

RU-BIX
ADVANCED MATERIALS



**SUSTAINABLE
TOOLING BOARD**

This summary provides an introduction to our Halo® tooling board, specifically designed for those that are in a hurry and want to get an immediate impression of what this award-winning material is all about. Further details can be found in the rest of the brochure and any specific queries can be forwarded to the Ru-bix office at info@ru-bix.com.



Introduction

Halo® tooling board is a high-performance material with unique environmental attributes, allowing users to significantly reduce CO₂ emissions.



Engineering

Designed for today's complex engineering applications, the sustainable Halo® board is ideal for direct tooling applications and can be used with epoxy/carbon-fibre pre-pregs.



High Temperature Stability

This board is on a par with traditional epoxy boards. The high glass transition temperature and low coefficient of expansion renders it suitable for most engineering applications.



Low Global Warming Potential (GWP)

This is what puts Halo® in a class of its own. Compared with polyurethane, polyimide and epoxy thermosets, the use of Halo® stands out as the obvious way to reduce CO₂ emissions to the atmosphere.



Automotive Applications

From low-volume niche vehicles to Formula 1 applications, there is nothing to match the environmental credentials of this high-performing tooling board.



Award Winning Product

Presented to Ru-bix Advanced Materials at the Global Motorsport Symposium in London, the William Kimberley Green Tech award was in recognition of a game-changing product for the composites industry.



Bio-Carbon Content (C_{bio})

Whilst the use of bio-carbon chemicals can be used to help reduce the GWP of a material, the quoted level of bio-carbon can be very misleading. For this reason, we no longer provide a C_{bio} value in our specifications. Instead, we provide the more meaningful value of GWP, reflecting the actual level of CO₂ emissions (pages 7-12).



Recycled Plastic Content

In addition to compounds based on bio-carbon, Halo® contains products derived from single-use plastics. This initiative was taken in order to help reduce the amount of plastic sent to landfill sites. A Halo® Life Cycle Assessment shows that this process positively impacts the environmental attributes of the tooling board.



Ethically-Sourced Raw Materials

Some bio-carbon products have been 'outlawed' for various ethical reasons. They often fail when evaluating worker's labour rights, safe working practices, business ethics, child labour and fair wages. In addition, deforestation can lead to habitat destruction, much to the detriment of indigenous plant and animal species. We do not use 'outlawed' products, including palm-oil based chemicals.



Market Acceptance

Since the introduction of the first version of Halo® in 2023, the use of this high-performance, low GWP material has gained acceptance across many engineering facilities. This unique product, based on 21st Century sustainable chemistry, is used in some of the most demanding applications, particularly within the automotive and aerospace sectors. Further advances will follow shortly.



Halo® Tooling Board TDS

High-Performance, Low GWP, Engineering Tooling Board



APPLICATIONS

- Direct Tooling
- Cubing Models
- Master Models
- Patterns
- Thermoforming Tools

PROPERTIES

- Fine Surface Structure
- High Temperature Stability
- Low Coefficient of Expansion
- Compatible with Epoxy Prepregs

Property	Units	Test Method	Halo
Density	kg/m ³	ISO 1183-3	800
Hardness	Shore D	ISO 868	75
Tensile Strength	MPa	ISO 527	33
Tensile Modulus	MPa	ISO 527	1850
Compressive Strength	MPa	ISO 604	48
Flexural Strength	MPa	ISO 178	35
Flexural Modulus	MPa	ISO 178	1950
Tg	°C	ISO 11359	135
CTE	10 ⁻⁶ m/m/°C	ISO 11359	38
Global Warming Potential	kgCO ₂ e/kg	ISO 14040/IPCC	2.9

Please see Halo brochure for comparison with other thermoset materials

PROCESSING: The product should be at 20-25°C during processing.

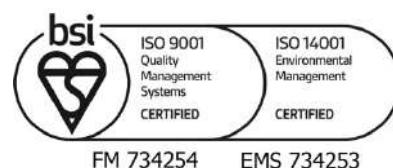
BOARD SIZES:
1490 x 500 x 50 mm
1490 x 500 x 75 mm
1490 x 500 x 100 mm
1490 x 500 x 125 mm
1490 x 500 x 150 mm

STORAGE: Halo boards should be stored flat in a dry place. Temperature variations should be avoided during storage and transportation.

HANDLING PRECAUTIONS: Good workplace ventilation must be in place during processing. In addition, workers must adhere to safety measures described within the Halo Safety Datasheet.

LEGAL DISCLAIMER: Recommendations and technical information are provided in good faith, based on current knowledge and experience. However, due to variations in storage conditions, storage period, substrates and site conditions, no warranty in respect of fitness for purpose can be inferred from this information. The user must test the product's suitability for the intended application. Ru-bix Advanced Materials is happy to provide free-issue samples for this purpose. All orders are accepted subject to our current terms of sale, a copy of which can be obtained from the Ru-bix office.

Contact: +44 1485-313020 enquiries@ru-bix.com



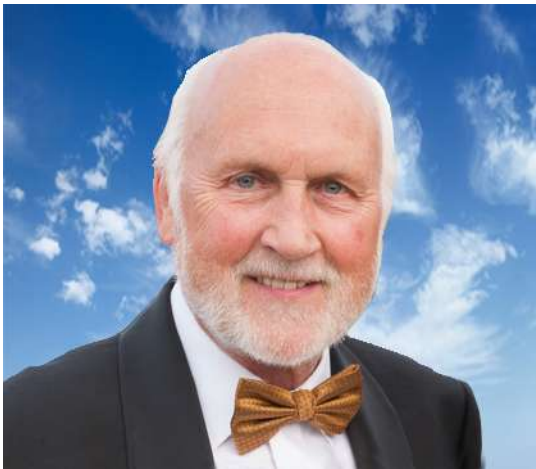
Performance

Halo® boards are increasingly used within the composites industry, often in conjunction with epoxy prepregs.

In terms of mechanical properties, Halo® boards are on a par with epoxy boards. Compression, tensile and flexural strength/modulus are virtually equivalent.

