



Boosting oilfield output to help close the energy gap

An average oilfield only yields 30 – 35% of its potential using conventional production techniques so it is not surprising that oil companies are looking to Enhanced Oil Recovery (EOR) to extract more crude oil from their existing reserves. Chemical EOR involves the injection of specialty surfactants and brine into an oil reservoir to release trapped oil. The surfactant package works by lowering the Interfacial Tension (IFT) between the oil and the brine to reduce capillary forces and allow the oil to move within the pore space of the reservoir rock.

Indorama surfactants can be used in Surfactant-Polymer (SP) or Alkaline-Surfactant-Polymer (ASP) packages that are formulated for specific reservoir conditions. The choice of surfactants depend on the crude oil, the reservoir temperature, the injection brine composition (Total Dissolved Solids and hardness), and formation geology. Indorama has the technology to create surfactants to meet these varied demands.

About Indorama

Indorama Ventures is a world-class chemical company and a global integrated leader in PET and fibers serving major customers in diversified end-use markets. Following our core strategies, we develop innovative products for customer needs and to make great products for society. Headquartered in Bangkok, Thailand, Indorama Ventures has operating sites in 31 countries on five continents – in Africa, Americas, Asia, Europe & Eurasia.

Integrated Oxides & Derivatives

Indorama Ventures Oxides & Derivatives is a leading chemical intermediates and surfactants producer with a diverse range of products in growth markets such as home & personal care, agrochemicals, oilfield technologies, fuel & lube additives and more.

In January 2020, Indorama Ventures Public Company Limited completed its acquisition of Huntsman's world-class integrated oxides and derivatives business, including:

- **Surfactants:** Integrated producer of a wide range of products for home and personal care, oilfield technologies, agriculture and process industries.
- **Ethylene and Derivatives:** Highly integrated manufacturer of ethylene, ethylene oxide, ethylene glycol, ethanolamines and other derivatives.
- **Propylene Oxide & Derivatives:** Highly competitive technology offerings in propylene glycol, methyl tertiary butyl ether (MTBE) and other derivatives.

Our operating sites include a large flagship site on the US Gulf Coast (USGC) at Port Neches, as well as Chocolate Bayou, Dayton and Clear Lake in Texas, Lake Charles, Louisiana, Ankleshwar, India and Botany, Australia.



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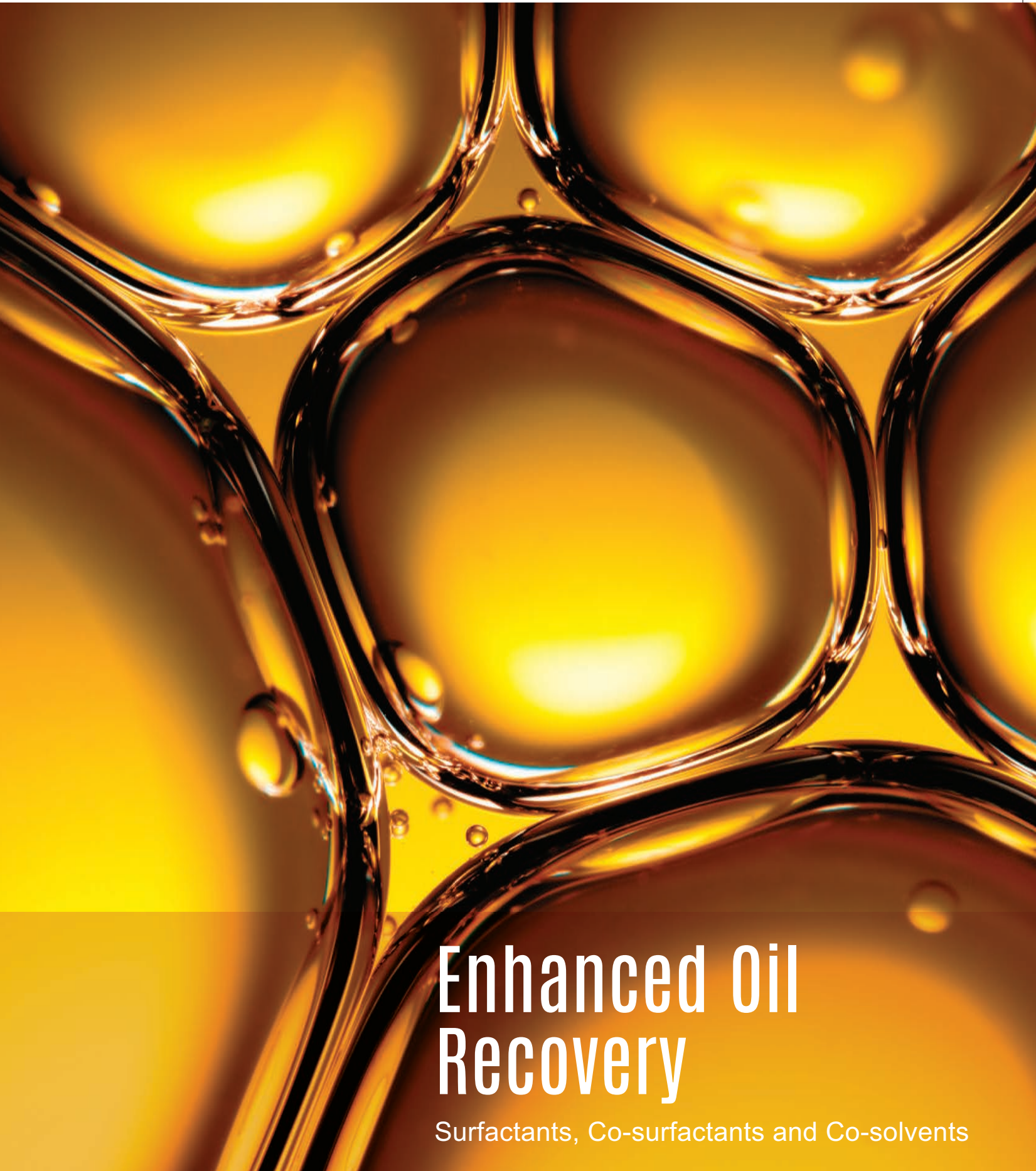
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Enhanced Oil Recovery

