Sustainable Bio-based Surfactants

100% Bio-based ECO Range

Sustainability is in our DNA. It is integral to everything we do. From the raw materials we source and the way we use them, to the ingredients we create, we believe in being a responsible company.

We are pleased to introduce our new ECO range of 100% bio-based surfactants. Over 50 products make up the ECO range made by using bio-based ethylene oxide (EO) which we manufacture from biomass ethanol. Coupling the use of bio-based EO with the high proportion of renewable energy used at the manufacturing plant, leads to a significant reduction in carbon footprint for the ECO product range.

Formulators can now access 100% renewable surfactants without sacrificing performance to help meet increasingly demanding sustainability targets.

The new range of ECO surfactants:

- 100% renewable
- Performance identical to petrochemicalbased options
- Lower carbon footprint than petrochemically derived ingredients
- USDA BioPreferred[®] Program third party certification*
- RSPO Supply Chain Certified via Mass Balance[†]
- Made using renewable energy





Making Ethylene Oxide Sustainable

With increasing consumer demand for renewably sourced and sustainable products, we are pleased to introduce our new ECO range of 100% bio-based surfactants. In recent years, "greener" non-ethoxylated ingredients have been used in the pursuit of more renewable formulations, but the performance has not met the levels achieved when using traditional ethoxylates. With significant investment at our Atlas Point manufacturing site, located in Delaware, USA, our plant is the first of its kind in the US to produce bio-based EO from bio-ethanol (Figure 3). This development enables the production of sustainable and bio-based ethoxylates (Figure 1).



Figure 1: The petroleum and bio-based production pathways of ethylene oxide.

ECO Range Multi-layered Renewable Benefits

The ECO range provides multi-layered renewable benefits and value for our customers. Not only will formulators be able to replace petrochemicalbased non-ionic analogues while experiencing "zero sacrifice" in performance, they will be able to replace less-effective "natural" market alternatives as well.

Bio-based & Sustainable

- Sustainable palm sourcing, RSPO supply chain certified via Mass Balance[†]
- Biomass raw material for 100% bio-based ethylene oxide and derivatives

Low Carbon Footprint

- Made using energy sourced from landfill gas and solar energy
- Cradle-to-gate carbon footprint

ECO Range

• 100% bio-based surfactants

Community Benefit

- 30 new full time employees
- Reduced rail freight miles of highly flammable petrochemical EO from the Gulf of Mexico

Green Labelling

- EPA Safer Choice recognised for biodegradability and low toxicity
- USDA BioPreferred[®] third party certification of C14 measurements*

Figure 2: Highlights of the multi-layered sustainability benefits achieved by our ECO range.

Improved Bio-based Content

Chemically equivalent to petrochemical-based ethoxylates, Table 1 shows the improvement in bio-based content for key surfactant chemistries when produced using our bio-based EO.

Surfactant	Bio-based content with synthetic EO (%)	Bio-based content with Bio-EO (%)
Laureth-6	50	100
Laureth-7	46	100
PEG-40 castor oil	42	100
Polysorbate 20	31	100
Trideceth-9	0	58
C9-C11 + 6E0	0	55

Table 1: Comparison of percentage bio-based content between using petrochemical-based EO versus bio-based ${\rm EO^{\star}}.$

*Calculated using ASTM D6866 which is validated by carbon 14 testing †RSPO Grades - Certified sustainable palm oil grades by mass balance (minimum)

Certified Bio-based Content

Our new ECO range helps formulators meet renewability targets. Table 2 lists the BioPreferred bio-based content requirement of a finished formulation under a product category. Replacing petrochemical based surfactants for ECO range products will improve bio-based content of the formulation. All ECO products are being registered on the USDA BioPreferred Programme.

Product category	% Bio-based	
Bathroom cleaner	74	CERTIFIED
Dishwasher product	58	PRODUCT
Laundry product	34	PRODUCT 100%

Table 2: Examples of USDA BioPreferred product categories and associated minimum bio-based content to be eligible for certification.

Renewable Energy at Atlas Point

In 2012, we invested in a renewable energy project at our Atlas Point manufacturing site located in Delaware, USA (Figure 3). This investment saw the installation of a 3.5 mile pipeline from a local landfill site so that we could purchase local landfill gas. The gas feeds two combined heat and power (CHP) units and a multi-fuel boiler to generate electricity and steam for the plant. In 2014, we further invested in solar panels at the site, which reduced our annual carbon dioxide (CO₂) emissions by 11,600 tonnes CO₂e.

