

ECO Tween™ Series



Polyoxyethylene derivatives of sorbitan esters

The ECO Tween series of surfactants are polyoxyethylene derivatives of the Span™ series of products. ECO Tween surfactants are available as part of Croda's 100% renewable, 100% bio-based ECO Range of surfactants. ECO Tween surfactants are hydrophilic, generally soluble or dispersible in water, and soluble to varying degrees in organic liquids. The ECO Tween series are excellent O/W emulsifiers, solubilisers, wetting agents and dispersants. In emulsion systems, they are commonly used in combination with the corresponding Span. Manipulation of the Span/Tween ratio produces emulsifying systems of various HLB (hydrophilic-lipophilic balance) values. ECO Tween products are useful in the stabilisation of many types of emulsion systems found in household or I&I applications.

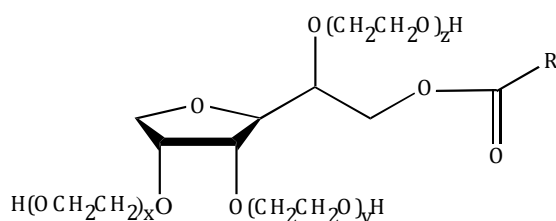


Figure 1: Chemical structure - polyethoxylated monoester

Product name	INCI name
ECO Tween 20†	Polysorbate 20
ECO Tween 21†	Polysorbate 21
ECO Tween 28	Polysorbate 28
ECO Tween 40	Polysorbate 40
ECO Tween 60†	Polysorbate 60
ECO Tween 61†	Polysorbate 61
ECO Tween 65†	Polysorbate 65
ECO Tween 80†	Polysorbate 80
ECO Tween 81†	Polysorbate 81
ECO Tween 85 / ECO Tween 85 LM†	Polysorbate 85

Features and benefits of the ECO Tween series:

- 100% Renewable
- 100% Bio-based*
- Reduces reliance on fossil fuel feedstocks
- Manufactured with renewable energy
- Performance identical to petro-based options
- Lower carbon footprint than petro-based versions
- Will be tested for certification to the USDA BioPreferred® Program
- RSPO Supply Chain Certified via Mass Balance**
- Safer Choice approved (listed on CleanGredients)†



*Calculated using USDA BioPreferred Method for determining bio-based content which is to be validated by carbon 14 testing (ASTM D6866)

** Products containing palm oil derivatives are RSPO Supply Chain Certified via Mass Balance

† Products registered as EPA Safer Choice

USDA BioPreferred is a registered trademark of the U.S Department of Agriculture

Product name	Appearance	HLB	Properties and functions
ECO Tween 20	Clear yellow liquid	16.7	Fully saturated liquid ester, recommended as an emulsifier for O/W systems and effective solubiliser for essential oils and perfumes in aqueous and aqueous/alcoholic systems. Also used as a mildness additive in detergent systems and a cleansing agent in wet wipes.
ECO Tween 21	Yellow liquid	13.3	
ECO Tween 28	Clear yellow liquid	19.1	Used in mild detergent systems such as baby shampoos as a solubiliser and cleansing agent. Also has some thickening properties in detergent systems. Suitable for use in hand cleansers and baby wet wipes.
ECO Tween 40	Yellow pasty liquid	15.6	Co-solvent and wetting agent.
ECO Tween 60	Yellow liquid/soft solid	14.9	Produces stable O/W emulsions, especially when combined with Span 60 and cetostearyl alcohol or other fatty alcohols. Excellent for the emulsification of esters, mineral and silicone oils. Skin creams exhibit good sensory profile.
ECO Tween 61	Amber paste	8.6	Co-emulsifiers.
ECO Tween 65	Yellow paste	10.5	
ECO Tween 80	Clear yellow liquid	15.0	O/W emulsifier and dispersant often used in conjunction with the appropriate Span. Good solubilising properties, recommended in systems with unsaturated lipid components such as oleyl alcohol and vegetable triglycerides.
ECO Tween 81	Clear amber liquid	10.0	
ECO Tween 85	Amber liquid	11.0	Less hydrophilic than Tween 80. Excellent dispersing agent for oils and waxes, particularly useful in shoe polishes and furniture waxes.