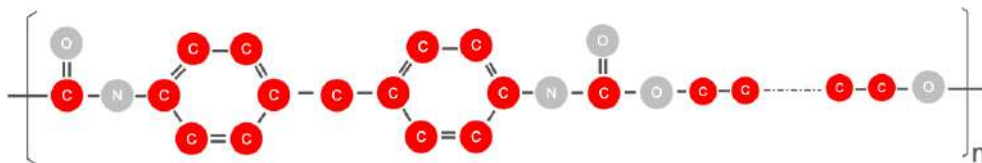
Thermal properties, particularly Tg and CTE, are also very similar. Halo® has been successfully used in many high-temperature applications, including direct tooling.

Milling and sealing properties are also similar. Customers tend to indicate that Halo® and epoxy boards are essentially equivalent in terms of processing parameters.

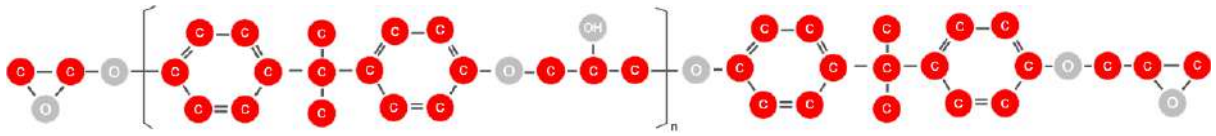


Formulating sustainable thermoset materials is a mixture of art and science. Following over 50 years of thermoset chemistry, our Chairman, Dr Barrie Colvin FRSC, has put together a series of compounds which can be regarded as our building blocks for current and future composite developments.

Essentially, we depict fossil-based molecules in the following manner:

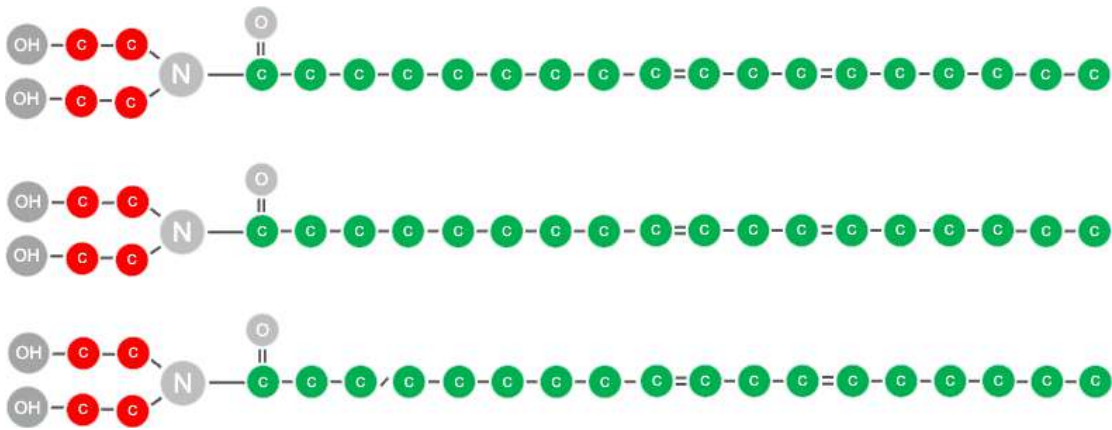


Traditional polyurethane based on petrochemical carbon atoms are coloured red. These need to be minimised.



Traditional epoxy based on petrochemical carbon atoms

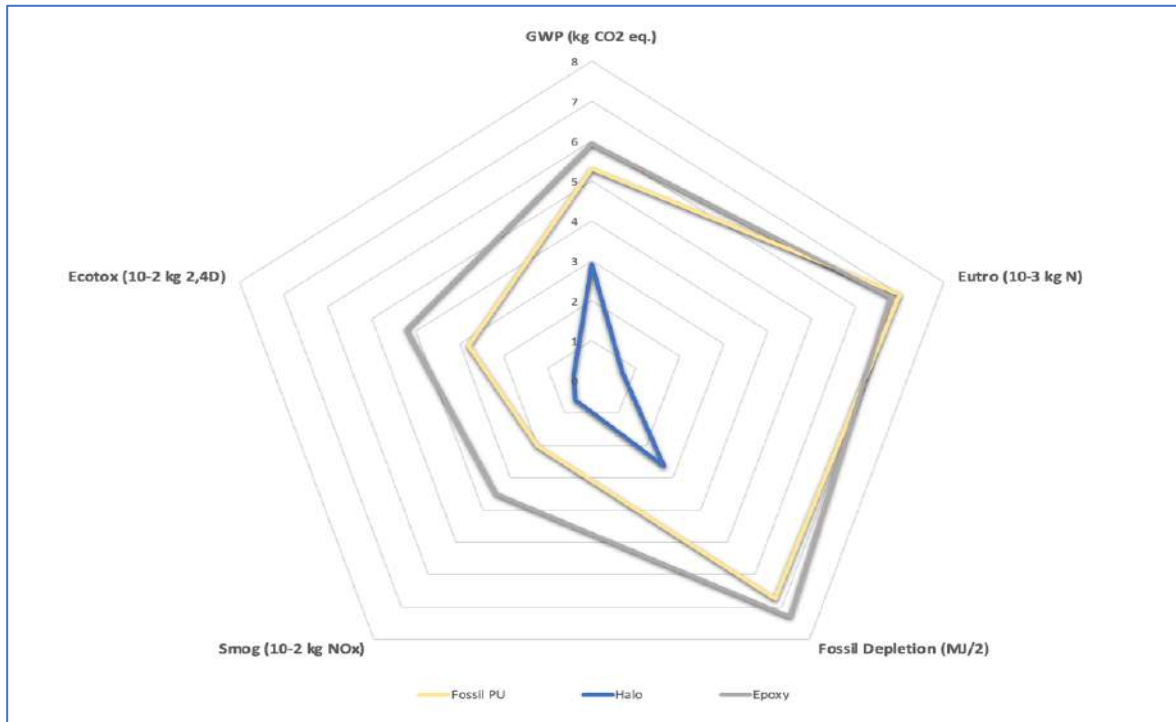
Bio-carbon derived molecules are depicted with green-coloured carbon atoms, normally obtained from a renewable, vegetable-based origin:



Triglyceride material containing a high level of vegetable-based (green) carbon atoms.

There are many bio-carbon based chemicals available for use in the composites industry. They include aliphatic, heterocyclic and aromatic species, each with their own attractive characteristics. However, the situation is changing all the time, as more work is carried out by our suppliers. The manner in which these new materials are used forms the basis of our R&D goals and ultimately to our undisclosed intellectual property.

