In Commercial Confidence

FIREDRAGON

GREEN & CLEAN FUEL

"The Ultimate Military Cooking Fuel"

July 2015

BCB INTERNATIONAL

Contents Page

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1. Background

UK soldiers have for many years been commenting on their need for a fuel that can be used quickly in combat situations, one that is easy to light, safe to carry, and can be used in confined spaces. Whilst the current generation of hexamine blocks used by the military offer an air transportable option, their overall quality is far from what is expected of modern military-grade products; problems with hexamine blocks include variable burning performance, formation of toxic gases when used, harmful if ingested, non-environmentally friendly, and tainting the taste of food being cooked.

The FireDragon Solid fuel is the result of collaboration between BCB International and world leading experts at Cardiff University, Wales. FireDragon Solid is so unique it has been granted patented status (GB patent No. 2500062), meaning that only BCB International will be able to offer this and similar products worldwide. Designed and made in Britain means it will have a short, easily sustainable supply chain.

This next generation fuel is a non-toxic, high-performance, and cost effective product designed to deliver the professional solider with a fuel that can meet the demands of the modern military arena.

2. Key Features

- ✓ **Non-toxic** and **odourless** when burnt
- ✓ Easy and **quick to ignite** – use a flint, match, or lighter
- ✓ Low luminosity flame
- ✓ **Burns cleanly** with **very little soot**
- ✓ Safe to be **packed with food**
- ✓ **High calorific value** in the region of 28,000 (kj/kg)
- ✓ **Air transportable** (UN class 4.1, packaging class III)
- ✓ Made from **sustainable**, natural derived bio-ethanol
- ✓ Lightweight
- ✓ Can be used in confined spaces (with adequate ventilation)
- ✓ Each block burns for approximately 7-8 minutes, with two blocks burning for 12-14 minutes[1]
- ✓ Will light and **burn even when wet**
- ✓ Suitable for extreme conditions (e.g. wind and rain)
- ✓ Can be used in a variety of cookers
- ✓ Recyclable packaging
- ✓ Made from renewable ingredients
- ✓ **Patented (GB 2500062)**
- ✓ **Made in the UK**
- ✓ **High performance** (graph, page 7)
- ✓ Unburnt and exposed FireDragon degrades quickly

[1] Performance varies depending on cooker setup and environmental conditions.

3. FireDragon Products

(Left to right) FireDragon Solid 6 × 27 g (0.9 oz), FireDragon Gel 250 ml, FireDragon Gel 1 litre.

Product	Product Code	NATO NSN
6 × 27 g FireDragon Solid	CN336	9110-99-505-2835
250 ml FireDragon Gel	CN336C	
1 L FireDragon Gel	CN336D	

3.1 FireDragon Solid Fuel

A Welsh Innovation Award Prize winner of 2014, FireDragon was created from the necessity for a new, high performance fuel replacement for hexamine tablets; FireDragon solid ethanol fuel blocks are the solution. Comprised of sustainably sourced ethanol, and thickening agents, BCB is able to produce solid ethanol fuel blocks that are lightweight, easy to light, and waterproof. These features make it suitable for cooking and boiling water in all weather conditions too.

FireDragon is odourless and non-toxic which helps keep you, your food, and cooking equipment safe and clean; this is possible because the components used to create FireDragon contain no nitrogen or sulphur atoms which could otherwise produce toxic gases such as hydrogen cyanide or sulphur dioxide along with various nitrogen oxides when burnt.

FireDragon solid removes the possibility of spillage accidents since it is not free flowing. Spillage of fluids from their packaging does not solely occur whilst in use but is also possible during storage and transport. FireDragon negates these risks as the fuel cannot leach out if the package if it were to be damaged; it will remain in the packaging or at least as a single block, which can be easily contained and cleaned.

It is due to this reduced risk that it is possible to ship FireDragon by air, sea, and freight, whilst liquid ('gel') fuels are far more restricted.

FireDragon Solid is sold as 27 g blocks in packs of 6. Average pack weight is 178 g.

3.2 FireDragon Gel Fuel

Derived from FireDragon Solid technology, we are proud to introduce our new all-weather gel biofuel made from UK sourced ethanol, which can be used in a host of outdoor cooking stoves, barbecues, and indoor ethanol/biofuel fireplaces.

We formulated and developed FireDragon Gel to help those who venture into the great outdoors; cooking their rations and boiling their drinks quickly, all whilst safeguarding their health and protecting the environment. Our fuel is non-toxic, non-drip and made from 100% natural ingredients including ethanol sourced from UK grown grain stocks. It is easy to light, burns cleanly, and our research shows that it boils water faster than methylated spirits (meths).

The FireDragon Gel fuel is an ideal companion for all outdoor pursuits. Whether in driving rain, the freezing arctic or searing heat, the fuel will perform in extreme conditions.

FireDragon Gel is supplied in two sizes: 1 L (left) and 250 ml (right).

4. Why FireDragon?

When deployed in demanding situations FireDragon fuel delivers.

FireDragon's non-toxic nature means that a soldier's health isn't risked each time they cook a meal, when compared to cooking with hexamine blocks. Its odourless nature doesn't taint cooked food, allowing the soldier to enjoy their meal – a vital morale booster.

FireDragon performs in a range of severe conditions including wind and rain. It is reliable to light and burns cleanly whilst producing a low luminosity flame - reducing the chances of being detected.

Its superior performance when compared to traditional hexamine blocks makes it the natural choice. One block of FireDragon Solid or 25 g of FireDragon Gel will bring 500 ml of water to a boil up to a minute faster than a hexamine tablet, and faster than all other solid fuels currently known on the market.

As FireDragon is easy to light with a flash point and fire point of 8˚C. Hence it can be ignited easily and quickly. Its auto ignition temperature however is significantly higher at 363 ˚C. It's easy to light nature saves time as well as matches in poor weather. Matches (which are expensive and unreliable especially in the damp) can be replaced by a small flint and steel striker, saving the MoD a considerable sum over a year.

Its lightweight nature allows for ease of carrying and transportation, with the added bonus of being suitable for use within confined spaces such as tents (as long as adequate ventilation is present).

Most of all, FireDragon can be transported by air freight (UN class 4.1, packaging group III) allowing it to be transported to its destination quickly; an "excepted quantity" meaning only dangerous goods details are needed.

The renewable materials used to produce FireDragon along with its recyclable packaging help to reduce the environmental impact of its use. The fact that it is made in the UK also reduces the transportation carbon footprint.

5. FireDragon vs. The Competition

Current commercial fuel technologies include methylated spirit burners and liquid alcohol gels. Both of these technologies offer massive advantages over hexamine tablets by lack of toxic gas production, higher levels of quality control and improved shelf lives. However, hazards associated with the transport of these liquids make them unsuitable for use in a military setting. A new generation of military focused solid fuels have been produced and are typically based on either methyl esters (bio-diesel) or ethanol (bio-alcohol).

The use of methyl ester (bio-diesel) based military fuel products for cooking are an alternative technology to that of FireDragon. Whilst an improvement over aforementioned and other established fuels, FireDragon still gives superior performance with quicker boil times by up to 2 minutes.

