



Naturally designed and engineered to deliver the performance that adds value to paints and coatings

## Sealants, and Inks

### Renewable Products

Green Biologics is a producer of 100% renewable n-butanol and acetone, which we aim to provide to the paints, coatings, adhesives, sealants, and inks industries to increase the sustainability of these companies' products and processes. Our renewable products are produced through selective fermentation of C<sub>5</sub> and C<sub>6</sub> sugars by proprietary *Clostridium* biocatalysts and have as much as an 85% lower carbon footprint than the analogous petrochemical equivalents. Additionally, as our renewable n-butanol and acetone are chemically equivalent to petroleum-based products, they are direct drop-in chemicals and no reformulation is necessary. Green Biologics is collaborating to chemically synthesise our platform chemicals into higher value derivatives such as specialty solvents (butyl acetate, butyl glycol ethers, isopropyl alcohol) and monomers (butyl acrylate, butyl methacrylate, methyl methacrylate) as well as aldol chemicals (MIBK, MIBC, MAK) utilised in paints, coatings, adhesives and inks.

**n-Butanol** – Our product name for renewable n-butanol is GB nC4-OL™. It is a four carbon primary alcohol used as an additive and solvent for a variety of paints and coatings applications. As an additive, n-butanol improves the flow and gloss of certain lacquers and helps prevent blushing of applied coatings in highly humid environments. Solvent applications of n-butanol range from acid-curable lacquers, baked enamel finishes, dyes, and printing inks. n-Butanol is a HAPS-compliant solvent, exhibits markedly low toxicity, and is readily biodegradable.



**Acetone** – Our product name for renewable acetone is GB C3-ONE™. It is a three carbon symmetrical ketone, and acetone is a highly valued solvent for its myriad of applications. Acetone is a VOC-exempt solvent, allowing for use in many applications without the restrictions of other more hazardous volatile chemicals. Acetone is used as a solvent in the production of many chemicals and as a propellant in spray paint. Additionally, acetone is a platform chemical for other industrially important molecules such as isopropyl alcohol (IPA), methyl isobutyl ketone (MIBK), methyl methacrylate (MMA), and Bisphenol A (BPA).

## Bio-Based Products

**Butyl Acetate** – A butyl ester produced from acetic acid and n-butanol, butyl acetate plays a critical role in the production of automotive OEM coatings. It is known for its excellent flow properties due to its low viscosity and potent solvency of hydrophobic components essential to highly durable paints and coatings, such as automotive coatings and wood finishes. As this compound is made exclusively from acetic acid and n-butanol, two chemicals capable of being produced through renewable fermentations, it is possible to synthesize it with 100% renewable components.



**Butyl Acrylate** – Acrylate polymers are excellent components of many paints, coatings, adhesives, sealants, and inks due to their resistance to water and environmental weathering such as sunlight and dust. Butyl acrylate, a common monomer in these polymers and is used throughout all the aforementioned industries, including toner resins like the one likely used to print this page. Containing an  $\alpha,\beta$ -unsaturated moiety as well as a 4-carbon long aliphatic ester chain, butyl acrylate has the valuable properties of being highly reactive as a monomer and chemically robust whilst within a polymer matrix. Use of renewable n-butanol to make butyl acrylate would result in a product that is 57.8% bio-based.

**Butyl Lactate** – A butyl ester produced from lactic acid and n-butanol, butyl lactate is used as an environmentally friendly, high boiling point solvent with a slow evaporation rate in paints and inks. It is readily miscible with a wide range of organic solvents, and partly miscible with water. Lactic acid is a well-known carboxylic acid that occurs naturally in the human body and can be produced through industrial fermentation. Use of renewable n-butanol to make a bio-based butyl lactate would result in a 100% bio-based product.



**Ethylene glycol butyl ether** – Renewable n-butanol can be utilised to produce a range of both propyl and ethyl glycol ethers. The most common polymeric composition is ethylene glycol mono butyl ether, or EGBE. It is safe for use in formulating paints, coatings, and printing inks. As a medium volatility solvent, EGBE modestly extends drying time while improving the flow of coatings during application. These effects are most important in improving the brushing and flow for alkyl resin paints and urea, melamine, and phenolic finishes. In addition to its utility as a solvent, this compound has been found to be the ideal organic additive to water based coating formulations as a coalescing agent with emulsion components. Use of renewable n-butanol to make EGBE would result in a product that is 62.7% bio-based.



**Isopropyl Alcohol** – A common three carbon alcohol utilised extensively as a solvent in paints, adhesives and inks, isopropyl alcohol is miscible in water and many solvents, and evaporates quickly with minimal residual impact. It can be esterified with acetic acid to produce isopropyl acetate. Hydrogenating renewable acetone to IPA would result in a product that is 100% bio-based.