Change Climate

PRODUCING THE WORLDS STRONGEST, HIGHEST PERFORMANCE EPOXY RESINS FROM SUSTAINABLE BIO SOURCES.

Change Climate CCBE

Product & Application Information

November 2020

Change Climate Mission

“Change Climate is a dynamic innovator of revolutionary new circular economy innovations with potential to disrupt existing industries negatively impacting our environment.”

We aim to replace toxic petroleum based epoxy resins with a bio-based epoxy resin made from 100% renewable resources are that are non-toxic and recycling a by-product from the manufacture of sustainable biodiesel and other industries, that will compete on quality and price.

A Circular Economy

CCBE Competitive Advantage

Change Climate
Bioproducts Sdn Bhd

- Change Climate Pty Ltd has CCBE – a two-part, clear, aliphatic, non-yellowing Bio-Epoxy Resin – from renewable, glycerol, unlike conventional diglycidyl ether Bisphenol A (DGEBA) epoxy, made from crude oil, petrochemicals.
- CCBE is available in two standard grades CCBE-1 and CCBE-5
- DGEBA epoxy resins are based on toxic Bisphenol A (BPA), being aromatic, so they yellow and chalk badly when exposed to ultraviolet (UV) radiation and sunlight unlike - *Change Climate's CCBE Bio-Epoxy resin.*
- Bisphenol A (BPA) is a known endocrine disruptor, recognised for producing major health concerns, when in contact with food, so BPA products are gradually being phased out around the globe, particularly in Europe.
- Therefore, there is a move, especially in Europe to prevent the use of DGEBA (Bisphenol A) based epoxy resins.
- CCBE has a glycerol (glycerine) core, used in the food and pharmaceutical industries because of its low toxicity.
- Glycerol is obtained from clean, green, environmentally friendly biofuel manufacture, with no BPA.
- Naturally occurring CCBE-1 and CCBE-5 Part A resins are renewable, having low odour and zero emissions.
- When cured CCBE Bio-Epoxy resins are non-yellowing, clean, green, aliphatic and have physical properties comparable, and sometimes exceed properties of common DGEBA (Bisphenol A) based, epoxy resin products.
- CCBE Bio-Epoxy resins exhibit excellent adhesion to a variety of timber, concrete, metal and other substrates so can be used in a variety of applications directly replacing, BPA containing, DGEBA epoxy resins.

Applications/Benefits

Change Climate
Bioproducts Sdn Bhd

- ***Building Industry:*** Adhesive applications; Clear and coloured coatings for construction and marine applications; Patching repair floor mortars; Bio-Epoxy wall renders; Vertical concrete, non-slump repair mortars; Green concrete; Hard wearing self-levelling and trowelable concrete screeds and Concrete waterproofing applications.
- ***Art Supplies:*** As a resin to replicate a glass finish. Used as a medium for sculpture/mouldings, laminates or inclusions;
- ***Manufacturing Industry:*** in fiberglass products, such as marine craft and rainwater tanks; in plastics for car light or traffic light lenses; electrical circuit boards or composite materials.
- ***DIY:*** a broad range of products from adhesives to water repelling sealants, feature finishes, and numerous hobby applications.
- ***Recreational Sports:*** in snow and surf applications, marketable low environmental impact product. Applications for boards with positive rider feedback for light, hard, fast and responsive. Has a unique characteristic that does not feel like any other board on the market. A major benefit of CCBE Bio-Epoxy resins is the inherent flexibility of the cured resin that imparts hardness, combined with resilience and high impact resistance, not seen, with most BPA containing, conventional DGEBA epoxy resins.

