Sustainability and biobased content of Eastman cellulose esters for formulated products

There is increasing interest in the use of sustainable chemical alternatives driven by consumer demand, brand owner goals or preferences, and legislation. This trend influences manufacturers to innovate products that contain biobased ingredients.

One of the main reasons for the increased demand for biobased products is to replace chemicals derived from fossil fuels. These sustainable alternatives reduce dependence on fossil feedstocks, lower greenhouse gas emissions, and can have a positive effect on the global carbon footprint. Given their reduced environmental footprint in comparison to their traditional counterparts, biobased chemicals are emerging as environmentally friendly alternatives to standard chemicals.

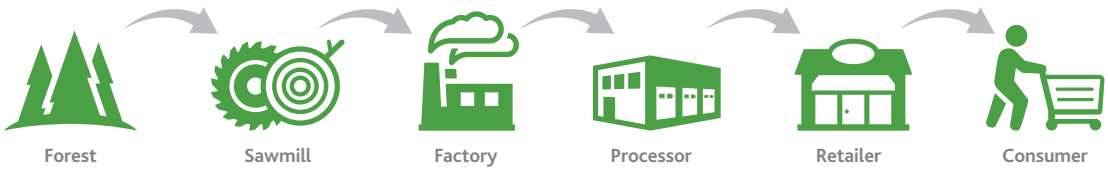
Eastman is dedicated to enhancing the quality of life in a material way by making a positive impact on the world. Our commitment is to offer a dedicated approach to sustainable innovation. For example, biopolymers such as Eastman cellulose esters are already used in the coatings industry, where they create high-quality coatings with higher biobased content levels.

Abundant natural renewable resources from sustainably managed forests

Eastman cellulose esters for formulated products are based on cellulose—one of the most abundant natural renewable resources—primarily from trees harvested from sustainably managed forests.* The trees are sourced from suppliers in multiple geographic locations, complying with the standards of internationally recognized forest certification programs such as the Forest Stewardship Council® (FSC®) and/or Programme for the Endorsement of Forest Certification (PEFC). Eastman also holds both FSC (license code FSC-C140711) and PEFC Chain of Custody certification, ensuring the traceability of the wood pulp sourced to make Eastman cellulose esters.

Managed forests consume about 49% more CO_2 per year than unmanaged forests.

The FSC Chain of Custody certification traces the path of products from forests through the supply chain.



The PEFC Chain of Custody is a process for tracking forest products from their place of origin through all stages of transfer and production to the end product used by the consumer.

A few Eastman cellulose ester products are manufactured from other sustainable sources of cellulose.

From trees to formulated products

The cellulose used in Eastman cellulose esters is derived from sustainably sourced, renewable resources. These resources deliver consistency for the highest-quality applications.

In the process of converting trees to cellulose, little is wasted. Bark is removed from trees, and the wood pulp is purified, rolled, and shipped to Eastman. The rolled pulp is processed through cellulose esterification into cellulose ester powders, which are used in a wide variety of formulated products—coatings, inks, adhesives, membranes, electronics, and more.

BIOBASED | RESPONSIBLY MANAGED

From trees . . .
Natural, renewable resources for cellulose-based materials, trees are harvested under a program of sustainable yield.

Softwood trees | Wood pulp factory | Cellulose esterification | Eastman cellulose ester powders | Formulators

. . . to products
Coatings, inks, adhesives, membranes, electronics, and more

This process results in a portfolio of cellulose ester products with approximate new carbon calculations ranging from 36% to 63%. The percentage of new carbon is the differentiator for carbon-based substances contained in living organisms compared to carbon-based substances from fossil sources. The use of carbon from living organisms such as trees and crops can help create a neutral carbon footprint.

A renewable backbone of new carbon

Eastman cellulose esters are polymers with a renewable backbone derived from one of the most abundant naturally occurring biopolymers—cellulose that is obtained from cotton linters and wood pulp. The hydroxyl groups on the cellulose are reacted through a proprietary esterification process with acetyl, propionyl, or butyryl groups derived from non-biobased sources to form the various Eastman cellulose acetates (CA), cellulose acetate butyrates (CAB), cellulose acetate propionates (CAP), and Eastman Solus™ performance additives.

How are biobased products able to reduce greenhouse gas emissions compared to fossil fuels?

Burning fossil fuels emits carbon dioxide into the air faster than photosynthesis and other processes can metabolize it back out. This creates an imbalance in the global carbon cycle. The use of biocarbon from products such as trees and crops can address this carbon cycle imbalance by helping create a neutral carbon footprint. With plant-based materials, the carbon dioxide liberated to the atmosphere is coming from the same quantity of carbon dioxide that is fixed into plants during photosynthesis (carbon fixation).

Given that products and chemicals may contain materials that are wholly or partly derived from biobased materials, it is essential to identify the amount of biobased material contained in the product.