FireDragon solid fuel offers the fastest boil time of any solid fuel we have currently tested. When used with the BCB Crusader II cooking system, 500 ml of room temperature water (20-24˚C) can be boiled in approximately 5.5 minutes[1], whilst our nearest competitor takes up to 7 minutes.

FireDragon also holds the advantage over methyl esters by being easier to light in a range of weather conditions; such as heavy rain or wind, and can also be lit when wet. Methyl ester based fuels can be susceptible to reduced performance when trying to light/burn in wet conditions. They are also more difficult to ignite without a match or lighter, whereas FireDragon easily and reliably lights even with the most simple of metal and flint strikers.

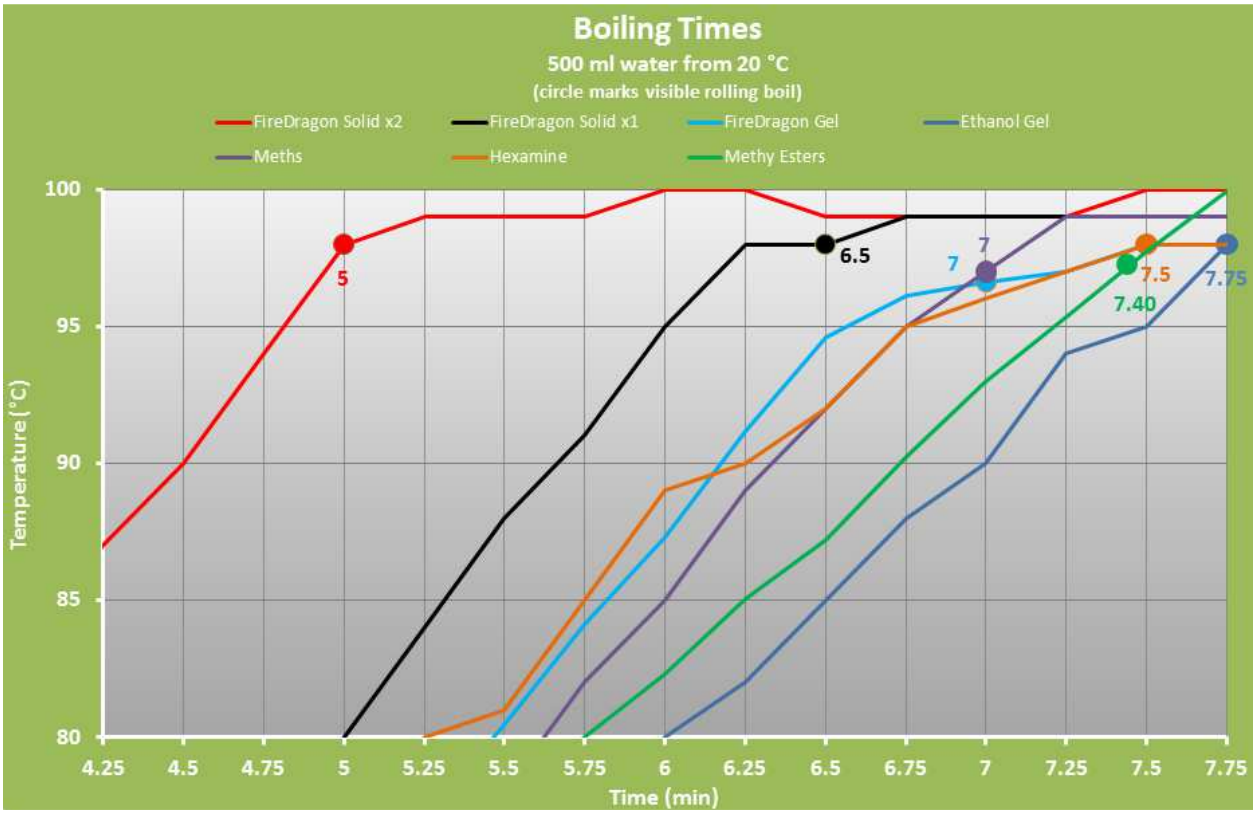
Ethanol's bactericidal properties have been well exploited, with ethanol routinely used in hand cleanser products for sanitation purposes. As FireDragon is also based on ethanol, we are currently undertaking testing to ascertain its efficacy as a hand cleanser. So far the results have been very positive; FireDragon has already passed the BS EN 1040:2005 and BS EN 1276:2009 standards in this field (see Section 24). Our hope is that FireDragon will then be marketed an efficient cleanser, allowing you to use it to clean your hands before preparing your food[2] - another unique feature of this innovative fuel.

Fuel Type	Characteristics
Hexamine	- Toxic - Cyanide gas given off during burning
Trioxane	- Toxic - Formaldehyde gas given off during burning
Gas Fuels	- Cannot be transported by air - Bulky waste
Meths	- Toxic - Noxious odour - Burn risk
Methyl Esters	- High amounts of soot - Unpleasant odour - Slower energy release = longer time to boil
FireDragon	- **Non-toxic ✓** - **Sustainable ✓** - **Transportable by air ✓**

[1] Boil time varies between 5 and 6 minutes depending on various factors including wind speed and temperature.

[2] If used to cleanse hands we will strongly advise that the ethanol should be allowed to evaporate and the hands dry fully before attempting to light fires with the fuel. This will be promoted for safe use of the product and avoid burn hazards.

FireDragon in Action: Performance vs Other Fuels



1 block of FireDragon Solid is 27 g, 2 blocks of FireDragon Solid is 54 g, 1 portion of FireDragon Gel is 25 g
Hexamine results were variable, with the best result shown above. All tests conducted under laboratory conditions.

FireDragon in Action: Fast Boiling Times

Performance varies depending on cooker setup. Tests conducted using 500 ml of water from 20 to 24 °C brought to a boil using the BCB Crusader cooking system. Each FireDragon block burns for approximately 8 minutes. Two blocks burn together for about 12 minutes.

FireDragon in Action: Low Soot

FireDragon – Cup base after burning 1 block of fuel

Methyl Esters competitor – Cup base after burning 1 block of fuel

FireDragon – Soot removed from base of cooker after burning 1 block of fuel.

Methyl Esters competitor – Soot removed from base of cooker after burning 1 block of fuel.

FireDragon: Comparison Summary

	Hexamine	Trioxane	Butane Gas	Methyl Ester	Fire Dragon
Non-Toxic			✓	✓	✓
Renewably Sourced				✓	✓
Suitable for Extreme Conditions (Wind and Rain)		✓	✓	✓	✓
Burns Whilst Wet			✓		✓
Easy to Ignite			✓		✓
Odourless			✓	✓	✓
Low Soot					✓
Safe for Wildlife			✓	✓	✓
Long Shelf Life	✓	✓	✓	✓	✓
Air Transportable	✓	✓		✓	✓
Indoor & Outdoor Use (providing suitable airflow)			✓	✓	✓
Low Luminosity Flame			✓	✓	✓
Made in the UK			✓		✓

All data believed to be correct at the time of writing.

6. Shipping

FireDragon can be easily transported by air, sea, or land. Both the Gel and Solid are Class 4.1 with the Gel falling in packing group II and the solid in group III as an excepted quantity.

