

Biorenewable Carbon Index For Green Formulations

Formulating green products is one of the current challenges facing developers of personal care and household cleaning products. Stepan's Biorenewable Carbon Index can help make ingredient choices easier.

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GREEN PRODUCTS are everywhere and with green being used to describe products ranging from hybrid cars to shampoos based on naturally-derived ingredients, the definition of green has been stretched to the breaking point.

Whatever the definition, green products are here to stay. In the household cleaning and personal care markets, these green or naturally-derived products started as niche products being sold in limited distribution. Now the market has reached mainstream consumers and green products have found shelf space in mass market retail stores. Sales of green cleaning products surged from \$17.7 million in 2003 to \$64.5 million in 2008, according to Mintel International, a Chicago-based research company. Similarly, Kline & Company, Little Falls, NJ, expects sales of natural personal care products to grow 13.2% a year to \$11.7 billion (retail) by 2013.

However, because there isn't an industry-recognized definition of "green" for products in the personal care and cleaning products markets, various groups have attempted to fill the gap, leading to a proliferation of government, non-governmental, third party or industry standards and certification development. As a result, companies are struggling to stay current with all of the new standards, revisions, definitions and

interpretations. Formulators are continually challenged to select ingredients with preferred environmental, health and safety profiles and, at the same time, are expected to deliver equal performance at no additional cost.

Personal care formulators must consider meeting standards such as the USDA's National Organic Program (NOP), Natural Products Association (NPA) and Ecocert. Household cleaning products have begun to show up on store shelves with the U.S. EPA's Design for the Environment (DfE) logo.

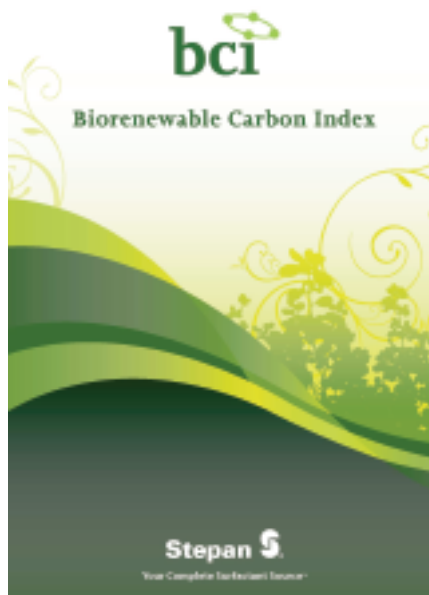
Industrial and institutional (I&I) products are also part of the green

cleaning movement. In order to meet an Executive Order that requires federal agencies to purchase "Environmentally Preferable" products, several states have elected to adopt statewide purchasing policies to buy I&I cleaning supplies that meet specific certification standards.

As a result, formulators continue to grapple with the definition of green, and consequently may ask their suppliers for assistance with recommendations on ingredient selection and starter formulations. This requires an open discussion between the supplier and customer as to the following: the customer's definition of green, intended label claims, marketing strategy and any other required information to support a certification submission.

In response, Stepan Company has decided to provide greater transparency about our existing chemistries, processes and commercial products. Stepan is committed to understanding current and future standards, regulations, directives and voluntary initiatives, and to help guide our customers in making informed decisions in choosing the appropriate ingredients for their formulations.

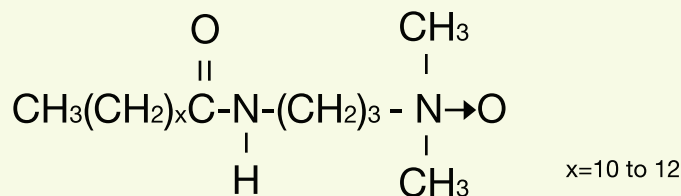
In March, Stepan Company introduced a tool called the Biorenewable Carbon Index (BCI) to assist customers. The BCI provides a single value based on the percent carbon derived from a biorenewable resource. Biorenewable is defined by Stepan as materials of animal or vegetable origin that can be replenished in a relatively short period of time. The Stepan definition corresponds to the USDA definition used for biobased products.