Features	Benefits
BPA free	Safe
Low odour	Confined space use and earlier site re-entry
UV stable	UV stability and yellowing resistance
Low viscosity	Pourable/spreadable liquid
Renewable sourced ingredients	Green building material
Smooth, glossy or matt (with additives)	High surface finish, easy to clean
Self-levelling and seamless overcoat	Easy to use
Hard cure	Corrosion and abrasion resistant
Additives	Colour and texture
Manufacturing	Bulk manufacturing and fill available
Bulk cost	Comparable to existing epoxy resins
Applications	Coating, adhesive and moulding

Liquid Component Properties

Change Climate
Bioproducts Sdn Bhd

Typical

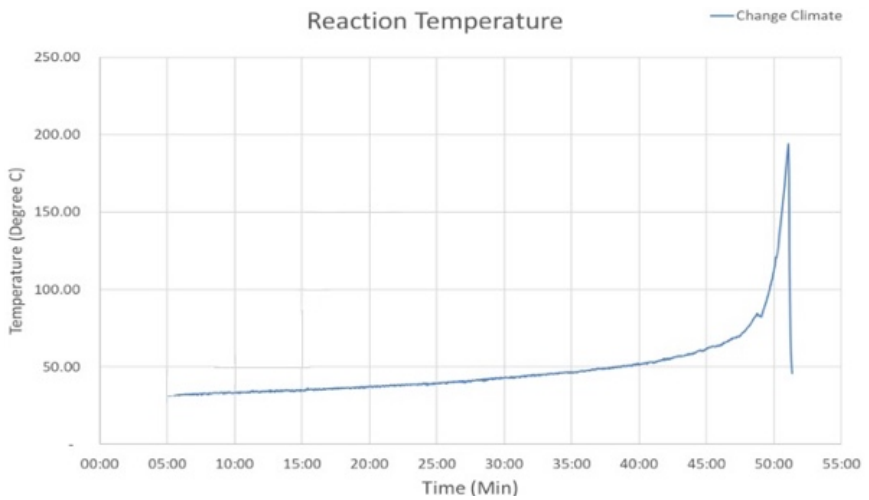
Property	CCBE-1 Part A	CCBE-5 Part A	CCBE - Part B
Viscosity (cP @ 25^{O}C)	750 – 850 cP (mPa.s)	6500–7500 cP (mPa.s)	15 -20 cP (mPa.s)
Density (kg/L @ 25^{O}C)	1.24– 1.25 kg/L	1.225 – 1.235 kg/L	0.92 – 0.95 kg L
EEW (g/ eq) Part A AHEW (g/eq) Part B	145 – 146 g/eq —	168 – 170 g/eq —	— 42 – 43 g/eq
Biobased content (ASTM D6866)	98 – 99 %	94 – 96%	0 %
Colour / Consistency	Colourless liquid	Colourless liquid	Colourless liquid
pH	6 - 8	6 - 8	11.6 (8.5g/L @ 25^{o}C)
pKa	13.0 – 13.5	13.0 – 13.5	10.7 at 20 ^{o}C
Melting point	—	—	10 ^{o}C
Boiling Point	378.7 ± 42.0 ^{o}C at 760 mmHg (185^{o}C at 1.5 mmHg)	378.7 ± 42.0 ^{o}C at 760 mmHg (185^{o}C at 1.5 mmHg)	247 ^{o}C at 760 mmHg
Flash Point	158.7 ^{o}C or (209^{o}C – Cleveland Open Cup)	158.7 ^{o}C or (209^{o}C – Cleveland Open Cup)	112 ^{o}C (open cup) (Not readily ignited)
Vapour pressure	1.35 x 10^{-5} mmHg at 25^{o}C (1.80 x 10^{-5} hPa) at 25°C	1.35 x 10^{-5} mmHg at 25^{o}C (1.80 x 10^{-5} hPa) at 25°C	(1.18 x 10^{-2} mmHg at 25^{o}C (1.57 x 10^{-2}hPa) at 25^{o}C
Vapour conc^{n} of liquid in a closed vessel.	0.0178 ppm (0.206 mg/m^{3})	0.0178 ppm (0.206 mg/m^{3})	15.5 ppm (118 mg/m$^{3)}$
Water solubility	Slight (<30 g/L @ 20^{o}C)	Slight (<30 g/L @ 20^{o}C)	492. g/L at 23.8 ^{o}C
Ignition temperature	> 270 ^{o}C (DIN 5174)	> 270 ^{o}C (DIN 5174)	380 ^{o}C (Not self igniting)
Thermal decomposition	> 180 ^{o}C	> 180 ^{o}C	< 400 ^{o}C (by DCC – DIN 51007)
Partioning coefficient (n-octanol/water)	Approx. –1.9 to –1.7 (Pow calc)	Approx. –1.9 to –1.7 (Pow calc)	0.99 (log Pow)