Fuel Blocks are packaging group III because they are of a smaller fuel amount making them easier to ship.

Fuel Blocks: UN1325, Class 4.1 PG III, Flammable solid, organic, n.o.s (Ethanol Fuel Gel).

Fuel Gel: UN1325, Class 4.1 PG II Flammable solid, organic, n.o.s (Ethanol Fuel Gel).

Hazchem/Kemler Code: 1Z/40

Approximately 27 grams of solid FireDragon fuel is packed in a plastic portion pack, which can also be burnt. Burning the plastic portion does produce more soot and odour. Each portion is hermetically sealed with a tri-laminate foil which is printed as seen above. Each pot also includes an easy tear off tab.

6.1 FireDragon Solid

Type	Quantity	Total Units	Length (mm)	Width (mm)	Height (mm)	Weight (kg)
Portion	1 × 27 g	1	67.5	40	25.6	0.027
Box	6 portions	6	80	70	70	0.166
Case	50 boxes	300	400	220	220	8.4
Pallet	72 cases	21,600	1200	880	1320	605

6.2 FireDragon Gel

Type	Quantity	Total Units	Length (mm)	Width (mm)	Height (mm)	Weight (kg)
Bottle	250 ml	1	-	52	153	0.245
Box	13 bottles	13	267	148	162	3.30
Pallet	120 boxes	1560	1200	880	1100	396

Type	Quantity	Total Units	Length (mm)	Width (mm)	Height (mm)	Weight (kg)
Bottle	1 L	1	-	79	246	0.910
Box	10 bottles	10	304	253	263	9.20
Pallet	96 boxes	960	1200	880	1215	883.2

7. BCB International

BCB International is a long established company. Founded in 1854 with the invention of Dr Brown's Cough Bottle, a cough medicine of notable success. Since then it has gone from strength to strength.

BCB International has cemented its name as a manufacturer and designer of personal combat equipment and is also a prime contractor to the UK MoD for over 50 years. Our core competencies include:

- Military equipment
- Airborne forces
- Safety and Survival
- Provisions and Rations
- Special Forces operations

BCB International likes to work and develop new unique products, within our core competencies as mentioned above. As such, we work closely with Special Forces Units throughout the world; explorers who venture to the extremes, and future soldier programmes.

We partner with Universities and Colleges of further education to enhance our design capability. This design, as long as we believe in the product, we normally undertake free of charge.

BCB is a trading name of BCB International Limited, an SME registered in the UK.
Company Reg. No. 1442485
Registered Office: Clydesmuir Road, Cardiff, UK, CF24 2QS.

8. Manufacturing Premises

In addition to our Headquarters in Cardiff, South Wales, a considerable investment has been made into the FireDragon Programme; resulting in establishing a capable manufacturing base in which both FireDragon Solid and Gel products are made and shipped from. Also based in South West Wales, this facility helps contribute to the UK manufacturing sector.

9. Quality

We intend to create and maintain the highest quality levels possible. With this in mind the company has implemented a quality management system to ISO 9001:2008.

Each batch of FireDragon fuel is subjected to routine in-house testing performed by skilled staff to ensure our products meet the necessary specifications.

10. Continuous Innovation

We believe in product innovation by committing a high proportion of resources to Research and Development. By undertaking R&D in this manner we hope to be at the forefront of new product development within our product sector in the UK.

“ Saving and protecting lives in hostile environments through innovation”

BCB International holds numerous patents and exclusive design rights to products and is partnered with the local university Centres of Excellence. These partnerships and rights facilitate the development of high quality, innovative products.

11. FireDragon Marketing Brochure

Continue overleaf.

FIRE DRAGON

GREEN & CLEAN SOLID FUEL

The Ultimate Military Cooking Fuel

A natural, environmentally friendly & sustainable biofuel

Fire Dragon is a new innovative environmentally friendly solid fuel. It is born out of a need for a new cleaner, greener, and safer fuel.

UK soldiers have for many years been commenting on their need for a fuel that can be used quickly in combat situations, that is easy to light, safe to carry, and can be used in confined spaces. Whilst the current generation of hexamine blocks used by the military offer an air transportable option, their overall quality is far from what is expected of modern military grade products. Problems with hexamine blocks include formation of toxic gases when used, and large variations in the burning performance of the blocks.

Born out of the natural firey passion of South Wales and its coal mining heritage, Fire Dragon, is the product to fix these problems.

Through its tradition of in-house development and collaboration with Cardiff University, BCB International is pleased to offer a truly unique and technically advanced solid fuel.

VISIT US ONLINE
firedragonfuel.com

Key features:

- Non-toxic and odourless when burnt
- Easy and quick to ignite - use the flint, match or lighter
- Low luminosity
- Very little soot - laboratory tests the soot index was 0 (Zero)
- Easy to store and handle
- Safe to be packed with food
- High calorific value of approx. 28,000 kJ / kg
- Air transportable
- Patented
- Made from sustainable, natural biofuel
- Each block will burn for about 8 minutes. Two blocks for about 12 minutes
- Potential for use as a hand sanitizer.* Simply rub over your hands like a waterless soap, to clean your hands
- Suitable for all weather conditions
- Will light & burn even when wet
- Can be used with a variety of cookers
- All packaging is recyclable

*May not be suitable for use on sensitive skin

FireDragon in action

START Quick, simple & easy to ignite

3 MINUTES Starting to boil. Little flame visible

5 MINUTES Rolling boil. No smell

All times are approximate

How does FireDragon compare with the rest?

The table below shows how FireDragon out performs the competition in almost every category.

- **Hexamine** is highly toxic, difficult to light and gives off Cyanide.
- **Trioxane** is toxic, gives off Formaldehyde and can be dangerous.
- **Gas** cannot be transported by air, is expensive and non-environmentally friendly.
- **Meths** can be dangerous and a burn risk. It is poisonous, gives off an obnoxious smell and taints food.

Comparison table *- Better than the rest!*

	Hexamine	Trioxane	Butane Gas	Fire Dragon
Non-Toxic	×	×	✓	✓
Renewably Sourced	×	×	×	✓
Suitable for extreme conditions (wind and rain)	×	✓	✓	✓
Burn whilst wet	×	×	✓	✓
Easy to ignite	×	×	✓	✓
Odourless	×	×	✓	✓
Hand Steriliser	×	×	×	✓
No soot	×	×	×	✓
Safe for wildlife	×	×	✓	✓
Low luminosity flame	×	×	✓	✓
Air transportable	✓	✓	×	✓
Made in UK	×	×	✓	✓

Fire Dragon beats:

✔ **Hexamine**
- Gives off Cyanide

✔ **Trioxane**
- Gives off Formaldehyde

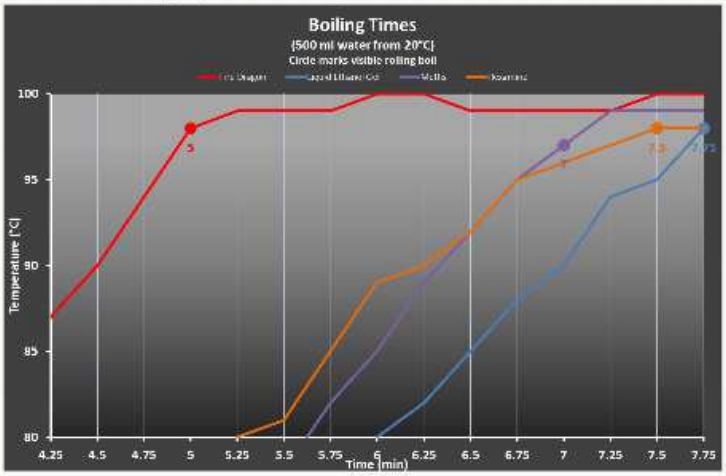
✔ **Gas fuels**
- Unable to be transported by air

✔ **Meths**
- Poisonous and a burn risk

FireDragon out-perfoms other cooking fuels

FireDragon can boil 500 ml of water in 5 minutes. This is over 2 minutes faster than the second best performing fuel. Meths boiled the same amount of water in 7 minutes, hexamine in 7.5 minutes and liquid ethanol gel in 7.75 minutes. That's a massive 2.75 minutes longer than FireDragon.