By quarter two of 2020, a third CHP unit will be installed, increasing our capacity for generating electricity and steam from landfill gas and increasing the estimated percentage of the site's energy being renewably sourced to above 30%.^Δ

Avoidance of Greenhouse Gas (GHG) Emissions

Capturing and converting landfill gas to electricity and steam avoids the release of methane into the atmosphere, which has a global warming potential 25 times greater than CO_2 when measured over 100 years. Our use of landfill gas since 2012, combined with the reduction in our usage of natural gas, has led to an aggregate reduction in GHG emissions of close to 1 million tonnes CO_2e . Annually, the amount of avoided emissions is a figure equivalent to our total combined Group 1 and 2 emissions.^{AA}



Figure 3: Photograph of the ECO plant at Atlas Point, Delaware, USA.

Carbon Footprint of ECO Range

We have used SimaPro software to model the cradle-to-gate life cycle analysis (LCA) of our ECO product families, focused on the climate change impact category, following the technical specification ISO 14067.

The high proportion of renewable energy available at Atlas Point, along with the use of bio-based EO, leads to a significant reduction in carbon footprint for a typical ECO product family, when compared to traditional ethoxylates made using petrochemical-based EO and without renewable energy (Figure 4).



Figure 4: Carbon footprint example for Tween 20. Demonstrates the unique carbon footprint reduction moving from petrochemical-based EO to bio-based EO, plus the plant's use of renewable energy for these ingredients.

ΔΔGroup 1 emissions are direct emissions. Group 2 emissions are indirect emissions from the generation of of purchased power

^ΔAtlas Point renewable energy calculated for the 2018 sustainability report

								Biodeg	gradability	Aquatic Toxicity		city		Applications								Functions		
		BSP0	Physical		FCO	Safer	Vegetable			Algae	Danhnia	Fish	Fabric	Fabric	Dish	Fibre S	Hard Jurface	Air	Waxes/					
Product	Chemical Description	Grades ^{††}	Form(s)	HLB	Label*	Choice	Based	Aerobic	Anaerobic	(mg/l)	(mg/l)	(mg/l)	Detergents	Conditioners	Washing	Finish C	leaning	I&I Care	Polishes	Detergency	Wetting	Emulsifying	Solubiliser	Concentrates
EC0 Arlacel™ 165	Polyoxyethylene-stearate		PW	11.0				biodegradable																
EC0 Arlatone™ T	Ethoxylated sorbitan ester	PF	LQ	10.0							>100	227											•	
EC0 Brij™ C10	Ceteth-10		SO	12.9	2173			Readily biodegradable					•					•						
ECO Brij C2	Ceteth-2		SO	5.3	2170			Readily biodegradable					•					•						
ECO Brij C20	Ceteth-20		SO	15.7	2173			Readily biodegradable										•						
ECO Brij CS20	Ceteareth-12		SO	15.7	2177			Expected to be biodegradable	Biodegradable									•						
ECO Brij L23	Laureth-23		SO	16.9	2167			Readily biodegradable	Biodegradable				•											
ECO Brij L23-69	Laureth-23		LQ	16.9	2167			Readily biodegradable	Biodegradable									•						
ECO Brij L3	Laureth-3		LQ		2162			Expected to be biodegradable	Biodegradable															
ECO Brij L4	Laureth-4		LQ	9.7	2162			Expected to be biodegradable	Biodegradable	100		3.3												
ECO Brij L6	Laureth-6		LQ	11.6	2163			Readily biodegradable	Biodegradable	100		3.3												
ECO Brij L6L	Laureth-6		LQ	11.6	2163			Readily biodegradable	Biodegradable	100		3.3						•						
ECO Brij L7	Laureth-7		LQ	13.3	2163			Readily biodegradable	Biodegradable	100		3.3												
ECO Brij L7L	Laureth-7		LQ	13.3	2163			Readily biodegradable	Biodegradable	100		3.3												
ECO Brij 010	Oleth-10		LQ	12.4	2167			Inherently biodegradable	Biodegradable															
ECO Brij O2	Oleth-2		LQ	5.0	2174			Inherently biodegradable	Biodegradable			4.7												
ECO Brij 020	Oleth-20		S0, SS	15.5	2177			Inherently biodegradable	Biodegradable			4.7												
EC0 Brij 020-22	0leth-20-22		LQ	15.5	2177			Inherently biodegradable	Biodegradable									•						
ECO Brij 03	Oleth-3		LQ	6.6	2175			Inherently biodegradable	Biodegradable									•						
ECO Brij 05	Oleth-5		LQ	9.0	2175			Inherently biodegradable	Biodegradable									•						
ECO Brij S10	Steareth-10		SO	12.4	2176			Inherently biodegradable	Biodegradable									•						
ECO Brij S100	Steareth-100		SO	18.8	2178			Inherently biodegradable	Biodegradable															
ECO Brij S2	Steareth-2		SO	4.9	2174			Readily biodegradable	Biodegradable									•						
ECO Brij S20	Steareth-20		SO	15.3	2177			Inherently biodegradable	Biodegradable									•						
ECO Brij S721	Steareth-21		SO, PW	15.5	2177			Ultimately biodegradable	Biodegradable			8.4						•						
ECO Cirrasol™ Care	Proprietary blend		LQ																					
ECO Cirrasol PE1185	Proprietary blend	PF	LQ																					
ECO Cirrasol PP842	Proprietary blend	PF	LQ																					
ECO Cosmowax J	Cetearyl Alcohol (and) Steareth-20 (and) Steareth-10	PF	PA					Inherently biodegradable	Biodegradable															
ECO Cosmowax P	Cetearyl Alcohol (and) Ceteareth-20	PF	PA																					
ECO Crodastat 400	Proprietary	PF	LQ	16.7				Readily biodegradable		>10,000	>100	216						•						
ECO Croduret 25	PEG-25 hydrogenated castor oil	PF	LQ	10.8																				
ECO Croduret 25G	PEG-25 hydrogenated castor oil	PF	LQ	10.8																				
ECO Croduret 40	PEG-40 hydrogenated castor oil	PF	SS	13.0				Inherently biodegradable																
ECO Croduret 1292	Alkoxylate	PF	LQ	11.0																				
EC0 Diversaclean™ CS	Proprietary surfactant	PF	LQ					Readily biodegradable			>100	96.64												