Mixed Properties - Liquid

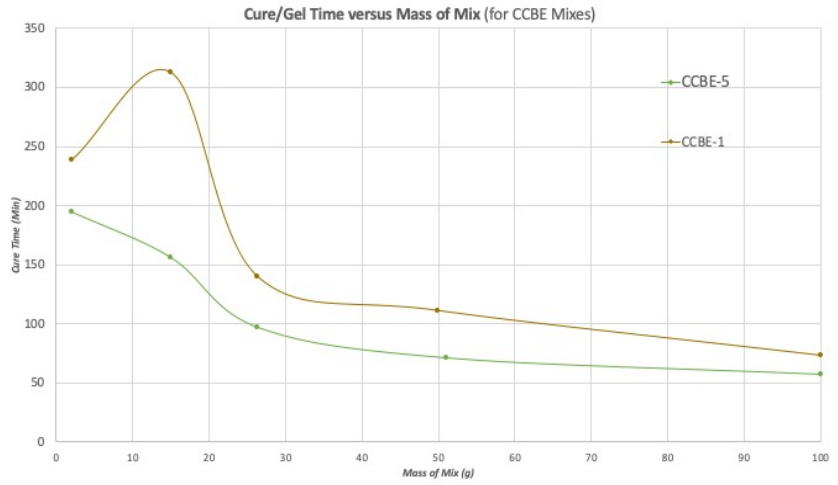
Liquid Mix Properties	CCBE-1	CCBE-5
Mix Ratio (by weight)	77.2 Part A : 22.8 Part B	79.8 Part A : 20.2 Part B
Mixed Ratio (by volume)	71.5 Part A : 28.5 Part B	74.8 Part A : 25.2 part B
Mixed Viscosity (cP @ 25^{O}C)	150 – 250 cP	2,300 – 2,450 cP
Mixed Density (kg/L @ 25^{O}C)	1.150 – 1.155 kg /L	1.150 – 1.155 kg /L
Pot Life (min for 100g @ 25^{O}C)	70 - 75 min	55 – 60 min
Tack free time (1 mm @ 25^{O}C)	230 - 250 min	190 – 210 min
Exotherm (^{O}C for 100g @ 25^{O}C)	> 175 ^{O}C	> 175 ^{O}C
Solids content %	100 %	100 %
Non-volatile material (NVM %)	0 %	0 %
Full Cure time (days @ 25^{O}C)	7 days	7 days
Estimated Mixed Vapour pressure of Part A and Part B	Approx. 4.6 x 10^{-3} mmHg (approx. 6.1 x 10^{-3} hPa) at 25^{O}C	Approx. 4.6 x 10^{-3} mmHg (approx. 6.1 x 10^{-3} hPa) at 25^{O}C
Estimated vapour concentration of mixed Part A and Part B, held in a closed vessel.	Aprox 6.0 ppm = (approx. 45 mg/m^3)	Aprox 6.0 ppm = (approx. 45 mg/m^3)

Typical Exotherm Profile of CCBE

Note: The precise time of exotherm depends on the mass of material cured and the ambient temperature



Typical gel time versus mass of CCBE



Note: The precise gel time will also depend on ambient temperature and humidity particularly when cured in thin films