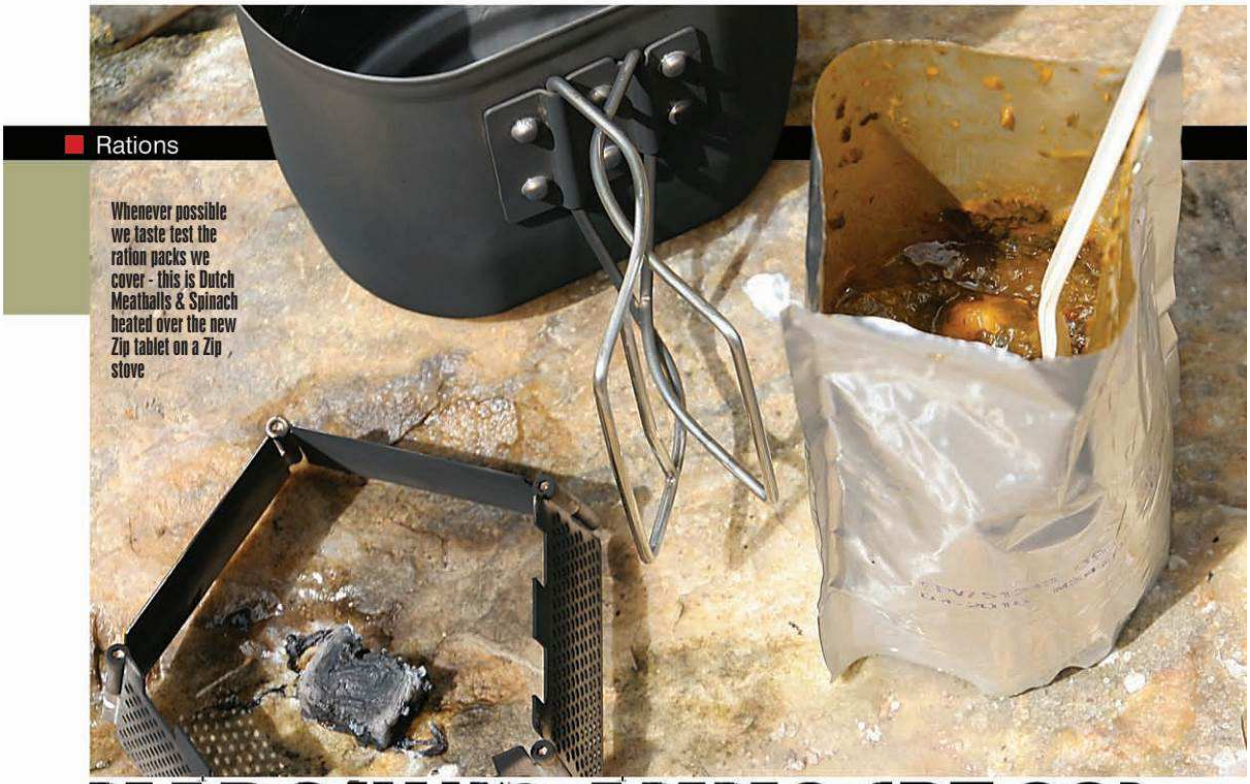
Performance graph *- Quicker than the rest!*



Code: **CN336B** (Case 50 qty X (6 X 27g)

Find out more at: **www.firedragonfuel.com**

12. Combat and Survival Magazine Review (Sept 2014)



Rations

Whenever possible we taste test the ration packs we cover - this is Dutch Meatballs & Spinach heated over the new Zip tablet on a Zip stove

MARCHING AMMO (PT.22)

NEW MILITARY FUELS

FireDragon & Zip

It has been said a million times before, and it is very doubtful that Napoleon Bonaparte was the first to say it, but an army really does march on its stomach. On the modern battlefield there is even less chance of living off the land in the way that Napoleon's troop's opponents were often expected to do, so the individual combat ration pack is an essential part of the kit carried by almost every frontline soldier today, be that in or on his vehicle or in his pack and webbing.

1: An old standard issue hexamine tablet and pressed metal stove - hexi fumes are noxious so the heater cannot be used in confined spaces

2: Fire Dragon, which was invented in Wales by BCB, is now widely available in both gel form for civvy use and as solid tablets for military uses

3: The BCB Crusader Cooker and Crusader Cup - the foil topped tub to the right contains the fuel which is non-toxic and can be used as a hand cleaner too

Modern combat ration main courses, with the exception of freeze-dried components intended for Arctic use, are usually prepared in such a way that they can be eaten cold but to derive maximum nutritional and morale benefit it is recommended that they are heated before consumption. Since WWII the standard method used by many armies for heating rations has been the hexamine (hexamethylenetetramine) solid fuel tablet, usually issued with a simple pressed metal disposable stove, though over the last twenty or so years the Flameless Ration Heater has been issued in US MRE rations and adopted by some other nations.

In their day hexamine fuel tablets provided a workable solution to the problem of reheating military rations in the field, but as the poisonous chemical formaldehyde is one of the ingredients the fumes given off during combustion are noxious, meaning this fuel can only be used outdoors or in a very well ventilated space, plus ingestion of the fuel can cause nausea and even organ damage, a search has been on for alternatives for quite some time. Over the last couple of years two British companies, BCB International of Cardiff and Standard Brands (Zip) of Leatherhead, have been keeping **C&S** abreast of developments in non-hexamine fuel tablets

A Dutch ration retort pouch being heated in the Crusader Cup over a Fire Dragon tablet in the Crusader Cooker

The bubbles are visible proof that the Fire Dragon tablet is able to bring water up to boiling point quite easily

developed for both the military and outdoor markets. Since the summer of 2013 we have been testing these in various (non-laboratory and non-scientific) conditions to get a feel for how they work.

Both companies have approached the problem from a slightly different direction, with BCB (FireDragon) developing tubs of denatured ethanol with polymer solidifier and Zip (Military Cooking Fuel) developing more conventionally shaped tablets of naturally derived methyl decanoate. FireDragon tablets (the company also produces the fuel in gel form in bottles) ignite very easily once out of their foil-topped tub and liquefy as they burn, so they need to be contained in a receptacle. Zip MCF tablets, which are solid and individually wrapped, are ignited by putting a lit match to the wrapper but as they are more like hexi tablets they can be burned on any flat fireproof surface including rock and soil.

