



ZLPAM
Exceeding Your Expectations

ZL EOR CHEMICALS

ENHANCED OIL RECOVERY

Chemistry, Equipment and Service,
From Design to Implementation

ZL Group Companies

Henan Zhengjia Green Energy Co.,Ltd (China): +86 371 6256 9628

ZL Chemicals Ltd (USA): +1 800 878 1694

ZL EOR Chemicals Ltd (Canada): +1 800 878 1694

Polymer Experts LLC (Oman): +968 2413 6333

Email: info@zlpam.com

Website: www.zlpam.com





PART.01

ZLPAM® SERIES

Choosing the right product technology and application strategy for each individual reservoir is extremely important in maximizing oil recovery. ZL has gained considerable knowledge since 1998 from its experience working on EOR projects in the petroleum industry. ZL uses their expertise and on-site experience to help their customers evaluate the reservoir characteristics to design the cost-effective programs.

Polymer flooding is the injection of long-chain polymer molecules dissolved in water to increase the viscosity of injected water. This method improves the oil-water mobility ratio, vertical and areal sweep efficiency. The polymer causes a reduction in the permeability and propagation through high permeability zones in the reservoir, ensuring water diversion to lower permeability zones. This lowers flow velocity and increases the sweep area to increase oil recovery.

ZLPAM Application

PRODUCT LINES	CHARACTERISTICS
ZLPAM® I	Used to enhance oil recovery in reservoirs with moderate salinity and temperatures. Linear HPAM.
ZLPAM® II	Suitable for reservoirs with medium salinity and temperature. Linear Terpolymer.
ZLPAM® III	Designed for high-salinity and high-temperature reservoirs. Linear Terpolymer.
ZLOFFSHORE POLYMER®	Designed for offshore polymer flooding. Dissolve quickly in sea water and high salinity produced water, Salinity and temperature resistant. Require minimal facilities.
ZL NANO-SPHERES®	Designed to improve water flooding sweep efficiency. Applicable to reservoirs with salinity up to 300,000mg/L and 130 °C /266F temperature.

PART.02

ZLPAM® III SERIES

SALINITY AND TEMPERATURE RESISTANT POLYMERS

Polymer flooding is one of the most common and effective means of EOR methods. Harsh conditions, such as elevated salinity and temperature, effect a large number of oil reservoirs throughout the world. ZL introduced its ZLPAM®III series to provide high-performing polymers for EOR projects where there are high-salinity and high-temperature reservoir conditions and produced water is used for injection.

! Main Requirements for EOR Polymer

Dissolve completely in injection water within a short period of time, to eliminate injectivity problems and minimize surface facility investment.



Maintain apparent viscosity target over time under high-temperature and high-salinity reservoir conditions to maximize sweep efficiency, minimize severe permeability decline, and reduce additional water treatment caused by precipitation of polymers.

☰ Summary of the ZLPAM Characteristics



Dissolves in produced water directly within required time. This minimizes surface facility footprint and eliminates injectivity problems caused by incomplete dissolution.



Product offerings are tailored to meet a customer's technical needs, offering maximized technical success and optimal chemical costs.



ZLPAM®III series are the leading temperature and salinity-resistant EOR polymer currently offered on the market.



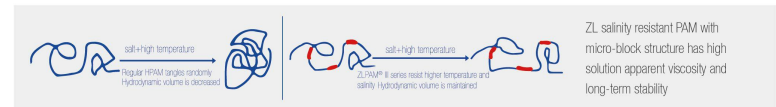
No incorporated hydrophobic monomers, no injectivity issues and minimal adsorption.



Maintains higher viscosity in high-temperature and salinity conditions.



Stays in linear shape to ensure good sweep efficiency.



PART.03

ENHANCED OIL RECOVERY

ZLNANO® – WATER FLOODING ENHANCEMENT TECHNIQUE

In addition to their linear polymer product line, ZL recently launched its polymer based ZLNANO® technology. ZLNANO® provides significant advancement in conformance control and improved oil production in various reservoir conditions.

ZL Nano-Sphere® and Microsphere technology can help increase production from reservoirs under water flooding through conformance modification deep in the reservoir. To increase water flooding efficiency, Nano-spheres and Micro-sphere will expand in water which creates resistance in existing water break through channels.



During the oil extraction process, the heterogeneity and porosity of the reservoir are the key factors that influence the water flow directions. Water flooding and chemical flooding's efficiency is highly dependent on the heterogeneity of reservoirs. ZLNANO® are designed to improve the heterogeneity of the reservoirs, to increase the water flooding or chemical flooding efficiency.



Summary of the ZLNANO® Characteristics

01

Particles have the initial diameter ranging between 20 and 100nm and can pass through different pore throat sizes. After predetermined time for given reservoir conditions, ZLNANO® will hydrate, expand and contract, constantly adjusting the water relative permeability of the channels deep within the reservoir.

02

Control the water flow and prevent water channeling in the thief zone, proving flow resistance and adjusting the water relative permeability. Their initial size guarantees that they can move through the near-wellbore region and travel deep into reservoir.

03

Leverages a short-period treatment method using multiple slugs at different injection rates, dependent on the permeability of the thief zone. This differs from other chemical treatments where the chemical agent is injected continuous.

04

ZLNANO® particles injection can effectively decrease the permeability ratio as a result and thus increasing water injection efficiency, which will increase recovery mainly from low permeability zone.

05

Oil reservoirs with relatively low oil viscosity benefit significantly from using this technology. To date, large-scale commercial applications have resulted in 60-500 tonnes of crude oil per ton of Nanospheres applied over 1.5 years period. Some of ZL's oil field ZLNANO® applications have increased the oil production by as much as 50%.