Mixed Properties – Cured

Change Climate
Bioproducts Sdn Bhd

Typical Cured Properties

Cured Properties		CCBE
Compressive strength – unfilled (MPa)		87 ± 3 MPa
Compressive modulus – unfilled (GPa)		3.0 ± 0.3 GPa
Compressive strength – sand filled (1:1 by vol – MPa)		108 ± 4 MPa
Ultimate Tensile strength – unfilled (MPa)		54 ± 0.6 MPa
Ultimate elongation at break		3.25 ± 0.25 % or (0.0325 ± 0.0025 as unitless)
Youngs (tensile) modulus (GPa)		4.5 ± 0.3 GPa
Yield stress		40 ± 0.5 MPa
Yield strain		1.25 ± 0.25 % or (0.0125 ± 0.0025 as unitless)
Tensile strength – 20% (vol) flax fibre reinforcement (MPa)		62.9 MPa
Glass Transition temperature - unfilled (Tg - ^{O}C approx.)		65 – 75 ^{O}C
Pencil Hardness (ASTM D3353)		8H to 9H
UVA - ASTM G154 (UV / Humidity @ 24 hours)		No deterioration
Mandrel Bend test - ISO 1519 (thin film)		No cracking > 10 mm
Flooring Fire test - AS/ISO 9239.1 (2003)		
Critical Heat Flux (CHF) – non directional		7.1 ± 1.9 kW/m^2
Smoke value – non directional		8 ± 3 %
Melting		Yes
Blistering		Yes
Penetration of flame through to substrate		Yes

Typical Chemical Resistance Properties

Thermal Properties		No decomposition at 100^{o}C over three weeks. (University of South Australia testing)
Electrical Properties		Untested
Renewable Properties		Primary ingredients from renewable sources.
Chemical Resistance	***Acid***	Acids pH < 4 cause weakening of epoxy resins, therefore Bio-epoxy resin is not recommended for long term exposure to acids.
	Base	Independent tests by the University of South Australia show very good resistance to alkaline environments. ➢ Stable in commercial bleach (NaOCl 5%) for 56 days ➢ Stable in very caustic environments (NaOH 12-14 M)
	Oxidiser	Remained intact for several weeks of constant exposure to commercial hydrogen peroxide (4% H_2O_2), became rubbery in week 8 but retained structure (University of South Australia study).

Carbon & CO_2 Sequestered by CCBE

Change Climate
Bioproducts Sdn Bhd

Sequestered Carbon in I kg of CCBE-1 Part A resin

- Mass of sequestered carbon in 1 kg of CCBE-1 Part A resin — ***0.529 kg***
- Mass of CO_2 sequestered carbon in 1 kg of CCBE-1 Part A resin — ***1.94 kg***
- Volume of CO_2 sequestered carbon in 1 kg of CCBE-1 Part A resin — ***987 litres***

Sequestered Carbon in I kg of CCBE-5 Part A resin

- Mass of sequestered carbon in 1 kg of CCBE-5 Part A resin — ***0.521 kg***
- Mass of CO_2 sequestered carbon in 1 kg of CCBE-5 Part A resin — ***1.91 kg***
- Volume of CO_2 sequestered carbon in 1 kg of CCBE-5 Part A resin — ***971 litres***

Sequestered Carbon in 1 kg of cured Glycerol Bio-Epoxy (CCBE Part A cured with CCBE Part B hardener)

- Mass of sequestered carbon in 1 kg of cured Glycerol Bio-Epoxy — ***0.403 kg***
- Mass of CO_2 sequestered by 1 kg of cured Glycerol Bio-Epoxy — ***1.48 kg***
- Volume of CO_2 sequestered by 1 kg of cured Glycerol Bio-Epoxy — ***752 litres***

Sequestered Carbon in 1 kg of cured Glycerol Bio-Epoxy (CCBE Part A cured with 100% biobased hardener)

- Mass of sequestered carbon in 1 kg of cured Glycerol Bio-Epoxy — ***0.513 kg***
- Mass of CO_2 sequestered by 1 kg of cured Glycerol Bio-Epoxy — ***1.88 kg***
- Volume of CO_2 sequestered by 1 kg of cured Glycerol Bio-Epoxy — ***957 litres***

Applying CCBE On-Site

Change Climate
Bioproducts Sdn Bhd

Application

CCBE is an unfilled, non-formulated Bio-Epoxy resin system, for general purpose Bio-Epoxy resin use. As such CCBE can be used for a wide variety of Bio-Epoxy applications.