4: Fire Dragon left little residue in the cooker - the charcoal stick is the match used to light it - and there was no soot build-up on the base of the cup after heating

5: The new Zip tablets look similar to hexamine - to the left of the tablet is a Boilex All-In-One emergency aircrew stove and to the right is the Boilex Hinged Stove

6: Assembled pentagonal Zip Boilex Hinged Stove with Zip MCF tablet in its wrapper

7: To successfully light the Zip MCF tablet ignite the combustible wrapper not the fuel

Images © Bob Morrison

When FireDragon was officially launched at the DSEi military expo in London last autumn Dr Stephen Hughes, BCB International's Chief Chemist, stated: "Hexamine is a potentially dangerous and outdated substance; burning it can give off cyanide. Soldiers are out there protecting our security but they need protecting themselves from preventable contact with toxic materials which can have a detrimental impact on their health and well-being.

"That's why we teamed up with world leading experts at Cardiff University's Chemistry Department to formulate and develop the FireDragon fuel which will help soldiers cook their rations quickly, safeguard their health, protect the environment as

well as help militaries reduce their logistics and medical costs. As it is non-toxic, unlike hexamine the FireDragon fuel can be packed with rations. Another benefit about the fuel is that when required, it can double as a waterless hand sanitizer – helping reduce the number of soldiers suffering from dysentery which has blighted troops for generations."
In their publicity material for their Military Cooking Fuel tablets Standard Brands state: "Zip's unique formulation is made using naturally derived, fully sustainable biofuel. It is non-toxic and poses little threat to humans or animals either when burning or if ingested accidentally. It burns cleanly and has a high calorific value when compared to conventional hydrocarbon fuels.

"The fuel ignites extremely quickly and easily, far more so than hexamine. It can be used both indoors (with adequate ventilation) and outdoors, and burns cleanly, unlike hexamine which releases toxic hydrogen cyanide when burning. The fuel is covered with an ignition wrapper, which also ensures the product is odourless and waterproof. The solid cubes provide the soldier with a lightweight and convenient format to carry and store."

Both manufacturers claim that their products meet or exceed UK MoD requirements which

8: The Zip MCF burns with an intense flame and leaves a heavy soot deposit

9: The Crusader II Cup and Cooker are designed to nest around a standard water bottle

10: This issue MTP water bottle pouch will hold both the Crusader II Cup and Cooker too

11: The Flameless Ration Heater requires a small amount of water to activate a chemical reaction - this water cannot be drunk afterwards and needs to be safely disposed of along with the outer bag and the toxic chemical pad it contains

12: The Zip Boilex All-In-One aluminium stove with Zip MCF tablet heating water

13: This French folding hexamine tablet stove is also issued to many armies as a rations heater

state that in given conditions one tablet should bring half a litre of water to the boil in under eight minutes. The companies have also produced portable cookers to support a boiling vessel above their fuel. BCB's popular Crusader Cooker has been modified into a Mk.II version with a small pot in the bottom into which the fuel tablet can be popped to give optimum combustion conditions. Zip have produced the pentagon-shaped Boilex Hinged Stove which is a simple fold-flat design that can be reversed as a stand for either a canteen cup or a larger mess tin, and they have also designed (primarily for downed pilots) a simple aluminium foil fold-out cup under which an MCF tablet can be placed to boil water.

Our initial impressions on these fuels are favourable but we see disadvantages in both, though each is clearly better than a hexi tablet. If asked to choose, FireDragon tablets would probably get our vote.

13. Gunmart Magazine Article (Feb 2014)

Fire Dragon fuel blocks and the BCB Crusader cooking system – a new Fire Dragon Cooker will be available soon

Fire dragon!

John Fenna tries out the new solid fuel blocks from BCB

Fire Dragon solid fuel has been developed as a "cleaner, greener and safer" environmentally friendly solid fuel that is easy to transport, easy to light and usable in confined spaces. Each 27g block of Fire Dragon fuel is sealed in recydable packaging and is easy to store and handle, safe to store with food products and is safe to air transport. The Fire Dragon fuel is safe to handle and can be used as a hand sterilizer as well as a fuel for a variety of cookers, as a fire starter or BBQ lighter.

Made in the UK from a natural and sustainable biofuel (denatured ethanol plus a polymer solidifier, sodium stearate and bitrex taste aversion agent) the blocks are non-toxic and odourless when burnt and although leaving a tarry deposit in the cooker, produce little smoke and very little visible flame.

Lighting up

Easy to light with a match, lighter or the sparks from a firesteel, each block burns for about 8 minutes, or 2 blocks together for about 12 minutes and will catch fire even after being soaked in water. The blocks can be blown out (if you have strong lungs) or doused with water, but as they liquefy when burning, when the fuel is liquefied it will solidify within a few minutes of the fuel being extinguished and can be re-ignited and/or scraped off and placed in a container (poly bag) for future use. Blocks can be reignited for later use if you are not moving on. If you cut a block in half and store the unused portion in a sealed poly bag, you could get a brew going without wasting fuel, even on the move.

The need for a spirited effort to blow out the fuel is a sign that it is burning well and blowing out similar alternative fuels also requires healthy lungs.

In my testing of the Fire Dragon fuel blocks I set them to boil 0.5L of cold water, using the BCB Crusader cooking system, on a warm, damp morning with next to no breeze, in a sheltered spot under some trees. Using single Fire Dragon blocks, the water got hot, but not boiling, in the 8 minutes that the block lasted, but refuelling with a second block had the water boiling after another 2 minutes. Using 2 blocks at once had the water boiling after about 5 minutes. Whether I used or did not use the plastic Crusader cup lid seemed not to affect boiling times. * (See note below)

Using a "control" of a single Green Heat Fire Gel sachet had 0.5l of cold water up to boiling in approx 12 minutes.

All in all I like the Fire Dragon fuel as it has proven clean, non-toxic, easy to use and environmentally friendly, but I would have preferred slightly larger blocks to ensure a good quick boil from each block.

Fire Dragon "green and clean" solid fuel is available in packs of 6 x 27g blocks at around £2.99. For more information contact BCB International on tel. 029 2043 3700 or visit www.bcbin.com

*Note: The advertised boil time is achieved with the NEW Fire Dragon Cooker which I didn't use but will soon be on the market.

Fire Dragon fuel blocks are easy to light with a match, lighter or the sparks from a firesteel, each block burns for about 8 minutes

Fire Dragon "green and clean" solid fuel is available in packs of 6 x 27g blocks at around £2.99

Liquidised fuel will solidify within a few minutes of the fuel being extinguished and can be re-ignited and/or placed in a container for future use

14. Military Systems & Technology Article (Sept 2014)

Production of Military Rations Biofuel Sparks Interest

The production of an all-weather solid flammable biofuel for military rations cookers, which can double as a waterless hand sanitiser has been launched by the UK military company, BCB International Ltd.