Surfactants, Co-surfactants and Co-solvents



> Empowering potential.

www.indoramaventures.com

Global Technology

UNITED STATES

Regional Office

- The Woodlands (Texas)

Research and Development Site

- The Woodlands (Texas)

Manufacturing Location

- Clear Lake (Texas)
- Chocolate Bayou (Texas)
- Dayton (Texas)
- Lake Charles (Louisiana)
- Port Neches (Texas)

SOUTH AMERICA

Regional Office

- Mexico City, Mexico

APAC

Regional Office

- Mumbai, India
- Botany, Australia

Research and Development Site

- Brooklyn, Australia
- Mumbai, India

Manufacturing Location

- Ankleshwar, India
- Botany, Australia

Our Synthesis Technologies

Infinite possibilities, added value, competitive advantage

Indorama is a global producer and supplier of surfactants. This broad portfolio includes products designed specifically to meet the challenges of the oilfield and EOR markets. Our success stems from innovative technologies, large scale manufacturing capabilities and a global distribution network.

For the EOR market, Indorama manufactures a variety of products for use as primary surfactants, co-surfactants, and co-solvents using the following technologies:

Alkylolation Production of Alkylaryl compounds with intermediate length side-chains. After sulfonation these molecules become thermally stable surfactants that are included in many EOR formulations because of their ability to interact with crude oil.

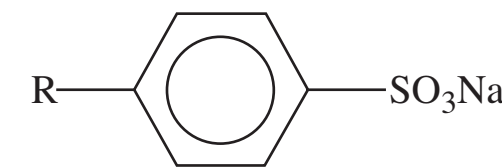
Alkoxylation Reaction of propylene oxide (PO) and ethylene oxide (EO) with active alcohols to produce nonionic surfactants and intermediates for further reaction.

Sulfation/Sulfonation/Carboxylation Addition of a sulfate/carboxylate group to an alkoxyated molecule or a sulfonate group to an alkylaryl molecule.



PRIMARY SURFACTANTS Interact with crude oil

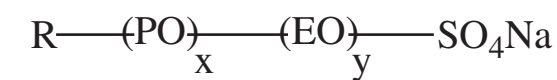
- Key ingredients in producing EOR formulations that give ultra-low IFT
- Hydrophobes selected for ability to interact with crude oils



Alkylaryl Sulfonates

Products: XOF-22A, XOF-26A and XOF-30A

- These are high active materials that are converted into surfactants by neutralization.