What are biobased chemicals?

Biobased chemicals or products are wholly or partly derived from materials of biological origin such as trees and crops or biomass.

How do we differentiate between fossil-sourced and biobased carbon?

To do this, we need to understand both biobased carbon content and biobased content.

Biobased carbon content (carbon-14 or new carbon)
In biobased carbon content, the isotope of carbon—carbon-14, sometimes abbreviated as 14C —is present in relatively "young" biobased products such as trees and plants. Because carbon-14 decays with time (radioactive decay), it is generally not detected in fossil products older than 20,000 years, such as oil and coal. The carbon-14 content can be measured analytically or it can be calculated. Carbon-14 is often referred to as new carbon.

Biobased content (carbon-14 plus other elements)
Biobased carbon content does not account for the content of other biomolecules that are bound to the biocarbon, such as hydrogen, nitrogen, and oxygen. Therefore, it is important to take into account the whole biobased content, which sums up the amount of biobased carbon plus the amount of biobased nitrogen, oxygen, and hydrogen. The biobased content is usually calculated and expressed as a fraction of the total mass of sample.

Manufacturers who want to innovate materials with higher biocontent seek biobased products. To quantify the amount of biobased material in their products, they require the carbon-14 content (new carbon) as well as the biobased content (carbon plus other elements).

Eastman cellulose esters for formulated products	Calculated approximate value	
	% Carbon-14 content (% new carbon)[a]	% Biobased content (% cellulose)[b]
Cellulose acetate		
Eastman CA 320S	63	68
Eastman CA 394-60LF	55	60
Eastman CA 398-3	55	60
Eastman CA 398-3, food contact	55	60
Eastman CA 398-6	55	60
Eastman CA 398-10	55	60
Eastman CA 398-30	55	60
Cellulose acetate butyrate		
Eastman CAB 171-15	46	53
Eastman CAB 321-0.1	42	50
Eastman CAB 381-0.1	41	50
Eastman CAB 381-0.1, food contact	41	50
Eastman CAB 381-0.5	40	49
Eastman CAB 381-0.5, food contact	40	49
Eastman CAB 381-2	40	49
Eastman CAB 381-2, food contact	40	49
Eastman CAB 381-2BP	41	50
Eastman CAB 381-20	41	50
Eastman CAB 381-20, food contact	41	50
Eastman CAB 381-20BP	40	49
Eastman CAB 500-5	37	46
Eastman CAB 531-1	38	47
Eastman CAB 531-1, food contact	38	47
Eastman CAB 551-0.01	37	46
Eastman CAB 551-0.01, food contact	37	46
Eastman CAB 551-0.2	37	46
Eastman CAB 551-0.2, food contact	37	46
Eastman CAB 553-0.4	41	51
Eastman CAB 553-0.4, food contact	41	51
Cellulose acetate propionate		
Eastman CAP 482-0.5	45	54
Eastman CAP 482-0.5, food contact	45	54
Eastman CAP 482-20	42	51
Eastman CAP 482-20, food contact	42	51
Eastman CAP 504-0.2	49	57
Eastman CAP 504-0.2, food contact	49	57
Performance additives		
Eastman Solus™ 2100 performance additive	36	45
Eastman Solus™ 2100 performance additive, food contact	36	45
Eastman Solus™ 2300 performance additive	43	51

[a]Although the values reported were not specifically measured for biocarbon, it can be estimated based on typical partition data for the product. The estimated biocarbon derived percentage was determined by using six biobased carbon atoms per anhydroglucose unit (AGU) divided by the total number of carbons per AGU. *[b]The % cellulose calculated approximate value was derived using the following equation: 100 – (wt% acetyl) – (wt% propionyl) – (wt% butyryl).*

The Eastman portfolio of cellulose ester products has continually expanded to meet the needs of multiple industries and markets. The environmental and sustainable attributes of these products, combined with their proven performance, make Eastman cellulose esters a logical choice for coatings formulations and other applications.

To find out more, contact your Eastman representative or your authorized Eastman distributor.

As the world's leading supplier of specialty cellulose esters for more than 85 years, Eastman has a long history of reliably supplying customers with consistently high-quality products manufactured using advanced processes and controls. Leveraging years of formulating experience and a diverse portfolio of more than 50 cellulose esters—CA, CAB, CAP, and C-A-P—for a variety of applications, our technical experts can provide guidance to help customers select the best cellulose ester or blend to achieve the specific performance desired for their unique application. Over the years, we've introduced innovative products that help meet customer needs and market demands, most recently Eastman Solus™ performance additives for high-solids coatings and Eastman membrane material products for membrane filtration. We work with regulatory agencies and industry associations on behalf of our customers to advocate for policies that allow industries to thrive, enabling sustainable innovation. At Eastman, our goal is to enhance the quality of life in a material way.

EASTMAN

The results of **insight**™

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