'FireDragon' All-weather Solid Flammable Biofuel for Military Ration Cookers

Many NATO forces currently issue hexamine fuel to their troops for cooking in the field and are looking to move to a replacement fuel due to the dangers that hexamine presents to the health of soldiers. Hexamine is a potentially dangerous and outdated substance; burning it gives off cyanide. Headquartered in Cardiff, BCB International Ltd, believe that their alcohol-based alternative fuel, 'FireDragon', will prove popular with soldiers on patrol who need to heat up their rations quickly without producing and inhaling toxic fumes.

Announcing the start of production, BCB's Managing Director, Andrew Howell said: "Over the last five years, we have been developing a green and clean solid biofuel made from ethanol called 'FireDragon'. I am happy to announce that after extensive research and pre-production trials, the eagerly awaited fuel is now in production.

"The launch of the fuel is good news for our troops. It will enable soldiers to cook their meals and make their brews with a safer and cleaner fuel than traditional military rations fuel blocks like hexamine. Our fuel is non-toxic, non-drip and made from 100% natural ingredients, including ethanol sourced from UK grown grain stocks. The FireDragon fuel can be packed with rations and doubles as a waterless hand sanitiser which will help Militaries reduce their logistics and medical costs."

Mr. Howell went on to explain how the fuel is more than a match for similar alternative fuels: "One tablet of FireDragon fuel (27 grams) can boil 500 ml of water in 5-6 minutes; that's at least two minutes faster than competitors' products. It can even be ignited whilst wet, something unique to FireDragon.

"Wherever they operate, whether in driving rain, the freezing arctic or searing heat, the fuel will enable soldiers to heat their rations right where they need them."

BCB INTERNATIONAL

15. Gizmag Article (Feb 2015)

Ethanol-based Fire Dragon biofuel starts fires in dire conditions

By C.C. Weiss - February 19, 2015*3 Pictures*

A single tab of Fire Dragon burns for about eight minutes
Image Gallery (3 images)

Even if you've never been in a situation rougher and more life-threatening than a KOA campground, there's something comforting about knowing that you're prepared to start a fire in the wettest, nastiest conditions that Earth can hurl at you. Perhaps that's why we're always fascinated with versatile, new fire-starting materials, especially when they have awesome names. Fire Dragon from BCB International is a new, ultra-versatile, purportedly eco-friendly way of getting a roaring blaze sparked or meal cooked.

In the past, we were impressed with demonstrations of fire-starting materials likeReady Fuel and InstaFire. Unfortunately, we haven't yet seen Fire Dragon in live action but we do know BCB International as a recognizable designer and manufacturer of innovative outdoor, tactical and survival gear, including protectiveBlast Boxers underwear.

BCB designed Fire Dragon in collaboration with Cardiff University over the course of five years. The goal was to create a solid fuel with a cleaner burn and more reliable performance than existing solid fuels based on hexamine or trioxane. They came up with a solid, ethanol-based biofuel that they say burns cleanly and odorlessly without any harmful fumes. It also leaves a minimal amount of soot. Between the clean burn and natural, sustainable ethanol base, BCB reckons that Fire Dragon is a considerably more eco-friendly fire starter/fuel solution.

While green attributes are nice, the main concern with a fire starter/ultralight cooking fuel is that it lights and lights reliably. According to BCB, and its video presentations, starting a fire with Fire Dragon is as simple as popping one or more of the solid tabs out into your fire pit or cooking device and applying a match or spark. It lights up without hassle, even when it's wet. We'd like to see how it performs in high wind, but BCB assures that it's designed for all weather conditions.
BCB also claims that Fire Dragon offers superior thermal performance when used as a solid fuel. Its test results show that it boils water faster than other solid fuels, including hexamine, methy esters and ethanol gel, bringing a half-liter (16.9 oz) to a visible roll in just five minutes.

A comparison with the other fire starters we've covered shows that it is indeed faster than them as well. InstaFire's website suggests using 1/2 a cup of InstaFire to boil 16 oz of water in 15 minutes, three times as long as it takes Fire Dragon to do the same. And Ready Fuel boils 8 oz of water in 5 minutes, same time, but half the amount of water. On the other hand, Fire Dragon offers a comparatively short advertised burn time of around 8 minutes for a tab, though that can be increased by using two or more tabs.

BCB is currently producing Fire Dragon on a small scale, but it's working to raise the funding it needs to ready its manufacturing facility for mass production and distribution. It's offering Fire Dragon on Kickstarter at a variety of price points, starting at £10 (US$15) for two boxes of six tabs each plus a Fireball flint striker. It's off to a very slow start, having raised less than £1,000 of its £125,000 goal with 39 days left to go. If all goes according to plan, which is looking unlikely as of writing, shipments will begin in September.

16. GearWeAre Article (Feb 2015)

Kickstart the FireDragon and fuel a world first.

160 years old Cardiff-based company, BCB International Ltd, have developed a groundbreaking environmentally-friendly solid cooking fuel called 'FireDragon'. It can be used to light fires, cook food and warm drinks in all weather conditions.

Philippe Minchin from BCB says: "The FireDragon solid fuel is a world first, there is nothing else like it on the market. In recognition of its uniqueness, it has been granted patented status. FireDragon enables people to cook their food and warm their drinks fast in all weather conditions. It is made from sustainable, naturally derived bio-ethanol which means that it also helps to protect the environment."

Outdoor enthusiasts are being urged to help kickstart the mass production of this waterproof and eco-friendly outdoor cooking fuel made in the UK. The business is seeking funds via the crowd-sourcing website, Kickstarter. The funds will enable the company to expand production.

The company started started producing the fuel on a small scale last year, which went into selected retail outlets. This has now sparked interest from international retailers. With this interest, BCB now need to design and fabricate specialised parts and tools to enable them to achieve mass production for worldwide distribution.

"We don't have the financial means to do it alone. That's why we are asking the publicto contribute what they can to help us clear the final hurdle to the mass production of a world beating product made here in the UK. They can contribute as little or as much as they like. Every pound donated brings us a step closer to introducing the 'FireDragon' fuel onto the world market and making outdoor cooking a safer and more eco-friendly experience"

If you'd like to support the scheme you can donate via KickStarter here

17. Video Link List

1. **Lights When Wet**

   https://www.youtube.com/watch?v=n9V_9jFbrS0

   https://www.youtube.com/watch?v=UNKylcQ1KKU

2. **Quick Boil Time**

   https://www.youtube.com/watch?v=wV5YxOnPW-I

3. **Clean Burn / Low Soot**

   https://www.youtube.com/watch?v=iD8TaRcG_d0

   https://www.youtube.com/watch?v=Z-plQSMQ2Fo

4. **Easy to Light**

   https://www.youtube.com/watch?v=6FJlWiCxoPY

5. **IndieGoGo Full Campaign Video**

   https://www.youtube.com/watch?v=9hf5ejnbdis

18. Supplementary FireDragon Solid Performance Data

All information below is to be used as a guide. Figures are based on laboratory test conditions, so are subject to change when used in varying weather conditions outdoors and/or with cooker setups not listed.

