproduce both SAP and osmotic swell behaviours alongside a specific strengthening component. The result is a water swell compound which has a better performance at low temperatures and significantly improved performance in saline solutions.

Benefits of Using Tendeka Water Swell Technology in Injectors

Tendeka's proprietary combined swell has been engineered to withstand both acid and breaker exposure, commonly seen throughout injection. The compound is able to be exposed to these fluids and still swell and perform as expected when immersed in a swell fluid, providing a seal and pressure integrity throughout acid/breaker injection. This elastomer can be used between 0-180°C in up to 26% (by weight) saline fluids, including in divalent salts. This compound has been used to reliably isolate over 10,000 zones to date.

Where thief zones and/or fractures in the formation are identified, Tendeka's water swell can swell in the recycled produced water and seal the zone preventing any communication between the reservoir layers, where high injection rates may affect oil recovery.

Another consideration for completion in water injectors is sand production. This needs to be managed effectively to prevent sand breakthrough preventing corrosion to the sand control equipment, as well as potential blocking the injection paths. Utilising zonal isolation technologies along with sand control effectively compartmentalises the well, closing off any potential troublesome zones, reducing annular flow and preventing the risk of hot spot corrosion on the completion equipment. This reduction in annular flow in-turn reduces the risk of mobilising sand. If sand is mobilised due to the high pressures and stresses associated with injection in weaker formations, sand production needs to be controlled to prevent a perforated tunnel being blocked by the sand and injection being unable to occur.

If there is a sudden pressure surge or water hammer, in wells without sand control and zonal isolation technologies, the weakened formation can completely collapse impairing any ability to inject from this well. By ensuring adequate

sand control, coupled with swellable products for zonal isolation, this wellbore collapse can be prevented. This is crucial as if such a collapse occurs, it can render an injection well redundant.

Tendeka's water swells can be run with Tendeka sand screens to ensure a multi-faceted completion approach for injector wells.