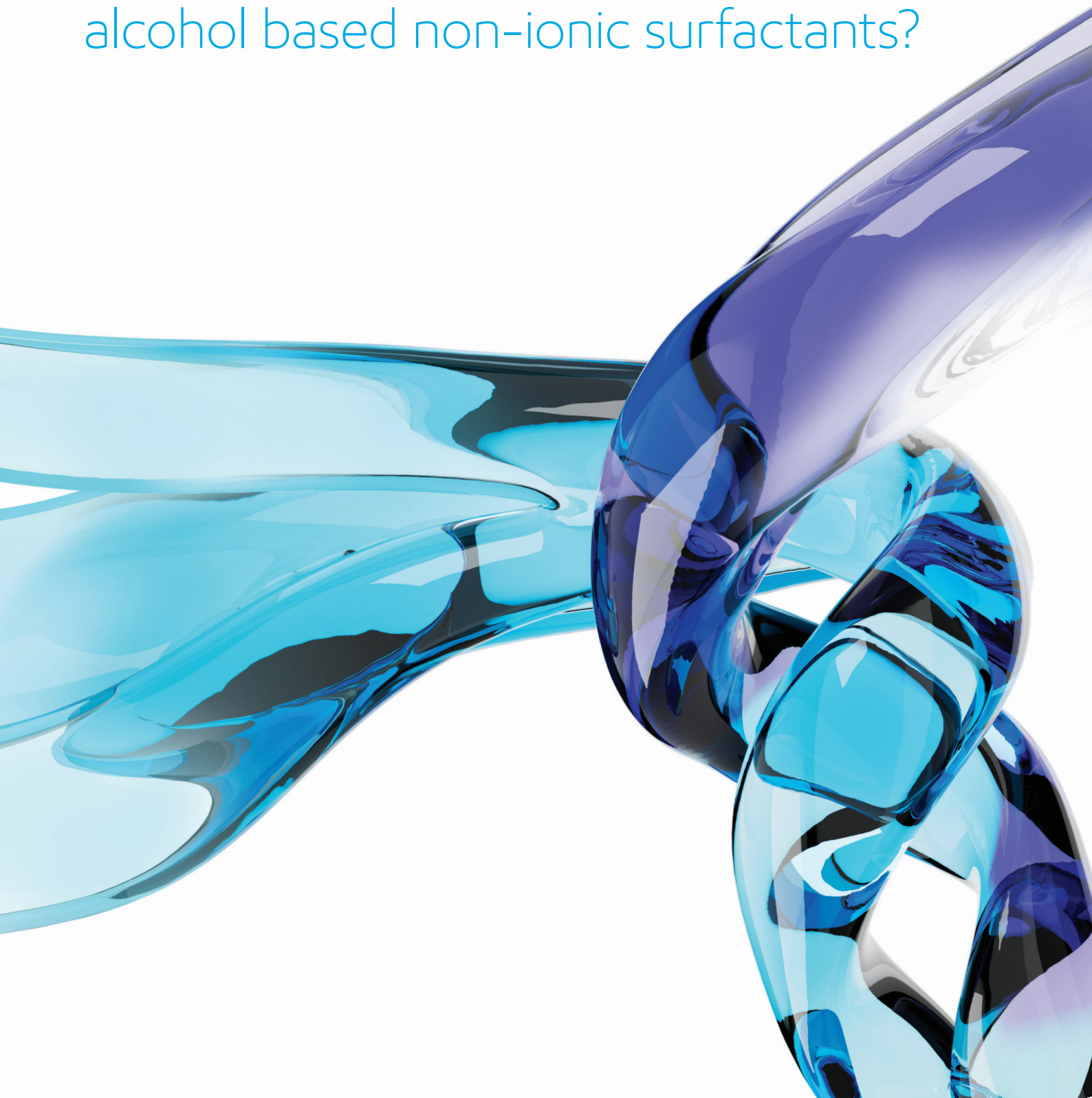
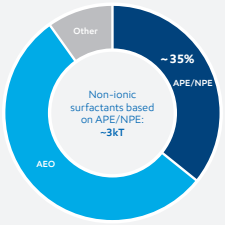
ExxonMobil

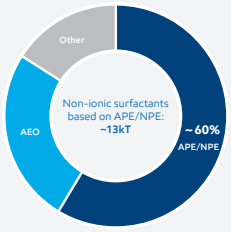
How to achieve high performance and **APE-free emulsion polymerization** and paint formulation with Exxal™ alcohol based non-ionic surfactants?