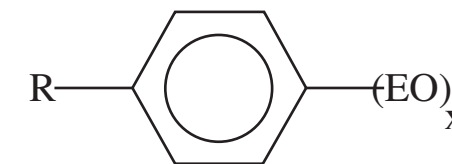
Extended Chain Surfactant

Products: XOF-100S, XOF-101S, XOF-202S, XOF-112C, XOF-314C, XOF-315C and XOF-316C

- S designated for ether sulfate and C is for ether carboxylate

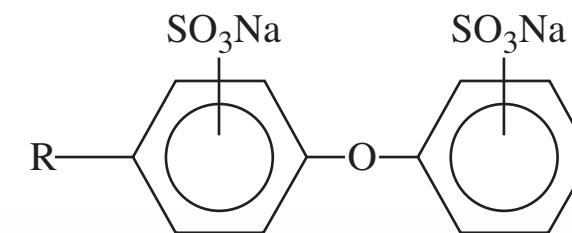
CO-SURFACTANTS Formulation stability

- Increase formulation tolerance to salt and hardness
- Can participate at the oil/brine interface and lower IFT



Alkyl and Alkylaryl Ethoxylates

Products: SURFONIC® L Series and SURFONIC® N Series

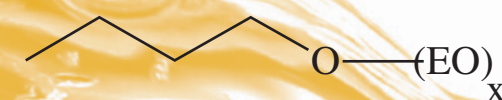


Alkylaryl Disulfonates

Products: Boosters XOF-600S, XOF-602S

CO-SOLVENTS Performance tuning

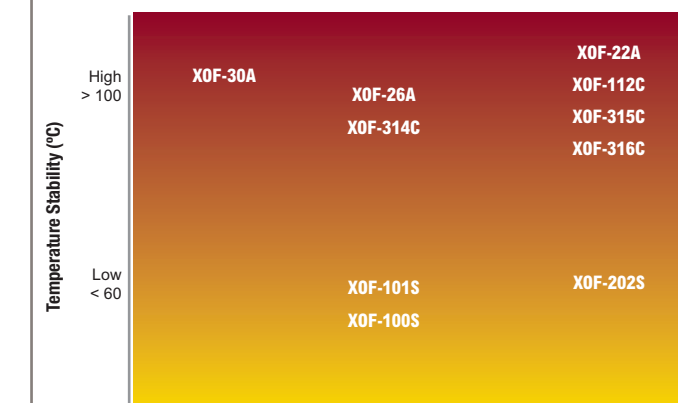
- Broad distribution of ethylene oxide (EO)
- Improved brine compatibility
- Shift interfacial tension (IFT) minima to higher salinity



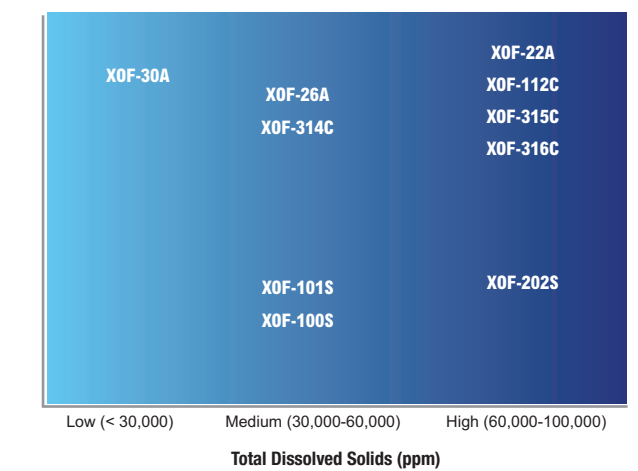
Short Chain Alcohol Ethoxylates

Products: SURFONIC® L4 Series

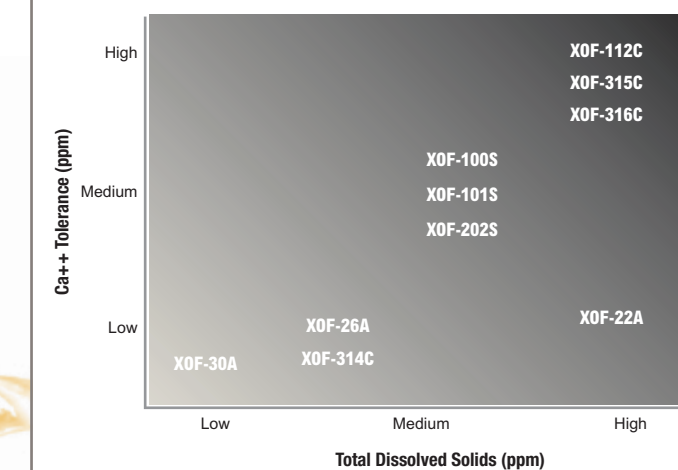
Temperature Stability



Total Dissolved Solids



TDS Usage Range



TDS Usage Range Extension

