

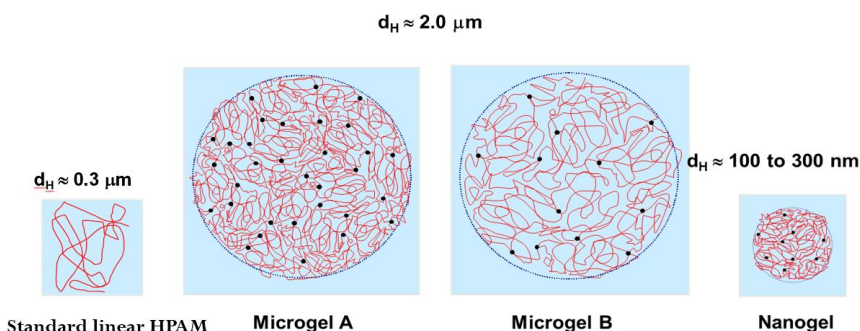
POWELGEL Water Control by Microgels

POWELGEL™ is a new technology using microgels with different sizes, which is now proposed on the market by POWELTEC. The main domains of applications are:

- Water Shutoff / Conformance Control
- Sand Control

The process uses preformed water-soluble microgels, produced in the plant and delivered under liquid (emulsion) or powder form. POWELGEL™ microgels have a remarkable thermal (up to 120°C), shear and chemical stability, a narrow size distribution and are environmentally friendly (some have been qualified for offshore North Sea applications). When injected into a formation, POWELGEL™ microgels adsorb strongly on the rock, thus forming a thick and continuous gel-like layer on pore walls, which improves rock stability and induces RPM effects (Relative Permeability Modification). Actually, POWELGEL™ microgels can strongly reduce the relative permeability to water, while affecting very little the relative permeability to oil or to gas. They can thus be bullheaded into the whole open interval surrounding the wellbore, with very little risk of well impairment.

Chemistry of Microgels

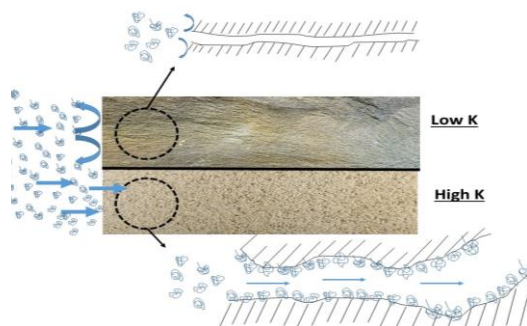


The Small Microgels (SMG) are a **Patented Technology** owned by Poweltec. Microgels are polymer particles that have rock adsorption capacities and that provide a Relative Permeability Modification (RPM) effect. The proposed Microgels by Poweltec are available in a broad range of sizes from **0.1 μm to 2μm**, with various chemical compositions, in order to be adapted to most reservoir conditions and reservoir rock qualities.

Placement of microgel through size exclusion process

For a given application, the size of the Microgel is chosen in such a manner as to penetrate easily the high-permeability parts of the reservoir while invading very little the other zones by a phenomenon of size exclusion. The placement is thus favored in the high-permeability streaks where water encroachment occurs.

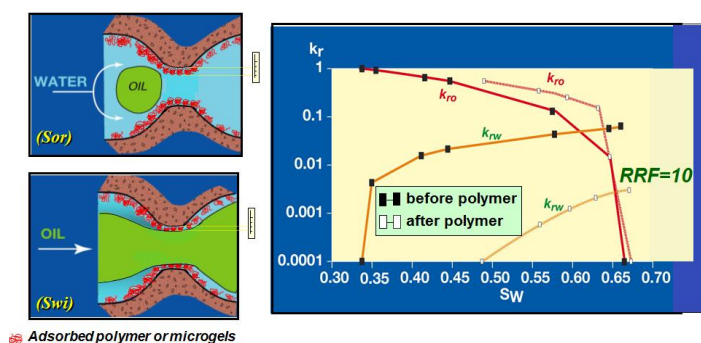
The risk of low permeability layer impairment is minimized through a size exclusion phenomenon



Treatment mechanism

For Water Shut Off application, Microgels are squeezed into the formation surrounding the wellbore at a depth of several meters from wellbore. The product adsorbs on the surface of the rock, resulting in a selective reduction of the relative permeability to water, with low impact on the relative permeability to oil or to gas (RPM effect).

The risk of well impairment is minimized through a relative permeability modifiers effect



Relative permeability modification after Microgel adsorption

POWELGEL Applications

- Sand control in Oil and Gas wells
- Water Shut Off in Oil and Gas wells
- Conformance control for water injection wells

Powelgel specifications

Temperature (°C)	Up to 120
Salinity (g/l)	Up to 300
Permeability range (mD)	10 - 10 000
Shut in time (hours)	no
Regained permeability to oil %	>80

Treatment design

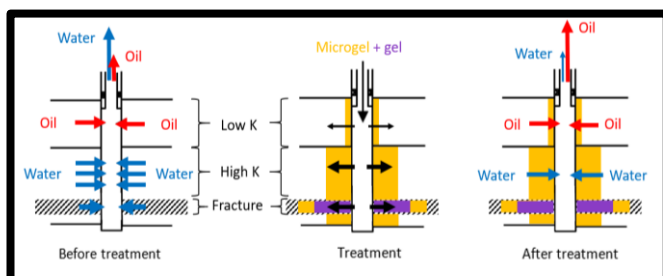
- Evaluation of candidate well according to analysis of pertinent data (a Check List is delivered on request),
- On request - Laboratory study to optimize microgel composition (bulk tests and coreflood experiments),
- On request - Numerical simulations with PumaFlow reservoir software using laboratory coreflood results as input data, to size up the treatment and predict performances,
- Product delivery / On-field assistance
- Post-treatment evaluation.

Specific design - Hybrid technology

Poweltec offers Microgel and Gels for WSO. These technologies can be combined as hybrid technology especially when the zone to be treated cannot be isolated. It also avoids the need of work over and coil tubing.

This technology applies especially to treat reservoir with fractures (example : horizontal well, fractured carbonate with strong bottom aquifer SPE 203394 and SPE 217009).

A Microgel slug is injected before the Gel to prevent Gel invasion of oil-rich low-permeability zones. With such hybrid strategy, by simple bullheading, the placement of the gel occurs in the high-permeability zones only, while the Microgel protects the low-permeability oil-rich zones from Gel leak-off. By avoiding the coil tubing to inject/squeeze the Gel in the formation, it reduces the cost of the treatment



Product delivery and field assistance

POWELTEC delivers the products and send a technical team to support the operation manager, supervise the chemicals preparation and check the quality of the solutions prepared on site.

POWELTEC can also assist the operator in post-treatment monitoring.



References

Treatment of underground gas storage wells

- SPE 71525, SPE 106042

Treatment of Heavy Oil Reservoirs

- SPE 24661, SPE 177914, SPE 206333

Treatment of fractured carbonate wells

- SPE 56740, SPE 203394, SPE 217009

Treatment for conformance

- SPE 185864, SPE 179765

Treatment of carbonate wells

- SPE 188871

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