Surfactants emulsion polymerization industry India, 2022 (1)



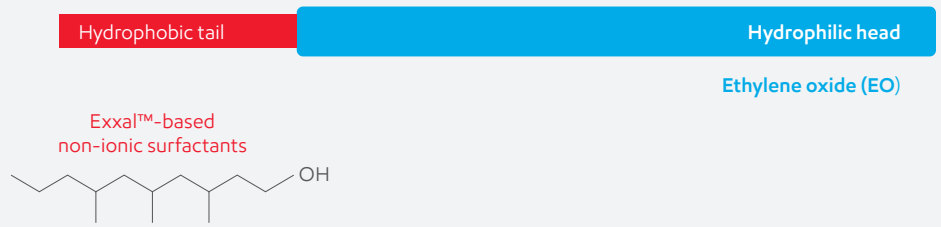
Surfactants paints and coatings industry India, 2022 (1)



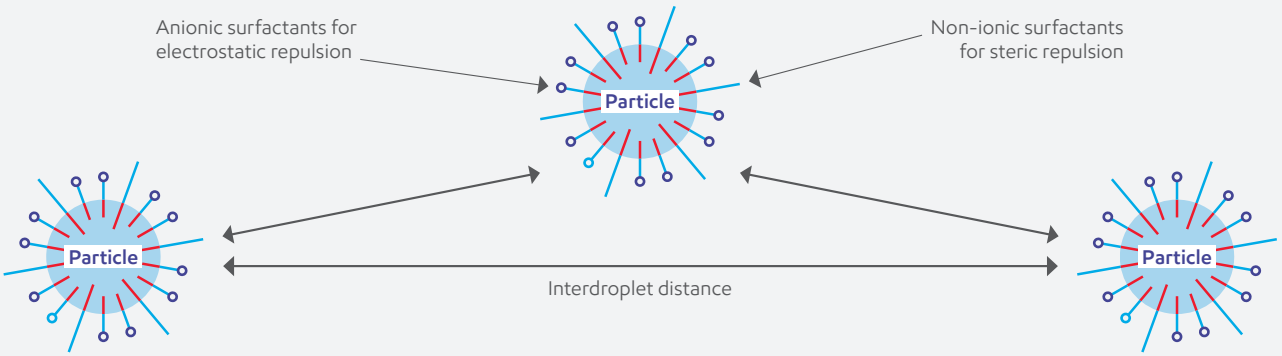
(1) Rapport Kline 2022

Consumer and regulatory trends

- Ongoing shift from solvent-based to water-based paints
- Demand for formaldehyde-free, APE-free and low-VOC water-based paints is increasing in India
- Alcohol ethoxylates have a good environmental profile compared to APE/NPE and are increasingly being used as a replacement for APE-based products.



Non-ionic surfactants for emulsion polymerization and paint formulations



Alcohol	CAS #	Pour point (°C) ASTM D5950(2)	Purity wt% total alcohol(3)	Viscosity at 20°C mm²/s ASTM D7042	Average carbon number(3)	Average Branching per molecule(3)
Exxal™ 11	68551-08-6	< -40	> 99.0	27	10.9	2.1
Exxal™ 13	68526-86-3	< -40	> 98.5	48	12.8	3.0

