

An Inorganic Nanogel for Produced Water Shutoff

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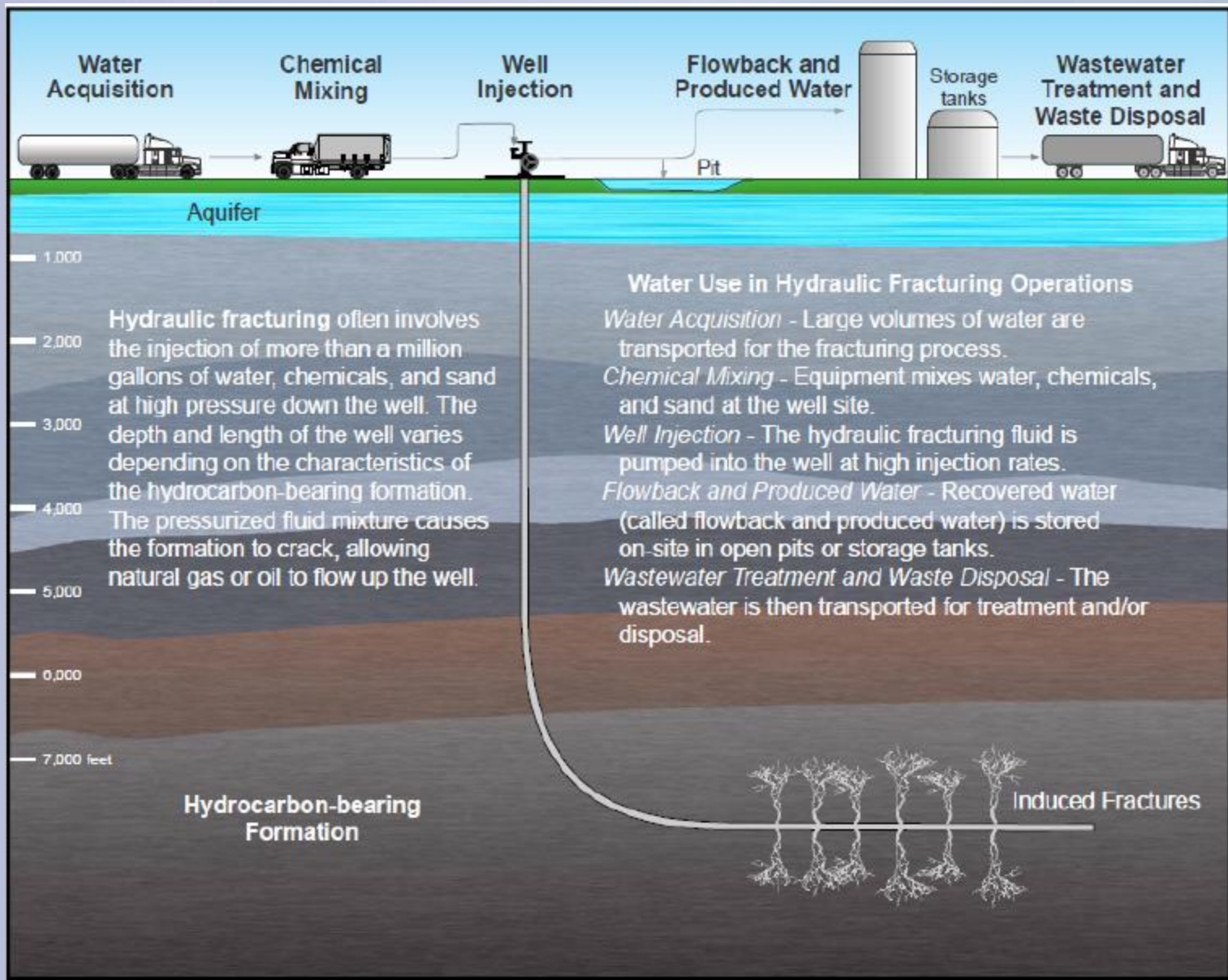


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The background of the slide features a photograph of an oil pumpjack (jack-o'-lantern) in silhouette against a bright, clear sky. The sun is positioned high in the sky, creating a strong lens flare effect that radiates across the upper portion of the image. The pumpjack's complex mechanical structure, including the walking beam and the vertical support tower, is clearly visible. The overall color palette is dominated by the blue of the sky and the white/yellow of the sun, with the dark tones of the pumpjack providing a stark contrast.