*Detergent Ingredients Database Number ⁺⁺PF = Palm-free, LQ = Liquid, PA = Pastillated, PW = Powder, SO = Solid, SS = Semi-solid

Smart Science to Improve Lives™

								Biodeg	gradability	Aq	Aquatic Toxicity		Applications									Functions			
		RSPO	Physical		ECO	Safer	Vegetable			Algae	Daphnia	Fish	Fabric	Fabric	Dish	Fibre	Hard Surface		Air	Waxes/					
Froduct	Chemical Description	Grades	Form(s)	12.0	Label	Choice	Based	Ultimately	Anaerobic	(mg/i)	(mg/l)	(mg/l)	Detergents	Conditioners	wasning	Finish	Cleaning	1&1	Care	Polisnes	Detergency	wetting	Emuisitying	Solubiliser	Concentrates
ECO Etocas 40	PEG-40 castor oil	PE	CQ CC	12.0			12.	biodegradable Ultimately									- 21		21				- 21		
ECO Elucarox 767			00 90	13.0			÷.	biodegradable									- 24		÷.,	÷.,					
ECO Glycerox HE		- 21	22	10.6			12.1										- 21		э.	-	-	12.1			
ECO Glycerox PK-70	PEC 45 palm kornel alveerides	÷.	00	15.0			÷.,										- 24		-	-					
ECO MyriTM S8	PEG-8 stearate	PE	50	11.1			-	Inherently		×320		15					-			-	-				
ECO Myri S40	PEC 40 stearate	DE		16.0				biodegradable Inherently		>020		15	÷.,							÷.,					
ECO Myri S100	PEC 100 stearate	DE	r W, FA	10.9				biodegradable Inherently															- 21		
ECO NatraSonsoTM 125			10	0.6				biodegradable Expected to be					÷.							-				-	
ECO NatraSense 205		- 21	LQ	11.5		- 21	- 21	biodegradable Expected to be							- 21		- 21	- 21	а.		- 21	12.1	- 21		
ECO NatraSense 205		÷.,	LQ	10.0		- 2-	÷.,	biodegradable Readily			. 100		÷.,		÷.,		- 24	÷.	а.		- 24	÷.,			
ECO NatraSense 205		- 21	LQ	14.0		- 21	- 21	biodegradable Readily			>100						- 21		а.		- 21	- 21	- 21		- 21
ECO Releway A 21		÷.,	LQ	14.0		-	÷.,	biodegradable			>100		-		-			-	-						
ECO Polawax NE							- 21																- 21		
ECO Polawax NF	Nonionic emulsitying wax	DE	PA		0500		÷.,													-					
ECO Renex MEC 400	PEG 200	PF	LQ		2539		÷.										- 21	- 21				÷.			
ECO Renex PEG 400	PEG 400	PF	LQ		2039		÷.,						÷.,				- 24	÷.				÷.,			
ECO Renex PEG 600	PEG 600	PF	LQ		2539		÷.										- 21	- 21				÷.			
ECO Renex PEG 800	PEG 600	PF	LQ		2039												- 24								
ECO Renex PEG 1000	PEG 1000	PF	LQ		2039		÷.										- 21	- 21				÷.			
ECO Renex PEG 1450	PEG 1450	PF	LQ		2039		÷.,						÷.,				- 24	÷.				÷.,			
ECO Renex PEG 2000	PEG 2000	PF	LQ		2039		- 21										- 21	- 21				- 21			