(2) Modified method

(3) ExxonMobil internal method

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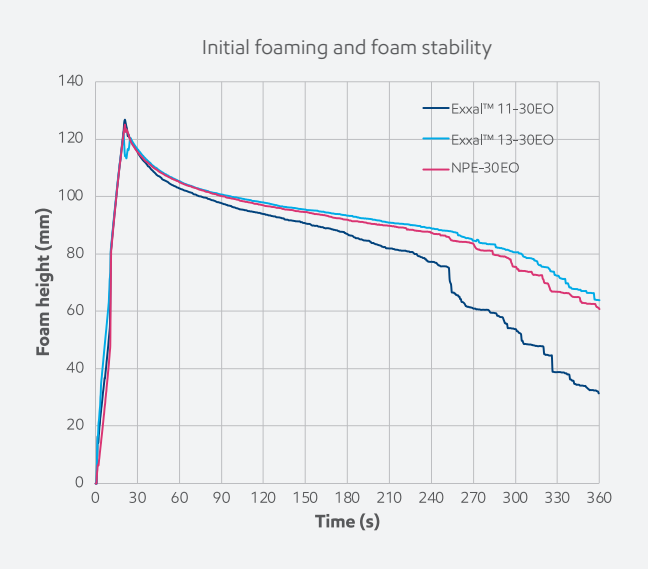
High ethoxylates HLB for emulsion polymerization[4]

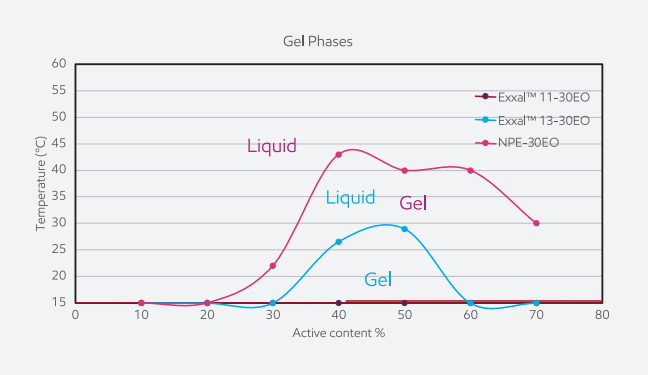
	Exxal™ 11	Exxal™ 13	Nonyl Phenol
Mole EO/mole (nominal)	~30	~30	~30
HLB	17.5	17.5	17.5
Aspect at 20°C	clear (70% active)	clear (70% active)	clear (70% active)
Dynamic viscosity @ 25°C (mPa.s) ASTM D7042	~650	1000	~1000
Surface tension (mN/m)	38.8	35.2	38.7

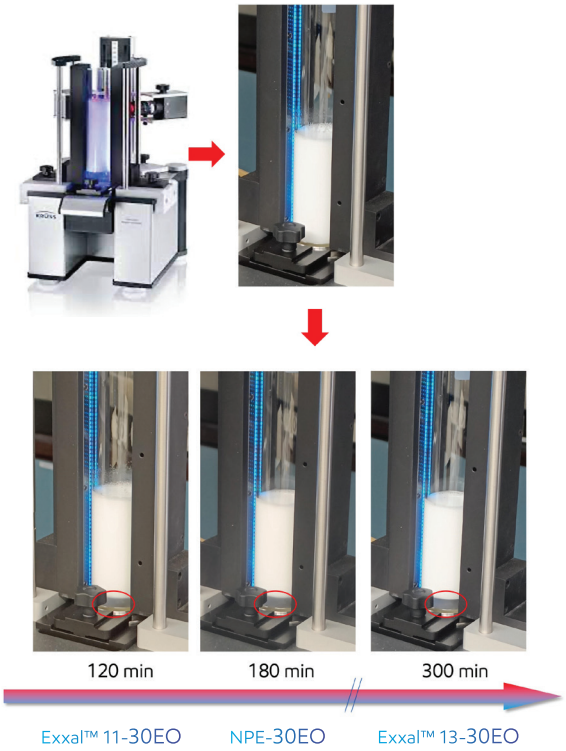
Benefits[5]	Surfactant properties
Could enable defects-free emulsion, stable dispersion Could enable clean polymerization process	Low initial foaming and foam stability, Low dynamic surface tension values Good emulsification power
High productivity, Potential for less-energy intensive processes	Low to no gel phases