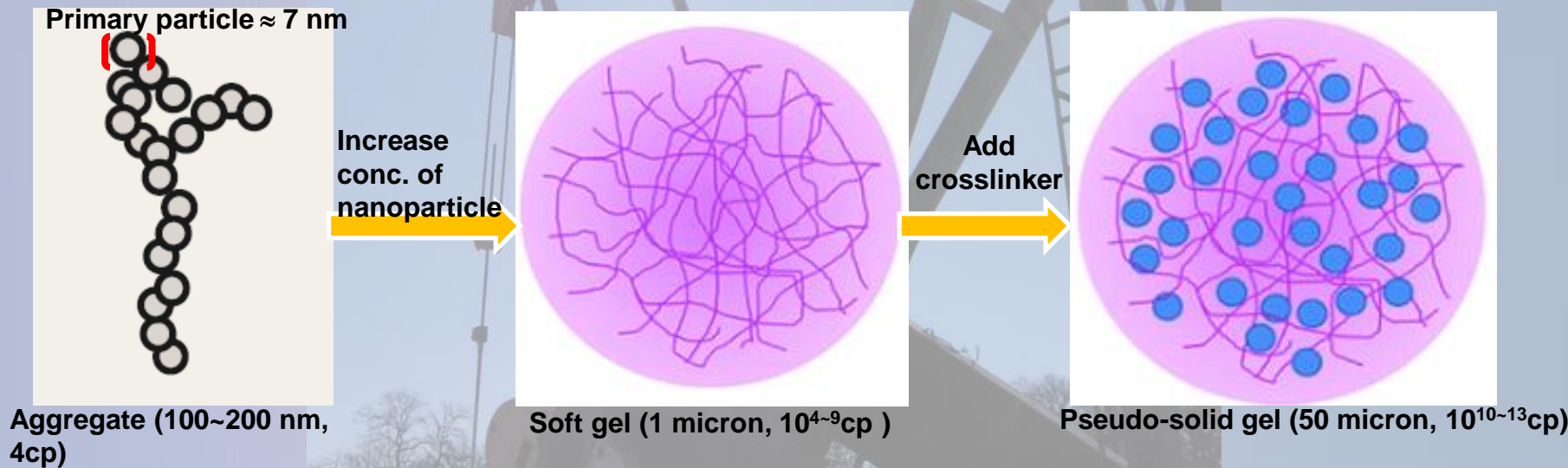
Aim of the Research:

DEVELOPING ECONOMICAL AND EFFECTIVE WATER SHUTOFF TOOLS



OU Nanogel Technology

- Robust and versatile chemistry applicable to a wide range of reservoir conditions



Advantages of Nanogels

Fast gelation time:
(< 5 minutes)

Easy Injection:
1 vol% suspension,
4cp

Immune to thermal,
mechanical, and
biological
degradation



Excellent tolerance
in salinity (up to 25%
TDS) and
temperature
(tested to 120 °C)

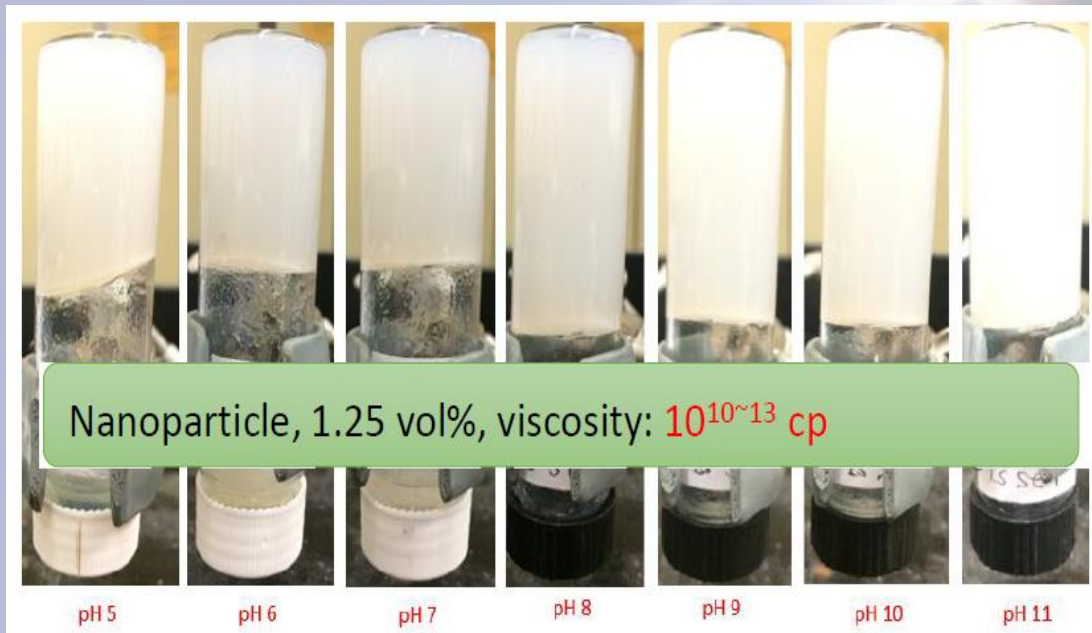
**Wide range of
viscosity:**
4 cp ~ 10¹⁰⁻¹³ cp

Inorganic based
nanogel outperform
polymer based
formulations

Nanogel vs. Other plugging materials

	Nanogel	Other PM (plugging materials)
Viscosity	4 ~ 10 ¹³ mPa.s Easy to adjust wide range in viscosity	10 ~ 150 mPa.s
Stability in reservoir conditions	No biodegradation. High temperature/salinity tolerance (permanent)	Thermal and Biodegradation at high temperature (several months)
Structural peculiarities Deformation and strength properties	High deformation and strength (pseudo-solid gel)	Moderate deformation and strength
Injectivity effectiveness	No injectivity issue	Moderate
Conc. needed to form gel (wt%)	Less than 0.1 wt%	1~10 wt%
Cost (\$/lb)	~ \$1/lb	\$10/lb (polymer)

Design Strategy:



- Dispersion Stability (aggregate size, zeta potential)
- Rheological Behavior (viscosity at different shear rates, concentration of nanoparticles, temperatures)
- Flow Tests (quantify the efficiency of nanogels in coreflooding experiments)
- Field Pilot Test (collect data for full-scale design & implementation)

Summary

- The developed **pseudo-solid gel** which exhibits both strength and rigidity even **at low concentrations**
- Adjustable for a variety of permeability zones at different depths
- **Excellent tolerance** of harsh reservoir conditions
- Simple field operations and environmentally safe