However, the GWP associated with our composite materials can be significantly reduced by several means, in addition to the biocarbon content. For this reason, we choose to refrain from providing biocarbon content in our datasheets, but prefer to provide the more relevant GWP figures, which relate directly to CO₂ savings realised by the use of Halo® products.



The above graph depicts five of the main environmental impact categories commonly studied in Life Cycle Assessments. The respective areas covered by the three thermosets (PU, Epoxy, Halo[®]) provide an overall comparison between them. The Halo[®] thermoset (blue line) has comparatively little effect on the various impact categories.

The level of emitted CO₂ is measured by the Global Warming Potential (GWP), 2.91 kg CO₂/kg for the current Halo[®] product. This low value, when compared with the two fossil-based polymers, arises as a result of the fundamental and very different processes involved in the manufacture of each type of product.

Fossil-based thermosets exist as a result of a rather tortuous chain of petrochemical processes. The journey begins with crude oil and involves many energy-intensive steps to achieve the final product.

On the other hand, the production of Halo[®] boards involves a few simple, low-energy steps for the conversion of vegetable-based oils and resins to useful industrial chemicals. In addition, the Halo[®] manufacturing process incorporates refined waste products from the plastics industry.

CO₂ Savings Compared with Epoxy Products

When using Halo® in a manufacturing process, the low GWP provides a real opportunity to reduce the adverse environmental impact of the process. If you know the amount of tooling board that you plan to use on a project, simply contact us and we shall be able to provide you with the amount of CO₂ that you will save by using Halo® in place of a conventional, fossil-based equivalent. This is readily calculated from the GWP figures for the relevant materials.

For example, a recent automotive project saved 3.9 tonnes of CO₂ simply by using Halo® boards in place of a conventional fossil-based product.

Note the quote from Sir David Attenborough:



“We have been putting things off year after year. We’ve been raising targets, saying ‘oh well, if we do it in the next 20 years ‘ ***the moment of crisis has come.***”

At Ru-bix Advanced Materials, we are determined to make a significant contribution towards solving this ‘moment of crisis’. Thankfully, our customers feel the same way. Collectively, we can all make a real difference. Look out for further significant advances as we continue to introduce more unique products during the course of 2025.

Introduction

Tooling boards and other composite-related products are being modified in order to ensure that they become substantially more sustainable than at present. Composites UK has rightly emphasised that the industry will champion the *“use of materials and chemicals from secondary and bioderived sources”*.

Bio-Carbon Content

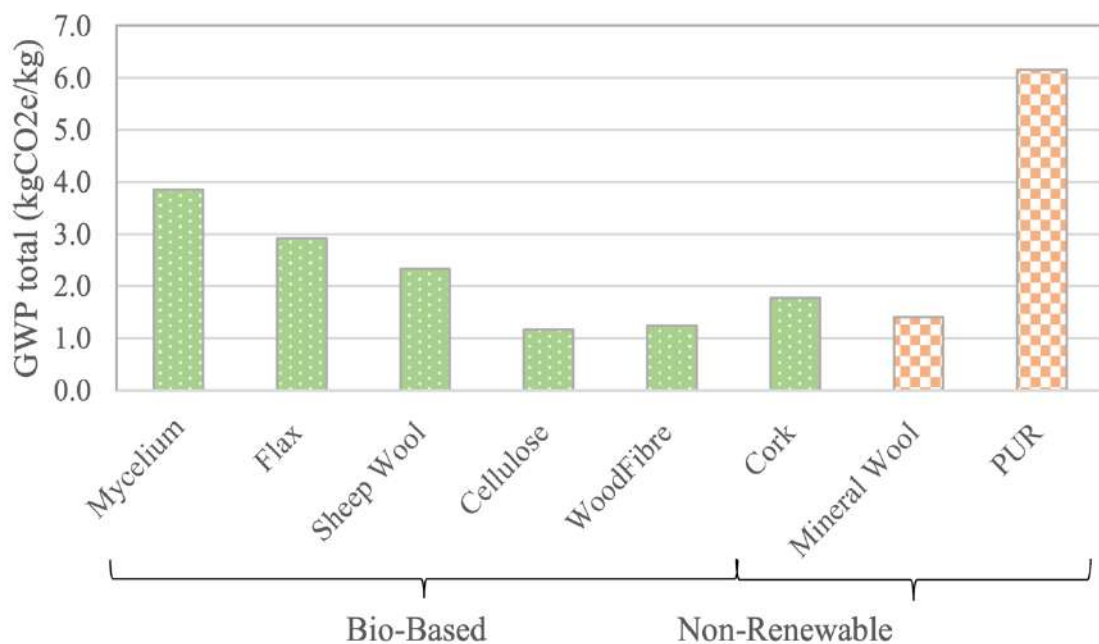
Tooling boards can easily take advantage of the changes in 21st Century polymer chemistry. As new chemicals are produced from a vegetable base, the Rubix approach lends itself to incorporating these sustainable biomaterials into high-performance thermoset boards. We have developed a series of nine Bio-Res[®] products that form the backbone of our composite innovations. In some cases, the resin bio-carbon content can extend to 99%. Importantly, some tooling board grades also incorporate species derived from recycled plastics.

However, biogenic carbon is only one aspect of our development programs. We must not lose sight of the fact that the important environmental property of any product relates to the level of emitted carbon dioxide (CO₂), expressed as the Global Warming Potential (GWP₁₀₀).

A great deal of effort has gone into the optimisation of tooling materials to reduce the GWP to very low values. Indeed, the most important impact category within LCA evaluations (ISO 14040/14044) is the GWP. It is significant that this value may be related to the biocarbon content, but it is clear that the situation is more complex than that. As we head towards a situation where EPDs (Environmental Product Declarations) become commonplace, emphasis must be placed on emitted CO₂ and not on biocarbon content per se.

Example

Bio-based building insulation products were studied by academics at Bath University, sponsored by the European Union Regional Development Fund. Various types of insulation products were included, some of which were bio-based, others were based on 'non-renewable' products, as shown below.



It is evident that mycelium, which is 100% bio-based, has a higher GWP (3.9 kgCO₂e/kg) than mineral wool (1.4 kgCO₂e/kg). This is partly because mineral wool contains 25% recycled content and can be recycled at end-of-life. Even if the mineral wool is land-filled, it does not generate significant emissions.