(4) Data from tests performed by or on behalf of ExxonMobil"

(5) To be compared with corresponding APE surfactants







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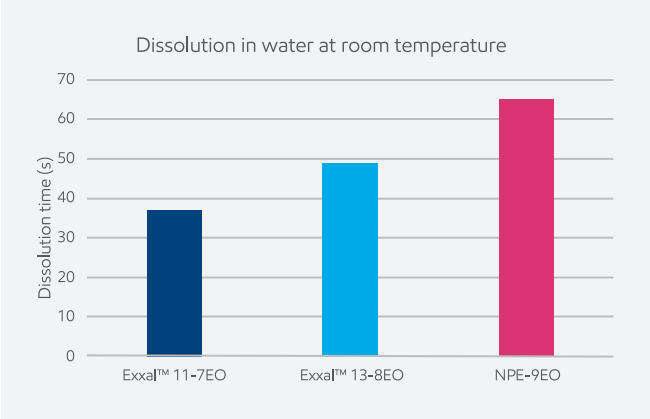
Medium ethoxylates HLB for wetting of pigments (paint formulation)[4]

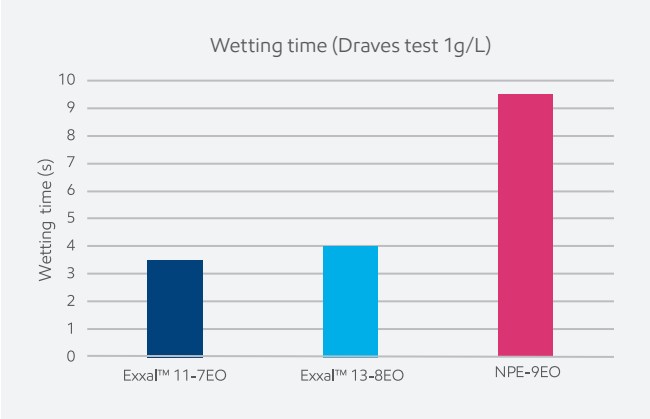
	Exxal™ 11	Exxal™ 13	Nonyl Phenol
Mole EO/mole (nominal)	~7	~8	~9
HLB	12.8	12.9	12.7
Aspect at 20°C	slightly hazy	slightly hazy	clear
Dynamic viscosity @ 40°C (mPa.s) ASTM D7042	27.5	36.8	177
Surface tension (mN/m)	26.1	26.7	31.9

Benefits[5]	Surfactant properties
Could enable uniform surface coverage and defect-free coating	Low surface tension values, Fast and effective wetting (Draves test, low contact angle) Low initial foaming and foam stability
High productivity Potential for less-energy intensive processes	Rapid dissolution in water

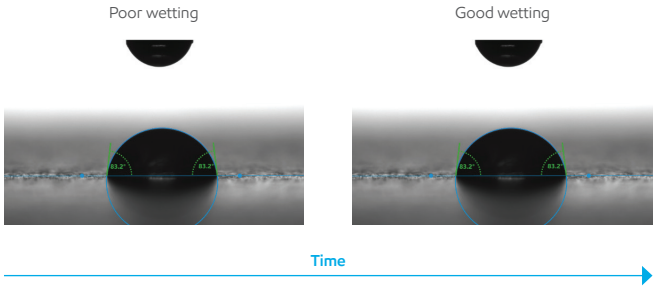
(4) Data from tests performed by or on behalf of ExxonMobil"

