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Gas Swellable Seals for Gas Migration Prevention

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Abstract

SEAL UNITS prevent gas/fluid movement at the interface between the outer surface of the casing and the inside of the cement sheath. In spite of the improved practice of releasing pressure on the casing after the top plug bumps, investigations by different research and development groups confirm that leakage at this interface is very possible.

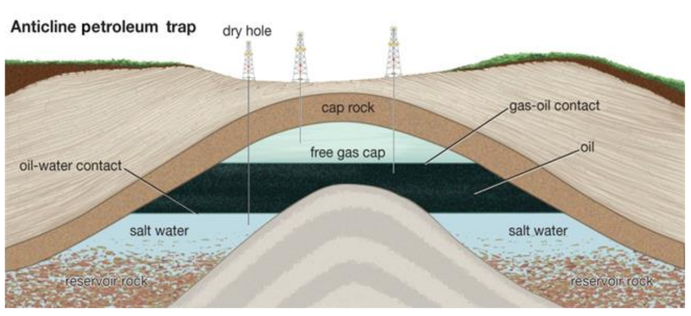
When subjected to differential pressures, often encountered in completing or producing a well, inter-zonal communication at this point will occur, like "channeling" in the remainder of the annulus. This will prevent efficient production of the producing zone or cause stimulation work (fracturing, acidizing, etc.) to be ineffective due to uncontrolled fluid migration in the annulus.

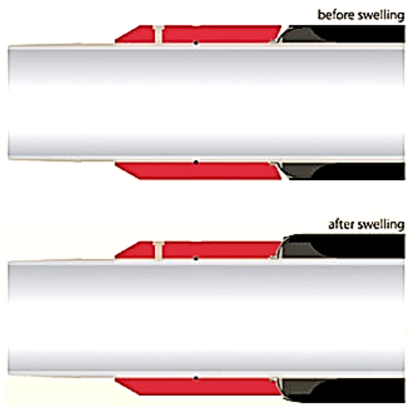
Swelling Concept

When a polymer exposes to its solvent, the solvent molecules surround polymer chains and separate them from each other. If the polymer chains be cross-linked together in some points, the chain separation will be limited and finally there will be a polymer network and embedded solvent molecules that obviously has a greater volume than initial polymer network.

Fluid Migration Pathways

Throughout the life cycle of a well, the integrity of well barriers must be maintained to prevent uncontrolled flow of downhole fluids to the surface. Cement is a good barrier, but thermal fluctuations, shrinkage, earthquakes, etc. can make cement fractured and damaged; this causes in increasing fluid permeability in cement sheath or at cement-casing and cement-formation bonding areas as micro annuluses and fractures. Cement-casing micro-annuluses have a thickness of about 1 to 1000 µm (mostly 100 to 700 µm) and is the main way of fluid migration.





Gas Migration Challenge

Gas migration occurs in reservoirs having a gas cap and also occurs when a gas injects in a depleted well Gas and can also occur from non-sufficient sealing of liner hangers and can observe as surface casing vent flow or through soil.

. When a pathway be available for fluid flow, gas flows with a rate of 20 to 100 times more than water and oil. Gas migration causes safety and hazard risks, pressure drop and corrosion.

Gas Swellable Rubber Composition

Gases present in oil wells, has a 2% – 70% percent of condensate content that is usually propane, butane, pentane and water vaper. These condensates evaporate at shallow heights and migrate to surface with gaseous content and cause gas migration. A way to eliminate condensate content is absorption of these condensates and trap them in an insitu embedded media in oil well. When a nonporous material absorb a fluid, its volume expands freely to a specific limit. PETROCO special swellable rubber material is engineered to interact efficiently with nonpolar liquids and absorb them. The rubber composition has a very high affinity to gas condensates due to very oleophilic structure.

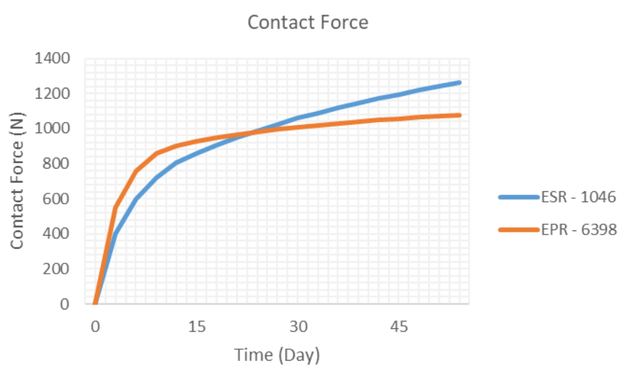
Gas Swellable Seal

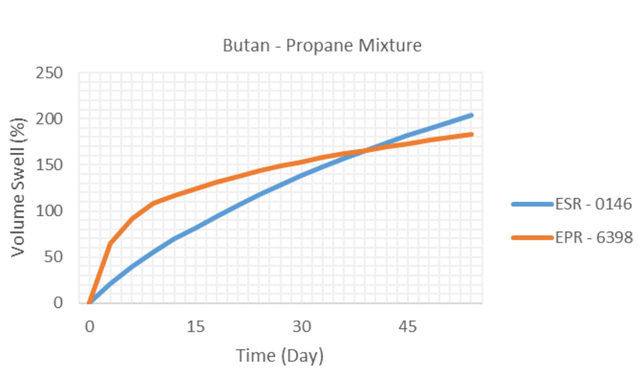
Constraint swelling of gas swellable rubber composition can result in sealing. If rubber inhibit to swelling freely, the absorption of liquids present as reciprocal force. This force that is called contact pressure, applies to its peripheral wall. Contact force can result in sealing pressure. If gas swellable rubber composition apply on a cylinder and gets expose to gas condensates, absorbs liquified condensates, swells, and finally seals the peripheral hole and prevents the gas flow. This is a very efficient way to prevent gas migration.

A gas seal with a length of 300 mm and an OD of 190 mm can seal an open hole with 203 mm ID by tolerating a differential pressure of about 1200 psi. Using 10 number of gas seals can seal about 12k differential pressure that assures no gas migration.

Case Study

A non-swellable class of gas migration preventing seals, used by Weatherford Inc. that firstly, introduced this technology. To prove that it works properly and assurantly, Weatherford Inc. did a very extended case study in UAE. 700 seal units used in 63 wells in a field with 82 well. Long term results shows no leakage in all 63 wells and other 19 wells showed decrease in production pressure and gas migration observed obviously.





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