This example is one of many that demonstrates that a material with high bio-carbon content does not necessarily result in low CO₂ emissions.

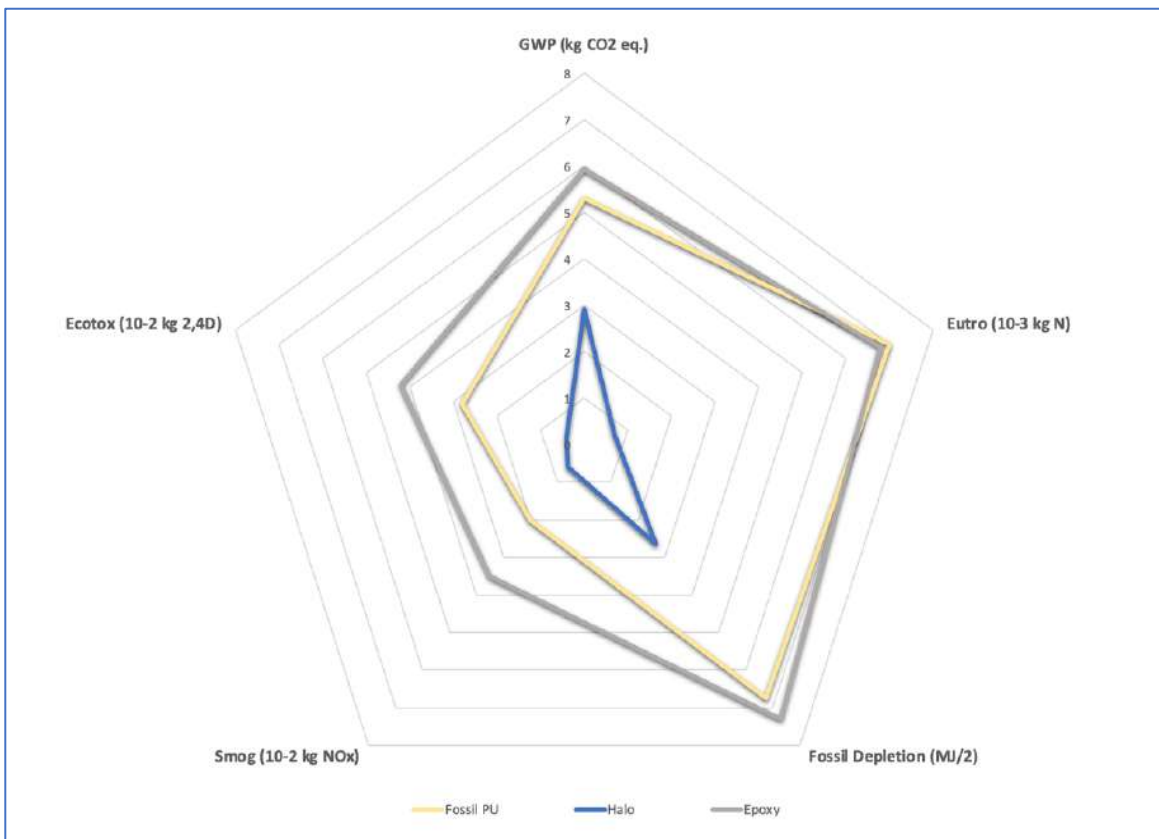
GWP and Tooling Boards

Extending the issues described above to tooling board applications, the principal objectives of Rubix is to develop a range of products with unprecedented sustainability attributes, including the formulation of materials with very low values of GWP₁₀₀, but not necessarily containing very high levels of bio-carbon.

GWP₁₀₀ of Thermoset Materials

The graph below depicts five of the main environmental impact categories commonly studied in Life Cycle Assessments. The respective areas covered by the three thermosets (PU, Epoxy, Halo[®]) provide an overall comparison between them. The Halo[®] thermoset (blue line) has comparatively little effect on the impact categories.

The emittance of CO₂ is measured by the Global Warming Potential, currently at 2.91 kg CO₂/kg for the Halo[®] product. This compares with 5.30 for a typical polyurethane and 5.93 for a typical epoxy board. The fossil-based products involve many energy-intensive steps from the conversion of crude oil into polyol and isocyanate raw materials.



Radar diagram showing 5 principal impact categories commonly used in LCA evaluations

CO₂ Savings Compared with Epoxy Products

When using Halo[®] in a manufacturing process, the low GWP provides a real opportunity to reduce the environmental impact of the process. The Halo[®] tooling board has a high Tg and a low CTE. It can be used directly with epoxy prepregs. In order to obtain an approximate CO₂ saving, simply by changing from a fossil-based product to a low GWP material, the following equations can be used:

If the **volume** of tooling board used in a project is known (in cubic metres), multiply this volume by 2.27 to obtain the CO₂ saving, in metric tonnes.

Or, if the **weight** of the tooling board is known (in kg), multiply the weight by 0.00302 to obtain the CO₂ saving.

For example, a recent project used 1300kg of Halo[®] tooling board, giving a CO₂ saving of 3.9 metric tonnes compared with the use of an epoxy equivalent.

Summary

1. The use of bio-carbon based raw materials helps in the development of composite products with low levels of CO₂ emissions.
2. The use of compounds derived from recycled plastics can be advantageous in reducing CO₂ emissions.
3. Compounds with a high bio-carbon content do not necessarily have a low Global Warming Potential.
4. Sustainable Halo[®] tooling boards can be used as alternatives to fossil-based PU and epoxy boards.

Halo® Tooling Board Performance and CO₂ savings



Polyurethanes, epoxies and other thermoset materials have been available since the 1930s. Surprisingly, many of today's products are based on vintage chemistry from that time period. Our aim is to provide our entire product range based on 21st Century chemistry, a chemistry that has sustainability at its core.