CCBE can be used, unfilled as a low viscosity adhesive; or filled with fine powder to convert into a gap filling adhesive paste. It can be used with glass fibre and carbon fibre for reinforced resin systems such as surfboards, snowboards, skis and other sporting goods applications, requiring enormous strength properties. It can be used (as received) for clear or pigmented, floor coating systems; or as a Bio-Epoxy primer; or for low viscosity crack grouting applications in concrete. It can also be filled with graded silica sands to produce self-levelling and trowelable concrete flooring screeds. CCBE can also be used, following appropriate formulation, to produce non-slump concrete repair mortars, coving and renders. There are many other applications, for which CCBE can be used.

It is for this reason that Change Climate cannot provide detailed application information in this document, given the wide breadth of applications, which CCBE can be used. Change Climate therefore recommend that those seeking such high-level, technical and application information contact Change Climate directly for advice. See the Change Climate Technical Support statement at the end of this document.

CCBE Mixing & Cleaning Procedures

Change Climate
Bioproducts Sdn Bhd

Mixing

It is recommended that the epoxy resin is mixed in a 25L metal container.
Pre-measured hardener provided in Part B is added to the contents of Part A and mixed thoroughly using a manual paint mixer or low revolution mechanical mixer for at least 5 minutes scraping all surfaces of the container to ensure compete mixing.
Allow the reaction to start before application, usually within 10 minutes depending on ambient temperature.

Note: All ingredients must be thoroughly and intimately mixed to achieve maximum hardness. When the Part B hardener is added, it reacts with the Bio-Epoxy resin (Part A). The reaction generates heat so should not be left unattended, during the application and applied well within the usable pot-life of the material. Refer to CCBE-1 and CCBE-5 pot life data provided in this document in relation to projected pot-life and mass of mixed material.

Cleaning

Remove from clothes, tools and equipment with methylated spirits, mineral turpentine or acetone before setting. Tacky surfaces can be cleaned with methylated spirits and cured material can only be removed mechanically.

CCBE General Comments

Change Climate
Bioproducts Sdn Bhd

General Comments

- CCBE-5 has a faster gel time than CCBE-1; but releases less heat energy than CCBE-1
- Slower gel-times result from smaller batches of CCBE material, but smaller batches will release less heat of reaction.
- Place all the mixed material well before gelation time is reached
- Keep any unused material to a minimum to prevent unexpected heat exotherm
- Place any unused material in aluminum trays and in thin layers (< 25 mm thick)
- Mix only the amount of CCBE material intended to be placed
- Exotherm temperatures can exceed 175 – 200^{O}C for material exceeding 100g
- As a general rule, gelation time roughly halves for every 10^{O}C rise in mix temperature
- It is unwise to use CCBE if temperature is less than 10^{O}C or greater than 30^{O}C

CCBE Safe Handling

Change Climate
Bioproducts Sdn Bhd

Personal Protective Equipment

In a well, ventilated, conventional areas with good airflow

- Use standard industry standard PPE in usual application conditions
- Wear appropriate eyeglasses or chemical safety goggles
- Wear appropriate gloves to prevent skin exposure
- Wear appropriate clothing to prevent skin exposure
- Use of an approved Barrier Cream suitable for use with epoxy resins, to reduce the likelihood of contracting dermatitis is also strongly recommended

In environments with limited airflow

- In areas, having restricted airflow, such as large basements, or large rooms with restricted airflow, etc., consider wearing an approved organic vapour mask

In closed environments with no airflow

- In small contained areas, with zero airflow, such as underground tanks, closed hold of a ship, and so on, consider using air-fed breathing apparatus

CCBE Handling Precautions

Change Climate
Bioproducts Sdn Bhd

Handling Precautions

- Refer to Change Climate's Material Safety Data Sheet (MSDS) for hazard precautions
- CCBE – Part A can absorb up to 8% by weight moisture from the atmosphere. This can greatly accelerate setting times and reduce end-product performance. It is recommended to keep unused Part A material sealed from air when not in use.
- CCBE – Part B can absorb moisture and carbon dioxide from the atmosphere, which can reduce end-product performance. It is recommended to keep unused Part B material securely sealed from air when not in use.
- Application in condition of high humidity (> 70-80%) can cause the surface of clear applications and clear coatings to turn cloudy, and it is not recommended to apply CCBE for such applications in high humidity conditions. If cloudiness does occur you may need to contact Change Climate for further advice.