Key application areas

Polishes

Spans and Tweens are key emulsifying agents for a number of applications. By using combinations of Spans with their corresponding Tweens, it is possible to prepare a variety of oil in water and water in oil emulsion systems. Span 80 is excellent for water in oil emulsification of hydrocarbons and is particularly useful in aerosol systems such as multisurface spray polishes and cleaners. Water in oil based aerosol polishes using Span 80 break down rapidly upon spraying, ensuring an even application of wax and silicone. Span 60 and Span 80, when used in combination with ECO Tween 60 and ECO Tween 80, are excellent for emulsifying systems for silicone fluids in furniture polishes, shoe polishes, and vehicle exterior and interior polishes.

Air care

Tweens are extremely versatile as solubilisers for all types of fragrances and perfumes used in air fresheners and other household products. ECO Tween 20 and ECO Tween 80 have high HLB values and are of particular interest when solubilising volatile components. ECO Tween 20, a fully saturated ester, is most commonly used in this application due to its low odour. Typical inclusion levels are 1:1 Tween to fragrance, depending on the formulations and fragrance to be solubilised. Tweens are recommended for odour neutralisers and solvent based degreasers.

Wipes

For quick and easy removal of oily stains, Tweens can be incorporated into wipe formulations and added to non-woven substrates. ECO Tween 20, 80, and 85 are helpful in creating emulsions with oily fats, helping cleaning efficiency. ECO Tween 20 has the additional benefit of being a mildness additive and is suitable for use in wet wipes where contact with the wipe may be prolonged.

Hand barrier creams

Heavy duty hand cleaners are used for easy removal of oils, dirt, and greases. ECO Tween 21 and 60 may be used to form microemulsion gels based on solvents such as odourless kerosene. Barrier products form a film which is designed to protect the skin from the effects of oil and water borne irritants. Combinations of Span 60 and ECO Tween 60 or Span 80 and ECO Tween 80 form effective emulsifying systems which can be tailored to produce either oil or water resistant products. They are suitable for vegetable oils and lanolin derivatives. ECO Tween 80 in particular is a useful emulsifier for oil-resistant barrier products based on hydrophilic film-formers such as methyl cellulose or gum Arabic.

Formulating guidelines for emulsion systems

It is well established that a combination of a high and a low HLB emulsifier is often more effective than the use of a single emulsifier. Combinations of Spans and ECO Tweens can therefore be used to develop stable oil in water emulsions of various materials.

Through experimentation it is important to establish the required HLB of the material to be emulsified and the appropriate chemical type of the emulsifier blend. Selection of the appropriate chemistry is as important as choosing the correct HLB. For example, emulsifiers with an unsaturated alkyl chain, such as an oleyl chain, have an increased affinity for oils with unsaturated bonds. In this case a blend of Span 80 (Sorbitan Oleate) and ECO Tween 80 (Polysorbate 80) would be recommended to emulsify vegetable oils. Similarly a blend of emulsifiers with saturated alkyl chains, for example Span 60 (Sorbitan Stearate) and ECO Tween 60 (Polysorbate 60), would be appropriate for the emulsification of saturated materials.

Most raw materials that are likely to be emulsified (e.g. mineral and vegetable oils, emollient esters, silicone oils) have a published required HLB value. For example, required HLB values of approximately 10 are usually quoted for mineral oils. In order to develop a stable emulsion of mineral oil, a blend of Span 60 (Sorbitan Stearate) and ECO Tween 60 (Polysorbate 60), combined to give an HLB value of 10, could be evaluated at different concentrations. Further minor adjustments will be required to optimise formulation stability, viscosity, aesthetics etc.

In order to calculate how much of emulsifier (A) to blend with emulsifier (B) to reach a given required HLB of X:

$$\% (A) = \frac{100 (X - HLB_B)}{HLB_A - HLB_B}$$

$$\% (B) = 100 - \% (A)$$

To calculate the blend of Span 60 (Sorbitan Stearate) and ECO Tween 60 (Polysorbate 60) to emulsify an oil with a required HLB of 10:

HLB of ECO Tween 60 = 14.9

HLB of Span 60 = 4.7

$$\% \text{ ECO Tween 60} = \frac{100 (10 - 4.7)}{(15 - 4.7)} = 51.5\%$$

$$\% \text{ Span 60} = 100 - 51.5 = 48.5\%$$

If the required HLB of the material or blend of materials to be emulsified is not known, this can be determined by experimentation. Evaluation of the stability of emulsions formed with blends of an appropriate Span and ECO Tween pair covering a range of HLB values will identify the required HLB.