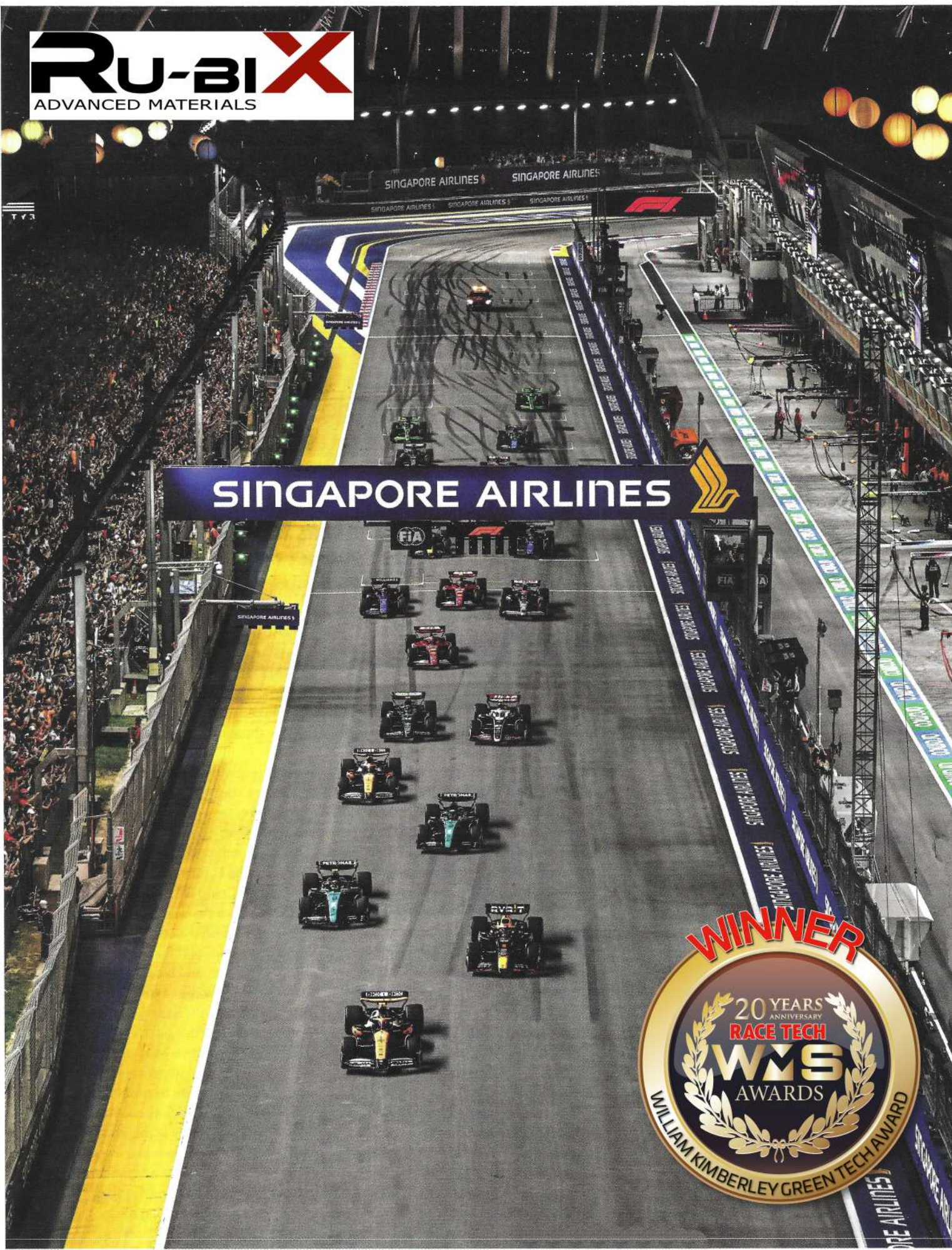
Introduction

Halo® tooling board is a hybrid syntactic polymer based on sustainable raw materials. It is characterised by high mechanical and thermal performance and formulated from chemicals that significantly reduce the level of emitted carbon dioxide to the environment.

Halo® is unique and is the result of many years of experience with thermosets derived from bio-carbon derivatives. As it penetrates further into the composites industries, particularly in the automotive and aerospace sectors, a growing number of engineers are excited about the combination of high performance and environmental benefits. This proven performance recently led to the presentation of the William Kimberley Green Tech award to Ru-bix Advanced Materials at the World Motorsports Symposium in London.



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SUSTAINABILITY – *WITHOUT* COMPROMISING PERFORMANCE

Once a source of great pride, motorsport's expertise with composite materials is hard to reconcile with the drive for sustainability. Or is it? **Chris Pickering** talks to the pioneers of vegetable-based chemistry in composite tooling

INNOVATION often comes from the ideas that others have overlooked – or sometimes dismissed completely. The story behind the revolutionary Ru-bix Halo-S tooling board, which won the William Kimberley Green Tech Award at the recent World Motorsport Symposium, involves both.

Tooling boards are the first part of the composite manufacturing process. They're blocks of material that are shaped to create the tooling used for laying up carbon fibre. In some cases, they're used as a direct tool for manufacturing. In others, they're used to produce a carbon fibre tool, which is then employed in production of subsequent parts. In either case, they are typically made with epoxy resins.

Most epoxy resins are formed by reacting epichlorohydrin with bisphenol A. Both compounds are known to cause significant health issues, and both are traditionally derived from fossil fuels. The curing of epoxy is also very energy intensive, with parts kept in an industrial oven for up to seven days while they solidify.

The Halo material is said to address all three problems, starting with bio-derived ingredients that are non-harmful, using far less energy to process them, and ultimately delivering significant cost savings too. Most importantly, it does so with a material that behaves in exactly the same way as traditional epoxy as far as composites production is concerned.

"It's always going to be difficult to get a truly sustainable epoxy, given the fundamental chemistry behind it. There are things you can do to make epoxies

less impactful, like using biopolymers as hardeners, but there's a limit to how much you actually gain," comments Ru-bix chairman Dr Barrie Colvin. "We set out to mimic the thermal behaviour of those materials with a sustainable alternative that can be used without any changes to the manufacturing process."

“Epoxy is around 7 to 8 kg of CO₂ emitted for every kilo of finished product; with the Halo board that number is between 1 and 2 kg”

Among the properties that make epoxy resins suitable for composite tooling are a low coefficient of thermal expansion (CTE) and a high glass transition temperature (T_g). In a nutshell, this limits the expansion that composite engineers have to allow for while the tool is placed in the autoclave and ensures that it provides sufficient rigidity at elevated temperatures. Although the degree of thermal expansion is relatively small on a typical motorsport part, it can run to multiple centimetres on a large component like a wind turbine blade.