AMMONYX LMDO

INCI Name: Lauryl/myristyl amidopropyl amine oxide

BCI **72**



	natural fatty chain C ₁₂₋₁₄			amidopropyl amine		biorenewable carbon index
	CH ₂	(CH ₂) ₁₁	C-O	-NH(CH ₂) ₂ N(CH ₂) ₂	0	biorenewable carbon divided by total carbon
# of carbone	1	11	1	5	0	100x(13÷(13+5)) - 72

Naturally-derived Body Wash

Total BCI*: 100

Ingredient	Surfactant BCI	%Wt.
Deionized water		q.s. to 100
Stepanol WA-Extra PCK (Sodium lauryl sulfate)	100	42.0
Stepan SLL-FB (Sodium lauroyl lactylate)	100	2.0
Stepan-Mild L3 (Lauryl lactyl lactate)	100	1.0
Flax Extract 120 (Natunola)		0.5
Sodium chloride		q.s.
Sodium hydroxide		q.s.
Citric acid		q.s.
Fragrance, dye and preservative		q.s.

Procedure: Add water, Stepanol WA-Extra PCK, Stepan SLL-FB and Stepan Mild L3 with mixing and heat to 54-57°C. When solution is clear, begin cooling to 32°C. At 32°C, add flax extract and mix well. Begin cooling. At room temperature, adjust viscosity with sodium chloride and adjust pH with citric acid or sodium hydroxide, if needed. Add fragrance, dye and preservative with mixing.

Properties: Appearance at 25°C: Clear liquid; pH, as is: 5.8-6.2; Viscosity at 25°C, cps: 5,000-7,000

*Total BCI was calculated only for the Stepan surfactants used in this formulation.

Because some product developers prefer plant-derived over tallow-derived products, we have included a special designation for plant-derived materials. Stepan has also included key product, property and commonly requested environmental information in the BCI guide.

How is the BCI value calculated? It is based on the number of biorenewable carbons divided by the total number of carbons in the entire molecule. The molecule that is used for this calculation is based on an idealized molecular structure. This makes the BCI determination relatively easy to calculate and understand. The figure above details how we calculate the BCI.

Though a calculated value, the BCI number is similar to the value derived by ASTM Method D6866, which is the method recommended as a part of the USDA BioPreferred Program. The ASTM method produces results that represent the amount of biobased carbon in a material as a weight percent of the total organic carbon in the product. ASTM D6866 measures the level of carbon-14 (14C) isotopes in the material compared to the level in the atmosphere. Biorenewable materials have not been decaying long and should have the same level as the CO₂ in the atmosphere. In fact, 14C has a half life

of about 5,700 years, so any carbons that come from a source that is greater than 50,000 years old will not have a measurable amount of ^{14}C . Petroleum-based carbon is formed from dead plants and animals, along with exposure to the heat and pressure in the Earth's crust for hundreds of millions of years. So, although petroleum may be originally from a natural source, it is being depleted at a much faster rate than it can be replenished.

Stepan has organized the BCI Guide into two market segments: personal care and household, institutional and industrial (HI&I) cleaning. Within each market segment, included products have a BCI equal to or greater than 50%, and are sorted either by BCI, alphabetized by trade name or by chemistry class. Also included is a "notes" field which contains additional information that will help differentiate among similar chemistries, provide

product attributes and indicate additional certification information. A glossary contains all definitions used within the guide.

On the previous page is an example of a high BCI personal care formulation as represented in Stepan's Biorenewable Carbon Index. The calculation is based on the surfactant BCI only.

The personal care industry has numerous natural and/or organic standards that may require greater detail about ingredients used in finished formulations. For that reason, Stepan has included the base starting material and end processes of the products listed in the personal care section of the guide.

Manufacturers may be using a definition of green that requires them to use ingredients made from biorenewable sources. For others, green ingredients may mean that the material is readily biodegradable, has a favorable aquatic toxicity profile or a low VOC content.

Other manufacturers have the infrastructure to look cradle-to-cradle and the desire to look at a full life cycle analysis of their products. A set of Green Chemistry principles, outlined in the book, *Green Chemistry: Theory and Practice* by Paul Anastas and John Warner, is considered by many as a good guide to making green products. The authors point out that green chemistry will be achieved in incremental improvements that move toward the goal of perfection.

Stepan's BCI Guide is one supplier's response to the demand for greater transparency about the ingredients that it markets. Stepan's BCI Guide gives formulators another tool to help them make informed ingredient choices. View Stepan's web-interactive BCI Guide at www.stepan.com.

For more information or assistance with green formulating, contact Stepan at bci@stepan.com. ●