CCBE Storage and Technical Support

Change Climate
Bioproducts Sdn Bhd

Storage

It is advisable to use Part A within 2 months in well-sealed, airtight containers
Longer shelf storage life is available subject to formulation change on demand.
It is advisable it use Part B several months
Store Part A and Part B in a dry place at 10°C - 30°C in original, unopened containers

Technical Support

Change Climate offers a comprehensive technical advice and service to customers seeking advice for use of CCBE. In addition, Change Climate offers a technical support package to specifiers, end users and contractors, as well as on-site technical assistance

Change Climate
Bioproducts Sdn Bhd

Bio-Epoxy Applications

CCBE warehouse flooring

- UV Stable
- Odorless application
- 4 X harder than concrete

Bio-Epoxy (CCBE)

Change Climate
Bioproducts Sdn Bhd

Global – Numerous surfboard shapers

Australia – Residential, commercial and industrial flooring

Indonesia – Waterproof roofing

Australia – Feature Art “Pacific” collection by internationally renowned environment artist Dr John Dahlsen

Australia – customers Resin arts projects & installations

Change Climate
Bioproducts Sdn Bhd

a) Composites / components
b) Interiors
c) Carbon fibre alternatives
d) High performance / motorsport
e) Advanced fibres

CCBE laminates and particle board (IKEA product development)

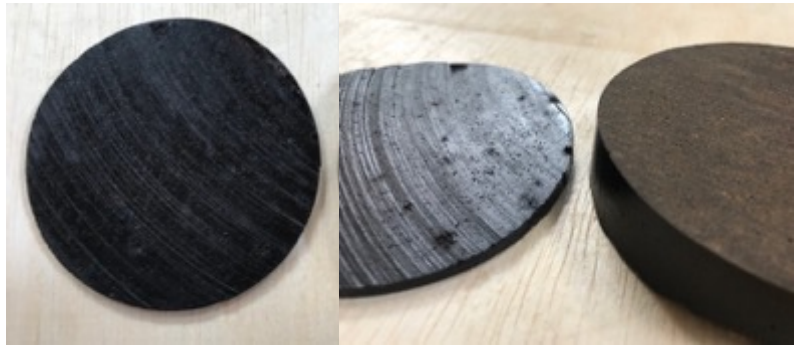
- Replaces traditional toxic Formaldehyde Medium Density Fiberboard (MDF) ~US$24.5B industry.

Composite & BioComposite Applications

Change Climate
Bioproducts Sdn Bhd

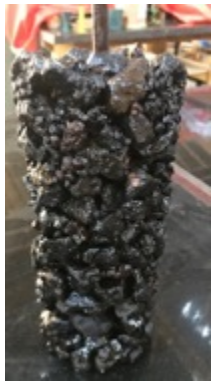
Indonesia - BPPT
MDF Board (CCBE + Palm Husk)

Indonesia - Potato Head & Bambu Indah
Coffee Ground based materials



Indonesia – Upcycled rubber safety floors – Green School

Indonesia - PT Bamboo Pure and IndoBamboo Bamboo composites



Australia - Hallet Concrete
Porous CCBE aggregate pavers

Indonesia – Bamboo Laminates
PT Bamboo Pure / Ibuku

Consideration

New materials development and sales opportunities may be directed to:

Change Climate

Mr. Sean Steed
CEO
Change Climate Pty Ltd
www.changeclimate.com.au
sean@changeclimate.com.au
Phone: +61 0417 778 020
Adelaide | Kuala Lumpur