"Aside from the cost and the environmental aspect, there can be other downsides to using epoxy," points out Ash Colvin, managing director of the family-run firm. "A lot of epoxy materials can produce significant ▶

LEFT Formula 1 teams are hot on secrecy, but at least four on the current grid use the sustainable tooling boards

RU-BIX Wins Green Tech Award



amounts of dust, they can give off a strong odour when they're machined, and they tend to be very brittle. One of the advantages of Halo is that it's less brittle and therefore more practical to use as a direct tool, so you're also reducing the need for additional composite tooling."

Inspiration

Halo is a recent creation, but it draws inspiration from a career stretching back more than half a century.

Barrie began as research scientist at Shell in the 1970s, where he led a team tasked with developing a new range of products. Rather than stick with the company's core range of petrochemicals, they took a deliberate decision to explore what could be done with plant-based polyols – something that nobody else was doing at the time.

"We were given free rein to experiment, so it really was just a matter of curiosity to see whether or not we could use other oils for the same purpose as the fossil-derived components," he recalls. "We knew that there were similarities in terms of molecular structure, so we reasoned that this should give them somewhat similar physical properties."

This hunch proved to be correct. Barrie's team developed a range of vegetable-derived polyurethanes that offered exceptionally good thermal stability.

He left Shell in 1978 and went to work for a company that used similar technology to develop foam insulation for pipelines, refrigeration and cold storage.

One of the first projects that used this technology was an above-ground ammonia pipeline installed in India in 1980. It ran for 11 km from a factory to the neighbouring port, carrying liquid ammonia that needed to be kept at very low temperatures, despite the warm ambient conditions. Barrie and his team developed a polyurethane foam based on locally sourced sunflower oil, but it lacked the high temperature performance required for applications such as composites manufacture.

In 1982, he set up his own company, IFS, which later set another sustainability landmark by pioneering the use of non-CFC blowing agents in polyurethane foams. Major manufacturers like Portakabin started switching to IFS from much larger chemical suppliers, and the company (sold in 2017) remains active today.

Under Barrie's leadership, IFS continued to expand its portfolio of high-performance thermoset materials, but the interest in the use of sustainable, non-fossil derived products wasn't always there at the time.

“Finding the resins and processes that will deliver a significant CO₂ saving rather than just ticking a box”

"I remember giving a talk at the UTECH conference in Singapore in 1994 about some of the things that we could make with natural oils," he recalls. "It was relevant to an awful lot of applications from building panels to the insulation in refrigerators, so I set 10 minutes aside for questions at the end. Instead, there was just silence. When I spoke to people later on, they said 'the petrochemical stuff we've been using works perfectly well, so why would we want to change it?'"

The prevailing attitude was much the same when Ru-bix Advanced Materials was formed in 2015 and ▶

LEFT Ru-bix Advanced Materials Chairman Dr Barrie Colvin receives the William Kimberley Green Tech Award from Race Tech Publishing Director Soheila Kimberley

BELOW The company's grounding in fundamental polymer science enables it to turn innovative chemistry into leading-edge products: the making of the sustainable tooling boards



the conversation turned to the use of vegetable-based chemistry in composite tooling.

"Someone came up to us at the Advanced Engineering Show and said, 'it's been tried before and it doesn't work,'" Barrie recalls. "They even said they'd refuse any samples as they just didn't believe it was possible."

This outright denial only served to strengthen Barrie's resolve. Decades of experience with vegetable-derived thermosets suggested that they could be developed to offer a viable tooling board material that was not only more sustainable, but also cheaper and more pleasant to work with.

The end result is a hybrid polymer. Instead of a single material, it uses a combination of ingredients, including bio-carbon and recycled plastic, polymerised together to combine the desired range of physical properties. With a T_g of 140 deg C, the sustainable board is said to exhibit very similar behaviour to a fossil-derived epoxy board of the same density.

"When you first talk to people about a sustainable product, they almost always expect it to be more expensive and less effective than the existing solutions," comments Ash. "We wanted to make sure that Halo would meet the same performance requirements as a traditional epoxy and that it would do so at a significantly lower cost. The aim has always been to

“At the end of my talk there was just silence. Later, they said, ‘The petrochemical stuff we’ve been using works perfectly well, so why would we want to change?’”

make the transition as simple as possible, with no change to the processes or the capabilities."

Halo production still starts with plant oils, but it uses different feedstocks and different chemistry to Barrie's earlier projects such as the pipeline.

"There are a lot of plant oils out there, and the chemicals within them vary tremendously," he notes. "When I first started working in this area, it was things like sunflower oil and rapeseed oil. Chemically, those are triglycerides. And there are certain things that you can do with triglycerides that allow you to produce a similar polymer, but you can't achieve the high T_g that you need for the sort of industries that we're talking about here."

Broader challenge

While the use of bio-carbon and recycled plastics is significant, they're just two elements in a much broader sustainability challenge.

"We're seeing a massive push towards sustainability



ABOVE The Callum Skye EV features two departures from conventional manufacturing methods: Codem Composites used a direct tooling approach by harnessing Ru-bix's Halo-750 sustainable tooling; it also replaced traditional carbon fibres with flax fibre

BELOW Ariel's electric E-Nomad used Ru-bix's Halo high-performance, sustainable tooling boards. It also features bio-composite fibre bodywork that is recyclable

in motorsport and I think something that's going to become incredibly important for all manufacturing businesses in the future is the concept of lifecycle impact," notes Ash.

"When we talk to the composites industry a lot of people are very much fixated on the use of bio-resins. Yes, those are naturally grown, but the CO₂ savings can be next to nothing in some cases. Having something that's rich in bio-carbon doesn't really help if you're expending a lot of energy to access that. It can actually generate a lot of CO₂. We're trying to find the correct resins and processes that will deliver a significant CO₂ saving rather than just ticking a box to say it's bio-derived."

Ru-bix is actively attempting to steer the conversation away from bio-carbon content and onto CO₂ savings. After liaising with early adopters of Halo, the company took the decision to state the global warming potential (GWP) of the material on its datasheets rather than a percentage of bio-carbon.

"The process of creating an epoxy board is very ▶



energy-intensive,” comments Barrie. “There are databases now that allow you to look up the GWP of any material. Epoxy – because it starts with fossil-based materials and then applies a lot of processing steps – is around 7 to 8 kg of CO₂ emitted for every kilo of finished product.