The optimum concentration of the emulsifier blend can then be determined by experiment. Generally 10-20% of the level of the emulsified material is a useful starting point, i.e. to make a 30% emulsion of oil would usually require an optimum level of 3% emulsifier blend. Both emulsifiers are usually introduced into the oil phase.

Solubilities

Product name	Water (1%)	Water (10%)	Propylene glycol (1%)	Propylene glycol (10%)	Isopropyl alcohol (1%)	Isopropyl alcohol (10%)	Xylene (1%)	Xylene (10%)	Cottonseed oil (1%)	Cottonseed oil (10%)	Mineral oil (1%)	Mineral oil (10%)
ECO Tween 20	S	S	S	D	S	S	S	S	S	D	I	I
ECO Tween 21	D	D	H	I	S	S	S	H	S	I	I	I
ECO Tween 40	S	S	D	I	S	S	S	S	S	I	I	I
ECO Tween 60	S	S	D	D	S	S	S	S	S	I	I	I
ECO Tween 61	D	D	I	I	S	S	S	I	S	I	I	I
ECO Tween 65	D	G	I	I	S	S	S	D	S	I	I	I
ECO Tween 80	S	S	D	D	S	S	S	I	S	I	I	I
ECO Tween 81	D	D	I	I	S	S	S	I	S	I	H	S
ECO Tween 85 / ECO Tween 85 LM	D	D	I	I	S	S	S	S	S	I	S	S

Key

S = Soluble, clear

H = Soluble with haze, hazy, turbid

D = Insoluble, self-dispersing or self-emulsifying; on standing, separates into distinct phases

I = Insoluble, gross separation into distinct phases

G = Insoluble, forms gel

ECO Range

The ECO Tween series is manufactured using ethylene oxide derived from bio-ethanol, resulting in 100% renewable surfactants with performance identical to petro-based options. These 100% bio-based products eliminate the need to choose between high performance and fully renewable ingredients. By using an alternative route to ethylene oxide with bioethanol from biomass sources, it significantly increases the bio-based content of ethoxylated products and reduces reliance on fossil fuels. Additionally, the ECO Tween series is manufactured with high levels of renewable energy. Sustainability informs and guides our development strategies and is an integral part of our business. The ECO Tween series addresses the consumer demand for more sustainable products and aids our customers in meeting their own sustainability goals, while delivering high performance products to the market.

Certified sustainable palm oil derivatives - mass balance

ECO Tween series are Croda's sustainable palm oil variants allowing customers to use sustainably sourced material if they wish. The product is manufactured by the RSPO's Mass Balance system which allows certified sustainable palm oil material and non-certified material to be mixed throughout the supply chain but administratively monitors the mass of certified material produced and sold. This process is fully audited allowing buyers of the material to view the product's life span. Another advantage of this system is that it actively encourages palm growers to produce sustainable palm and move towards a segregated supply chain system. By choosing these ingredients, you contribute to the production of sustainable palm oil. Products manufactured with sustainable palm oil do not in any way compromise their performance.

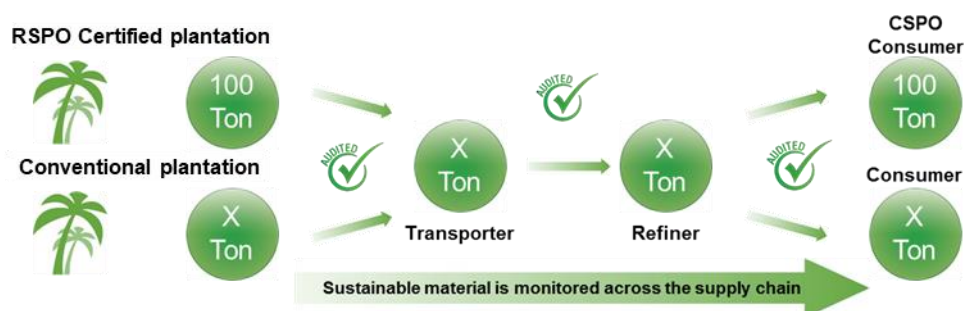


Figure 2: RSPO Mass Balance Supply Chain

Health and safety

MSDS for individual products are available on request or available at <https://msds.crodadirect.com>

Non-warranty

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