FIREDRAGON SOLID

Cooking System	Number of Blocks	Average Burn Time	Average Boil Time (500 ml water at 95 °C)
Crusader 1	1	8:20	6:35
Crusader 1	2	14:44	6:58
Crusader 2	1	5:52	(Fail) 88 °C
Crusader 2	2	8:25	5:39
BCB Folding Cooker Mk1	1	7:22	(Fail) 68 °C
Military Folding Cooker	1	11:45	10:42

METHYL ESTER COMPETITOR

Cooking System	Number of Blocks	Average Burn Time	Average Boil Time (500 ml water at 95 °C)
Crusader 1	1	17:18	8:49
Crusader 2	1	17:05	7:09
BCB Folding Cooker Mk1	1	15:22	(Fail) 95 °C
Military Folding Cooker	1	13:20	8:49

Notes:

1) All tests took place using water at a temperature between 17-22 °C and a room temperature between 18-24 °C
2) The average weight of tested Fire Dragon blocks ranged between 25-27 g and methyl ester fuel blocks from 22-24 g
3) BCB Folding Cooker open at position 2, one from fully open. Tests used the Crusader 1 cup and lid.
4) Military Cooker tests used the Crusader 1 cup and lid.

Standard Military Issue cooker (left) BCB Folding Cooker open to position 2 (right)

19. FireDragon Solid - Safety Data Sheet

Fire Dragon Safety Data Sheet (SDS)

Revision Date: 01/05/2015

Revision Number: 5

Replaces all previous versions.

1. Identification of the substance/mixture and of the company/undertaking

1.1 Product identifier

Product Name: Fire Dragon Green & Clean Solid Fuel

Company product code: FD336B

1.2 Relevant identified uses of the substance or mixture and uses advised against

Identified Uses: Substance is a true gel alcohol fuel.

Intended for use as a firelighter and/or cooking fuel.

1.3 Details of the supplier of the safety data sheet

Company / Supplier: BCB International

Address: Unit 21

Stradey Business Park

Llanelli

SA14 8YP

	United Kingdom
Telephone:	+44 (0)1554 823824
Fax:	+44 (0)1554 820493
E-mail:	info@bcbin.com

1.4 Emergency telephone number

Telephone:	+44 (0)1554 823824 (08:00 – 17:00 Mon-Fri only)

2. Hazards identification

2.1 Classification of the substance or mixture

Classification (EC) No. 1272/2008:

Physical and Chemical Hazards:	Flam. Sol. 2 – H228
Human Health:	Eye Irrit. 2 – H319
	STOT Single Exp. 3 – H336
Environmental:	Not classified

Classification 1999/45/EEC:	F, R11; Xi, R36; R67

The Full Text for all R-Phrases and H-Statements are displayed in Section 16.

The most important adverse effects:

Physical and Chemical:	See Section 9 for physicochemical information
Human Health:	See Section 11 for toxicological information
Environmental Effects	See Section 12 for environmental information

2.2 Label elements

Labelling according to Regulation (EC) No 1272/2008

Hazard pictograms:

Signal word:	Warning	
Hazard statements:	H228	Flammable solid.
	H319	Causes serious eye irritation.
	H336	May cause drowsiness or dizziness.
Precautionary statements:	P101	If medical advice is needed, have product container, or label at hand.
	P102	Keep out of reach of children.
	P103	Read label before use.
	P210	Keep away from heat, hot surfaces, sparks, open flames and other ignition sources. No smoking.
	P240	Ground/bond container and receiving equipment.
	P241	Use explosion-proof electrical/ventilating/light/equipment.
	P261	Avoid breathing vapours.
	P264	Wash hands thoroughly after handling.
	P271	Use only outdoors or in a well-ventilated area.
	P280	Wear protective gloves/protective clothing/eye protection/face protection.
	P304 + 340 +P312	IF INHALED: remove victim to fresh air and keep at rest in a position comfortable for breathing. Call a POISON CENTRE or doctor/physician if you feel unwell.
	P305 + 351 + 338	IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.
	P337 + 313	If eye irritation persists get medical advice/attention.

P370 + 378	In case of fire: Alcohol resistant foam, Dry Powder, Carbon Dioxide, Water Fog, Sand.
P501	Dispose of container/packaging in accordance with local regulations on waste disposal.
EUH066	Repeated exposure may cause skin dryness or cracking.

2.3 Other hazards

This product is highly flammable, with container open explosive vapour/air mixtures may be formed even at normal room temperatures.

During combustion/fire the product becomes molten and exhibits flow.

In high concentrations vapours and spray mists are narcotic and may cause headache, fatigue, dizziness and nausea.

3. Composition/information on ingredients

3.2 Mixtures

Hazardous Components	Amount (%)	Classification (Regulation (EC) No 1272/2008)		Classification (67/548EEC)
		Hazard Class	Hazard Statement	
Ethanol (Completely denatured alcohol, CDA) Index No.: 603-002-005 CAS No.:64-17-5 EC No.: 200-578-6 Registration No.: 01-2119457610-43-xxxx 01-2119457558-25-xxxx 01-2119457290-43-xxxx	80 - 90	Flam. Liq. 2 Eye Irrit. 2	H225 H319	F, R11; Xi, R36

The Full Text for all R-Phrases and H-Statements are displayed in Section 16.

4. First aid measures

4.1 Description of first aid measures

General advice: Rest, warmth and fresh air. Do not give victim anything to drink if unconscious. Seek medical attention if any discomfort continues. Show this safety data sheet to the doctor in attendance.

Inhalation: Remove to fresh air and rest. If symptoms persist, seek medical attention.

Skin contact: Immediately remove contaminated clothing. Wash off promptly and flush contaminated skin with water. Promptly remove clothing if soaked through and flush skin with water.

Eye contact: Flush with sterilised water for at least 10 minutes. Remove any contact lenses and open eyes wide apart. Avoid washing chemical from one eye into the other. If irritation persists, seek medical attention

Ingestion: Immediately rinse mouth and drink plenty of water or milk. Keep person under observation. Do not induce vomiting. If vomiting occurs, keep head low. Transport immediately to hospital and bring this safety data sheet.

4.2 Most important symptoms and effects, both acute and delayed

Symptoms: See Section 11 for more detailed information on health effects and symptoms

Effects: See Section 11 for more detailed information on health effects and symptoms

4.3 Indication of any immediate medical attention and special treatment needed

Treatment: Treat symptomatically.

5. Firefighting measures

5.1 Extinguishing media

Suitable Extinguishers: Alcohol resistant foam, dry powder, carbon dioxide, water fog, and sand.

Unsuitable extinguishers: Do not use high pressure water jets.

5.2 Special hazards arising from the substance or mixture

Specific hazards: The product will ignite upon contact with sources of ignition and will continue to burn after removal of ignition source.

The vapour may be invisible, heavier than air and spread along the ground. During combustion/fire, solid will become molten and exhibit flow. Vapours may form explosive mixtures with air. Flash back possible over considerable distance. During combustion/fire hazardous decomposition products may be produced such as: carbon monoxide (CO), carbon dioxide (CO_2). Combustion with other materials may liberate toxic gases or vapours.

5.3 Advice for firefighters

Special protective equipment: In the event of fire, wear self-contained breathing apparatus. Wear appropriate body protection e.g. boots, overalls, gloves, eye/face and head protection.