“With the Halo board that number is between 1 and 2 kg, so we’re talking about a massive difference. That’s because it starts with a plant feedstock and only requires a couple of low-energy processing steps to get to the material that we buy in and process into the board. The energy consumption of our processes is very low as well.”

Traditional epoxy is poured into the mould and requires the prolonged application of heat to cure. Halo is also a thermoset material, but it begins to react at room temperature while being mixed. Ru-bix has

a continuous production line with large roller tables, where the material solidifies. It’s then put into an oven for post-curing, which lasts 24 hours, as opposed to the week-long curing process with epoxy.

Recycling

Tool production is just one step in the composite manufacturing process. However, it can be a significant contributor to the carbon footprint in specialist applications like Formula 1, where sometimes only a handful of parts are made on each tool. More to the point, there’s a growing awareness that manufacturing businesses need to address each and every stage of the product’s lifecycle to be truly sustainable.

As well as working on the processes and the raw materials, Ru-bix has been looking into end-of-life and recycling options. For large boards, one

RIGHT A Belotti CNC machine being used at Codem Composites for milling and trimming of the Ru-bix Halo tooling board



RIGHT The finished product: in this case, a clam shell produced for the Callum Skye

LEFT One of the key ingredients that make Halo-S boards unique is their utilisation of recycled plastics



possibility is simply to re-machine it into a tool for a different part once the original production run is finished.

"A lot more people are starting to reuse the tools," comments Ash. "You need a really big tooling board to make something like the floor for a Formula 1 car, and you need quite a lot of material below that to give it the stability. If you start off with a 500 mm board, you can

skim it flat after you've used it and still have a depth of 200 mm left to reuse. We've noticed a significant shift in the mindset – people are starting to save tiny little offcuts to jigsaw together, which would previously have gone in the bin."

Ru-bix is also working with various partners on end-of-use applications. Much of the recovered material now goes to high-end furniture makers, where it's used

as a core material in place of wood. The company also worked with automotive OEM Cupra to produce a series of 3D artworks for its UK dealerships.

For the next step, Ru-bix is now investigating the option of purchasing an industrial shredder. This would allow the waste material to be returned to the company and shredded into sub-millimetre particles that can then be bound with a sustainable resin to produce its own composite. As tends to be the case, the recycled material will be a slightly lower grade, but Ash anticipates it being used for less critical applications like jigs and fixtures.

Exponential growth

The growing emphasis on sustainability in motorsport has led to conversations with a number of Formula 1 teams looking into Halo. Ru-bix already supplies several subcontractors who produce parts for the motorsport industry. Additionally, the company has worked with specialist road car manufacturers on low-volume projects and concept cars, such as the Callum Skye and the Ariel e-Nomad.

The Halo side of the business is growing exponentially, we're told. Work has begun on training new staff and the plan is to add a late shift to increase production. There are also several new products in the pipeline.

All of this can trace its origins back to that spark of inspiration to look at vegetable-based chemistry, long before sustainability and greenhouse gas emissions were on the agenda. Proof that sometimes it does pay to do things differently. **RT**



Section 1: Identification of the substance/mixture and of the company/undertaking

1.1. Product Identifier

Product Identifier:	Thermoset-Based Synthetic Board (Density: 750kg/m ³)
Product Name:	<i>Halo</i>

1.2. Relevant Identified uses of the substance or mixture and uses advised against

Use of substance:	Engineering & Prototyping Applications
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1.3. Details of supplier of the safety data sheet

Company Name:	Ru-bix Advanced Materials Venus Court Hardwick Industrial Estate King's Lynn Norfolk PE30 4HY United Kingdom
Telephone:	01485 313 020
Email:	ash.colvin@ru-bix.com

1.4. Emergency telephone number

Emergency telephone:	01485 313 020 (office hours only)
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Section 2: Hazards identification

2.1. Classification of a substance or mixture

Classification under CLP:	Not hazardous
Most important adverse effects:	Sawing, sanding or machining tooling board products may produce dust, which can cause an explosion hazard. <i>Halo</i> tooling board dust may cause irritation to the eye, skin and respiratory tract.

2.2. Potential Health effects

Manual handling:	Higher density tooling boards can be heavy. If possible, when moving boards, consider the use of a lifting aid, such as forklift truck, electric or hand-powered hoist or a conveyor. Refer to hse.gov.uk/toolbox/manual.htm
Inhalation:	<i>Halo</i> tooling board dust may cause nasal dryness, irritation and obstruction. Coughing, wheezing and sneezing have also been reported
Eye Contact:	Fine dust may cause temporary irritation. Larger particles can cause mechanical irritation.
Skin Contact:	No adverse effects.
Ingestion:	Not likely to occur.
Chronic:	No reported effects.

2.3. Other hazards

PBT: This product does not contain any substances as PBT or vPvB.

Section 3: Composition/information on ingredients

3.1. Composition/information on ingredients

Composition: A hybrid thermoset polymer based on sustainable raw materials.
It is chemically inert with no unreacted compounds.

Section 4: First Aid measures

4.1. Description of First Aid measures

Skin contact:	Wash affected areas with soap and water until dust is entirely removed from skin. Get medical attention if rash or irritation persists or dermatitis occurs.
Eye Contact:	Fine dust may cause mechanical irritation. Treat dust in eye as foreign object. Flush eyes with large amounts of water. Remove to fresh air. If irritation persists, get medical attention.
Ingestion:	Not Applicable
Inhalation:	Fine dust particles may cause unpleasant obstruction in the nasal passages, resulting in dryness of nose, dry cough, sneezing and headaches. Remove to fresh air.

4.2. Most Important symptoms and effects, both acute and delayed

Dust - Skin contact:	There may be mild irritation at the site of contact.
Dust - Eye Contact:	There may be irritation and redness
Ingestion:	Not Applicable
Dust - Inhalation:	There may be dryness of nose, dry cough, sneezing and headaches

4.3. Indication of any immediate medical attention and special treatment needed

Notes for the doctor: Treat symptomatically

Section 5: Fire-fighting measures

5.1. Extinguishing media

Extinguishing media: Suitable extinguishing media for the surrounding fire should be used.
Use water spray on boards.

5.2. Special hazards arising from the substance or mixture

Exposure hazards: Fire fuelled by tooling board dust or shavings is classified as a Class-A fire. Principal decomposition products include carbon dioxide and carbon monoxide.
Sawing, sanding or machining can produce shavings and dust as a by-product that may present an explosion hazard.

