

# POWELGEL

## Water Control by Gels

Powelgel Gel™ is a technology using crosslinked gels with different consistency, which is now proposed on the market by POWELTEC. The main domains of applications are:

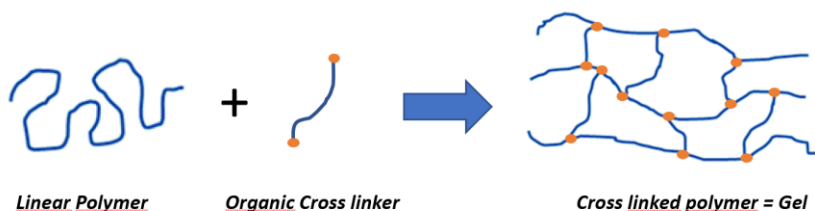
- Water Shutoff
- Profile Control
- Well or layer abandonment

The process uses water-soluble polymers which are mixed with organic crosslinkers to form gels with controlled gel time and gel consistency. Different gel chemistries have been designed, each one covering a given window of reservoir temperature. Products have thus been optimized for the following windows of temperatures: 15-50°C, 45-85°C, 80-120°C.

Gel time is adjustable to obtain delay from few hours to 4 weeks, with chemical additives. Gel consistency can be also adjusted, from weak RPM gels to strong sealing gels.

POWELGEL-GEL™ products are environmentally friendly, avoiding the use of hazardous agents such as heavy metal ions

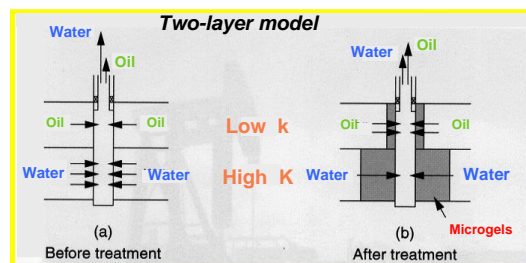
### Chemistry of Gels



POWELGEL-GEL™ is a gel technology which has been developed by POWELTEC for Water Shutoff and Profile Control purposes. It combines polymer and crosslinker (usually with some additives) that form a gel after a certain time and in certain conditions (temperature, salinity). The polymers are synthetic water-soluble copolymers and the crosslinkers are organic crosslinkers. All products are environmentally friendly and can be deployed without restriction.

### Applications

The main target is high-water-cut multi-layer production wells. In this type of well, frequently, water is mainly produced from high-permeability layer and overtakes oil production from lower permeability layer. To solve the problem, two approaches can be considered. (1) A strong gel can be spot to seal and block all production from a given layer. (2) A weak gel can be bullheaded into the whole open interval, which will reduce water influx from the high-permeability layer, while maintaining production from the low-permeability layer (Fig. 2). Approach 1 is generally preferred when water zone is clearly identified and well completion enables selective placement. Approach 2 is more risky but is easy to deploy at low cost. It does not require selective placement. To mitigate invasion of gels in oil production zone, a unique strategy has been developed by Poweltec called hybrid technology (see here below).



Sealing Gel (1)

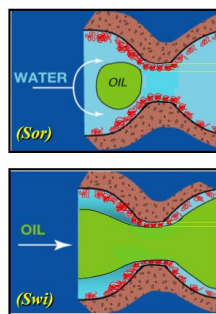


Weak Gel (2)

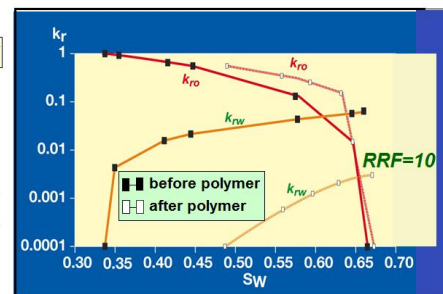
### RPM - weak gels

For Water Shut Off application, weak gels are squeezed into the formation surrounding the wellbore at a depth of several meters from wellbore. The result is 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.*



Adsorbed polymer or microgels



Relative permeability modification after Microgel adsorption

## POWELGEL Applications

- 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)	7 to 15 days
Regained permeability to oil %	>80

## Treatment design

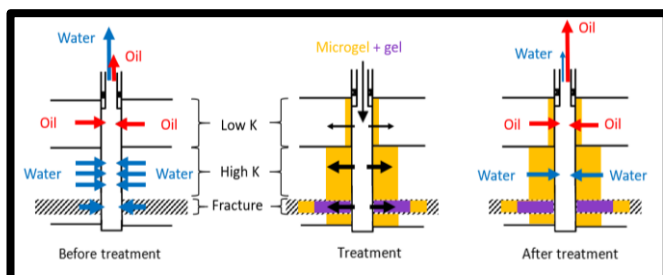
- Evaluation of candidate well according to analysis of pertinent data (a Check List is delivered on request),
- On request - Laboratory study to optimize microgel composition (bulk tests and coreflood experiments),
- On request - Numerical simulations with PumaFlow reservoir software using laboratory 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 Heavy Oil Reservoirs

- SPE 24661, SPE 177914, SPE 206333

Treatment of fractured carbonate wells

- SPE 56740, SPE 203394, SPE 217009

Treatment for conformance

- SPE 207850, SPE 208070, SPE 211430, SPE 211446

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**POWELTEC**

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