ECO TweenIM 20		PF	LQ	10.7	2039		÷.,	Readily		. 10.000	. 100	010	-				- 24	÷.						-	
ECO Tween 21		PF	LQ	10.7	2100	- 21	- 21	biodegradable		>10,000	>100	210					- 21	- 21					- 21		
ECO Tween 21	PEG-4 sorbitan monolaurate	PF	LQ	13.3		-	÷.,				>100	210						÷.		-					
ECU Iween 22	PEG-8 sorbitan monolaurate	PF	LQ	14.8			11										- 21	- 1					- 21		
ECO Tween 23	PEG-12 sorbitan monolaurate	PF	LQ	10.5			÷.,											-		-				-	
ECO Tween 24	PEG-16 Sorbitan monolaurate	PF	LQ	10.0			÷.				. 100	016					- 21	- 21		÷.			- 21		
ECO Tween 28	PEG-80 sorbitan monolaurate	PF	LQ	15.0			÷.,	Inherently			>100	210						-		÷.,				-	
ECO Tween 40	PEG-20 sorbitan monopalmitate		LQ	15.6		-	- 11	biodegradable Readily		100		2800						- 1					- 21		
ECO Tween 60	PEG-20 sorbitan monostearate		LQ	14.9				biodegradable Readily		>100		90						-						-	
ECO Iween 61	PEG-4 sorbitan monostearate		SU	8.6				biodegradable		>100		383												-	
ECO Iween 65	PEG-20 sorbitan tristearate		LQ	10.5	0454		_	Inherently		10.000	105	171													
ECO Tween 80	PEG-20 sorbitan monooleate	PF	LQ	15.0	2151			biodegradable Expected to be		>10,000	165	4/1													
ECO Tween 81	PEG-5 sorbitan monooleate	PF	LQ	10.0				biodegradable																	
ECO Tween 84	Ethoxylated sorbitan ester	PF	LQ	14.0			_	biodegradable																	
EC0 Tween 85	PEG-20 sorbitan trioleate		LQ	11.0		-		Biodegradable		>100		309					-								
ECO Tween 95	Polyoxyethylene sorbitol fatty acid ester	PF	LQ																						

 $\label{eq:prod} {}^{\text{th}}\mathsf{PF}=\mathsf{Palm}\text{-}\mathsf{free},\ \mathsf{LQ}=\mathsf{Liquid},\ \mathsf{PA}=\mathsf{Pastillated},\ \mathsf{PW}=\mathsf{Powder},\ \mathsf{SO}=\mathsf{Solid},\ \mathsf{SS}=\mathsf{Semi-solid}$

Smart Science to Improve Lives™

Sales & Technical Support

With over 30 years experience of working with formulators, Croda's global technical specialists are able to offer advice and support in selecting the most effective products for your application. This, coupled with our extensive sales network, means we have the ability to work closely with customers and develop the right solutions to meet market needs.

Further Information

For more detailed product information, regulatory staus, SDS and samples, please contact your local Croda sales office.

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