(5) To be compared with corresponding APE surfactants





Wettability via contact angle measurements



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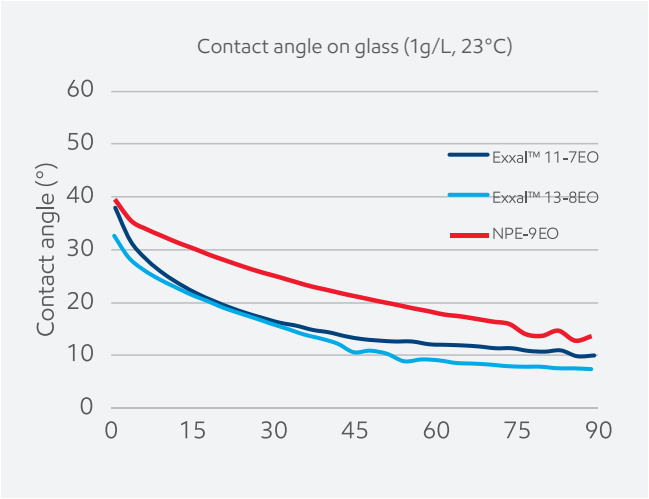
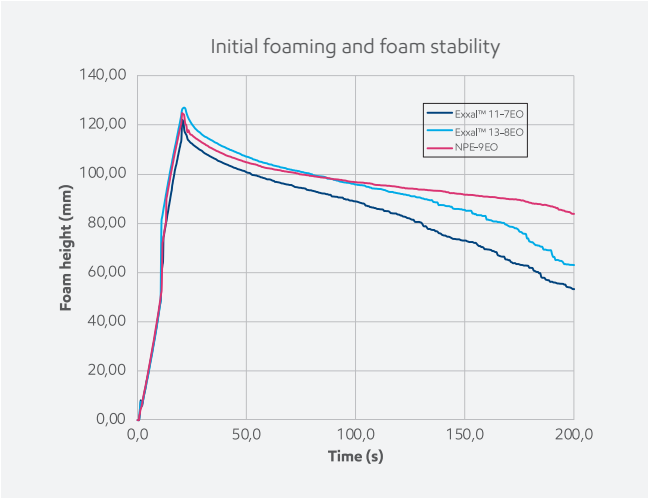
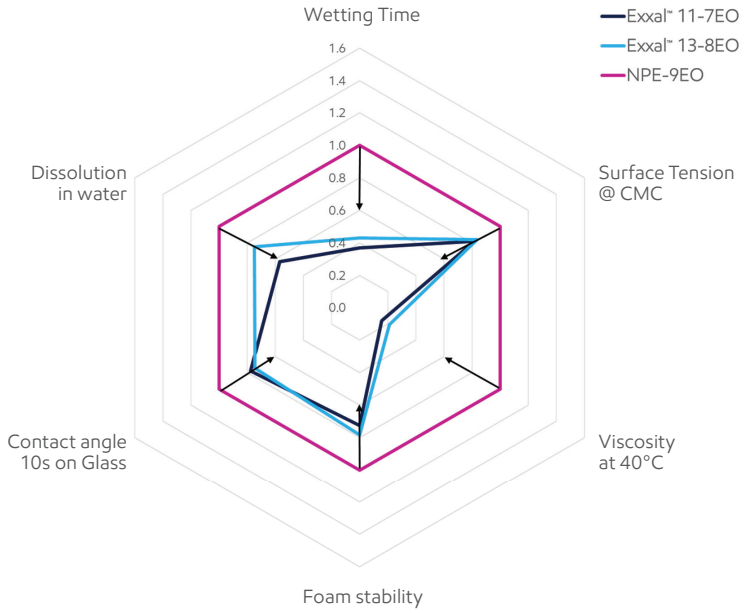




Key properties

Medium ethoxylates/HLB



High ethoxylates/HLB

Biodegradability of branched alcohol		Biodegradability of branched alcohol ethoxylates	
Exxal™ 11	✓	Exxal™ 11 - 7EO	✓
Exxal™ 13	●	Exxal™ 13 - 7EO	✓
		Exxal™ 11 - 30EO	✓
		Exxal™ 13 - 30EO	✓

✓ Within 10-day window
Readily biodegradable (>60%) per OECD 301F