5.3. Advice for fire-fighters

Advice for fire-fighters: Firefighting procedures for extinguishing a Class A fire should be followed. Use recommended Class A firefighting equipment when fighting an incipient fire.
This includes an air-fed respirator.
When extinguishing a fire in a pile of tooling board dust or shavings, care needs to be taken.
A direct stream of water, into the pile from a hose, could cause the burning material to become airborne creating a risk in spreading the fire to other areas.
Water is used to quench the burning material below its ignition temperature. The addition of Class A extinguishing foams (sometimes referred to as wet water) may enhance water's ability to extinguish Class A fires, particularly those that are deep seated in bulk materials (such as piles of shavings, dust etc.).
This is because the Class A foam agent reduces the water's surface tension, allowing it to penetrate more easily into piles of material.
Class A fires are difficult to extinguish using oxygen-exclusion methods like CO₂ flooding or coating with foam because these methods do not provide the cooling effect needed for total extinguishment.

Section 6: Accidental release measures

6.1. Personal precautions, protective equipment and emergency procedures

Personal precautions: Refer to Section 8 of SDS for personal protection details.

6.2. Environmental precautions

Environmental precautions: Land spill, generally not applicable to board products

6.3. Methods and material for containment and cleaning up

Clean-up procedures: Chippings/dust can be cleaned up using a conventional vacuum cleaner

6.4. Reference to the other sections

Refer to the other sections: Refer to Section 8 of SDS

Section 7: Handling and storage

7.1. Precaution for safe handling

Handling requirements: Wear gloves when handling *Halo* boards.
Avoid direct contact with an open flame.
Avoid repeated or prolonged breathing of air-borne dust.
Wet down accumulated dust prior to vacuuming or shovelling in order to prevent explosion hazards.
Avoid dusty conditions and provide good ventilation/extraction.
Shaving and dust clean up, and disposal activities, should be accomplished in a manner to minimize creation of airborne dust.
Do not inhale dusts during clean up.
Take care when moving boards and blocks.
Use mechanical handling devices to move heavy boards

7.2. Conditions for safe storage, including any incompatibilities

Storage conditions: This product should not be stored where exposure to water could occur or near a source of ignition.
Avoid storing in areas of high relative humidity and high temperature.
It is recommended to store product in an area of relative humidity and temperature that approximates end use.
Do not store near high heat sources.

Section 8: Exposure controls/personal protection

8.1. Control parameters

Workplace exposure limits: Provide adequate general and local exhaust ventilation to keep airborne contaminant concentration levels to meet OSHA requirements for general dust exposure.
Ensure a maximum average concentration of 10mg/m³ of total dust in the atmosphere

8.2. Exposure controls

Engineering measures:	Ensure there is sufficient ventilation of the area.
Respiratory protection:	Wear an approved respirator when the allowable exposure limits may be exceeded. (Refer to Section 3 of this SDS)
Hand protection:	Protective gloves
Eye protection:	Recommended goggles or safety glasses as conditions indicate when sawing, sanding or machining tooling board products.
Skin protection:	Wear side-shield safety glasses or protective goggles during all aspects of fabricating this product. Other protective equipment such as gloves and outer garments may be needed depending on dust conditions.

Section 9: Physical and chemical properties

9.1. Information on basic and chemical properties

State:	Solid
Colour:	Blue
Odour:	Odourless
Evaporation rate:	Not applicable
Oxidising:	Not applicable
Viscosity:	Not applicable
Kinematic viscosity:	Not applicable
Viscosity test method:	Not applicable
Flash point °C	>400
Relative density	various

9.2. Other Information

Other information:	No data available
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Section 10: Stability and reactivity

10.1. Reactivity

Reactivity:	Avoid product contact with an open flame and any temperature sources that could induce thermal decomposition. Avoid product contact with oxidizing agents, drying oils and strong acids.
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10.2. Chemical stability

Chemical stability:	Stable under normal circumstances.
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10.3. Possibility of hazardous reactions

Hazardous reactions:	Hazardous reactions will not occur under normal transport or storage conditions
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10.4. Conditions to avoid

Conditions to avoid:	Fine dust generated from sawing, sanding or machining the product is extremely combustible. Keep in cool dry place away from ignition sources.
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10.5. Incompatible materials

Materials to avoid:	Avoid product contact with oxidizing agents, drying oils and strong acids.
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10.6. Hazardous decomposition products

Hazardous decomposition products: Thermal and/or thermal-oxidative decomposition can produce irritating and toxic fumes and gasses, including carbon monoxide, carbon dioxide and hydrogen cyanide.

Section 11: Toxicological information

11.1. Information on toxicological effects

Hazardous ingredients: Not applicable

Dust: Tooling board dust (generated from sawing, sanding or machining the product) may cause nasal dryness, irritation and coughing.

Additional toxicity data: See acute and chronic health effects provided in section 2.

Target organs: See acute and chronic health effects provided in section 2.

Section 12: Ecological information

12.1. Toxicity

Ecotoxicity values: Not available for product in purchased form.

General product information: Not available for product in purchased form.

Environmental fate: Not available for product in purchased form.

Section 13: Disposal considerations

13.1. Waste treatment methods

Disposal operations: This board product is not recyclable. It is the user's responsibility to determine whether your product meets any applicable criteria for waste disposal.
Disposal must follow applicable national and local regulations.

Section 14: Transport information

14.1. Transport class

Transport class: This product is classified as 'Non-Dangerous' for ADR, IATA and IMDG Regulations.

Section 15: Regulatory information

15.1. Safety, health and environmental regulations/legislation specific for the substance or mixture

Specific regulations: Not applicable

15.2. Chemical safety assessment

Chemical safety assessment: *Halo* tooling board products are non-hazardous under criteria of European regulations.
However, shavings and dust generated by sawing, sanding or machining this product may be hazardous.

Section 16: Other information

16.1. Other information

Other information: None

Legal disclaimer: Recommendations and technical information are provided in good faith, based on current knowledge and experience.
However, due to variations in storage conditions, storage period, substrates and site conditions, no warranty in respect of fitness for purpose can be inferred from this information.
The user must test the product's suitability for the intended application.
Ru-bix Advanced Materials is happy to provide free-issue samples for this purpose. All orders are accepted subject to our current terms of sale, a copy of which can be obtained from the Ru-bix office.

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