PART.04

ENHANCED OIL RECOVERY

ZLNANO® – WATER FLOODING ENHANCEMENT TECHNIQUE

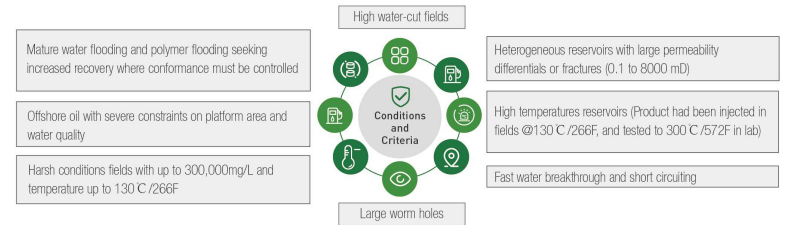


The ZLNANO® technology can provide many benefits to oil recovery, such as low dosage, efficient resistance, low cost, and are less influenced by geographical conditions. This technology can be used in oil fields with extreme high temperatures (up to 130 C /266F) and salinity (up to 300,000mg/L), especially in offshore oil fields with on the fly injection.

ZLNANO® particles are very stable in water, with small initial size. The spheres migrate through the pores and expand in the formation water in an oil reservoir. As the Nanospheres expand in size, it creates resistance in the seepage channels within the formation and redirects the water flow to lower permeability layers.

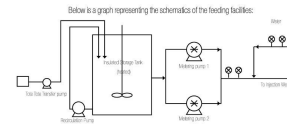


Conditions and Criteria For Nano-sphere Applications



Low Capital and Operational Costs

ZLNANO® technology is often used together with Microspheres and self-crosslinking Microspheres products, for the systems with premature water breakthrough and high-channels. Unlike conventional polymer floods, ZLNANO® and Microsphere technologies do not require hydration and mixing equipment. They are injected directly into the water injection line.



SPE 174654, SPE 156991, Appl. Nanosol DOI 10.1009/13284-0199-X. Please contact us for more published case and laboratory studies.

ZL Offers a wide range of Conformance control technologies, including polymer gel treatment, Polymer particles blocking technique, and weak polymer crosslinking gel treatment, along with Nano and microsphere technologies.

PART.05

ENHANCED OIL RECOVERY

OFFSHORE POLYMER FLOODING

Offshore polymer flooding brings a significant opportunity to enhance oil recovery. Much has been described in literature as to the required characteristics of polymers for offshore EOR. However, to date, very few commercial projects have started. In order to address the current challenges facing operators, ZL developed a new chemically advanced polymer structure and composition. This polymer structure helps to overcome these challenges and develop offshore fields by polymer flooding successfully.

The footprint requirements for product storage and polymer preparation and injection equipment are very strict. The polymer must achieve high dissolution and rapid viscosity development with no insoluble gels under harsh water conditions. Logistics and supply chain management of the polymer delivery to the site needs to be minimized. Polymer performance in offshore applications must be suitable for large well-spacing and overall size of the reservoir to be swept. As a result, the polymer with high active content, fast dissolution and high in-situ viscosity is critical for the success of such a project.

Overcoming the Current Challenges, Platform Restrictions and Polymer Performance

Chemical: ZL Offshore Polymer



Fast dissolution dry polymer technology incorporated with micro-block template terpolymer, enables full dissolution of polymer in pipeline prior to entering the reservoir without mixing and maturation tanks.



High salinity and high temperature resistance characteristics, use of seawater or produced water for polymer preparation and injection, stable polymer causes less produced water emulsion breaking issues.



Sound, long-term stability in situ provides better sweep efficiency and, higher oil recovery.

Facility - Compact Polymer Dispersion Unit (CPDU®)



- 01 No mixing or maturation tank required that guarantees compact design
- 02 Uniform feeding of polymer powders
- 03 Ensure the complete mixing of polymer with water, no fish eyes, clogs or precipitates
- 04 No chemical or mechanical degradation during dispersion
- 05 CPDU is Nitrogen-blanketed with PLC control

PART.06

ENHANCED OIL RECOVERY

OFFSHORE POLYMER FLOODING

Limited platform space requires all facility components to be as compact and light as possible. The same principle of small footprint and light weight applies to the FPSO and remote locations with harsh weather conditions challenging for delivery and storage.



Choosing the right technology for offshore reservoirs is extremely important in maximizing oil recovery. ZL EOR Chemicals has over 20 years of experience serving the EOR industry. ZL leverages its manufacturing and application expertise to help its customers evaluate

their reservoirs and design the most cost-effective programs. ZL's laboratory analysis, pilot projects and application methodology will help add success to full-field EOR implementation.

L*W*H (m)	PAM Dosage (kg/h)	Mother solution capacity (m ³ /h)	Weight (Tons)	Daily water injection capacity(m ³) (Q=1000ppm Target solution,10000ppm Mother Solution)	Total power (KW)
3.8*2.6*3.6	100	10	3.6	2400	18.5
4.5*2.8*3.8	500	50	4.5	12000	28.5
4.8*3*3.8	1000	100	5	24000	55
4.8*3.2*3.8	1500	150	5.3	36000	75
5.2*3.4*3.8	2000	200	5.6	48000	95



Minimal Transportation and Storage Facility



Good Sweep Efficiency



Minimum Foot Print

Note: More information on polymer and polymer dispersion unit for offshore application, please contact ZL



Net CPDU weight range from 3.2 Tons to 5.6 Tons