Additional information: During combustion/fire, solid will become molten and exhibit flow. Keep surrounding closed containers cool with water spray. Heating of containers will cause an increase in internal pressure leading to a risk of bursting. Collect contaminated fire extinguishing water separately. The must not be discharged into drains.

6. Accidental release measures

6.1 Personal precautions, protective equipment and emergency procedures

Personal precautions: Use personal protective equipment. Avoid breathing vapours, mist or gas. Ensure adequate ventilation. Remove all sources of ignition. Evacuate personnel to safe areas. Beware of vapours accumulating to form explosive concentrations. Vapours can accumulate in low areas. For personal protection see section 8.

6.2 Environmental precautions

Environmental precautions: Ensure waste and contaminated materials are collected and removed from the work area as soon as possible in a suitably labelled container. Do not flush into surface water or sanitary sewer system.

6.3 Methods and materials for containment and cleaning up

Cleaning directions: Contain spillage, and then collect with non-combustible absorbent material, (e.g. sand, earth, diatomaceous earth, vermiculite) and place in container for disposal according to local / national regulations (see Section 13). Collect waste absorbent with either an electrically protected vacuum cleaner or by wet-brushing. Wash area thoroughly with water after.

6.4 Reference to other sections

See Section 1 for emergency contact information.

See Section 8 for information on personal protective equipment.

See Section 13 for waste treatment information.

7. Handling and storage

7.1 Precautions for safe handling

Safe handling: Avoid spilling, skin and eye contact. Avoid inhalation of vapour or mist. Keep away from sources of ignition - No smoking. Take measures to prevent the build-up of electrostatic charge. If left exposed flammable and irritating vapours will be emitted. For precautions see Section 2.2.

7.2 Conditions for safe storage, including any incompatibilities

Storage: Store in sealed original container in a dry, cool and well-ventilated place. Keep away from direct sunlight and sources of heat. Do not store with oxidizing agents. This item is intended for single use.

7.3 Specific end use(s)

End uses: Apart from the uses mentioned in Section 1.2, no other specific uses are stipulated.

8. Exposure controls/personal protection

8.1 Control parameters

Component	CAS-No.	Value	Control Parameters	Basis
Ethanol	64-17-5	TWA 8 hrs	1000 ppm 1920 mg/m^3	UK. EH40 WEL – Workplace Exposure Limits.
Note: Where no specific short-term exposure limit is listed, a figure three times the long-term exposure should be used.				

8.2 Exposure controls

Appropriate engineering controls: Provide adequate ventilation or local extraction appropriate to ensure the defined work place exposure limits (WELs) are not exceeded.

Personal protective equipment:

Personal protective equipment should never replace effective elimination, reduction or isolation risk control measures.

Eye and face protection: Contact lenses should not be worn when working with this product. Wear suitable safety glasses e.g. EN 166.

Hand protection: Wear suitable gloves. The glove material has to be impermeable and resistant to the product. As the product is a mixture of several substances, the durability of the glove material cannot be calculated in advance and should be tested before use. Protective gloves should be replaced is damaged or otherwise compromised through wear and tear. Protective gloves should comply with EN 374.

Respiratory protection:	No personal respiratory protective equipment is normally required in well ventilated areas. In case of insufficient ventilation, wear suitable respiratory aid equipment. A Type A filter is recommended.
Skin and body protection:	Impervious clothing, Flame retardant antistatic protective clothing,
Environmental exposure controls:	Prevent further leakage or spillage if safe to do so. Do not let product enter drains.

9. Physical and chemical properties

9.1 Information on basic physical and chemical properties

Appearance:	Solid, colourless, partially translucent.
Odour:	Alcoholic
Odour threshold:	No data available
pH:	8
Melting point (˚C):	60-65
Boiling point (˚C):	78
Flash point (°C):	8 (Cleveland Open Cup; BS EN ISO 2592:2001)
Evaporation rate:	No data available
Flammability (solid, gas):	No data available
Upper explosion limit:	19% (V)
Lower explosion limit:	3.3% (V)
Vapour pressure:	5.85 kPa (20 ˚C)
Vapour density:	No data available
Relative density:	0.84 (20 ˚C)
Solubility:	Partially soluble in water.
Partition coefficient - n-octanol/water:	No data available
Auto-ignition temperature (˚C):	363
Decomposition temperature (˚C):	No data available
Viscosity:	No data available
Explosive properties:	Formation of explosive air/vapour mixtures is possible.
Oxidising properties:	No data available

9.2 Other Information

Fire point (°C): 8 (Cleveland Open Cup; BS EN ISO 2000-36:2002)

Gross calorific value (MJ / kg): 29 (approximately)

10. Stability and reactivity

10.1 Reactivity

Advice: Stable under recommended storage conditions.

10.2 Chemical stability

Stability: No decomposition anticipated if stored sealed in original package. Product is stable under normal ambient conditions when storing or handling.

10.3 Possibility of hazardous reactions

Hazardous reactions: No data available

10.4 Conditions to avoid

Conditions to avoid: Heat, flames, sparks, extremes of temperature, and direct sunlight.

10.5 Incompatible materials

Materials to avoid: Alkali metals, ammonia, oxidising reagents, peroxides.

10.6 Hazardous decomposition products

Decomposition products: Thermal decomposition or combustion can liberate carbon oxides will be produced (e.g. carbon dioxide (CO_2) and carbon monoxide (CO)). Combustion with other materials can release other toxic gases or vapours. See Section 5.

11. Stability and reactivity

11.1 Information on toxicological effects

11.1.1 Mixture

Acute toxicity:	Toxic Dose – LD_{50} > 2000 mg/kg (oral rat)
	Toxic Concentration – LC_{50} > 20 mg/l (4hr mouse)
Irritation:	Causes serious eye irritation.
Corrosivity:	No data available
Sensitisation:	No data available
Repeated dose toxicity:	No data available
Carcinogenicity:	No data available
Mutagenicity:	No data available
Toxicity for reproduction:	No data available
Information on likely routes of exposure:	
Inhalation:	In high concentrations vapours may irritate the throat and respiratory system causing coughing.
Ingestion:	Gastrointestinal symptoms; nausea, upset stomach, vomiting
Skin contact:	Repeated exposure may cause skin dryness or cracking
Eye contact:	Irritating, and may cause redness and pain.
Other information:	To the best of our knowledge the chemical, physical, and toxicological properties have not been thoroughly investigated.

12. Ecological information

12.1 Toxicity

Toxicity:	LC_{50}: > 100 mg/l (96 hrs, Fish)
	EC_{50}: > 100 mg/l (48 hrs, Daphnia)
	IC_{50}: > 100 mg/l (72 hrs, Algae)

12.2 Persistent and degradability

Persistence:	No data available

12.3 Bioaccumulative potential

Bioaccumulation:	No data available

12.4 Mobility in soil

Soil mobility: No data available

12.5 Results of PBT and vPVB assessment

Assessment results: PBT/vPvB assessment not available as chemical safety assessment not required/not conducted

12.6 Other adverse effects

Other information: Will dissolve, and disperse in an aqueous environment.

Do not flush into surface water or sanitary sewer system. Avoid subsoil penetration.

13. Disposal considerations

13.1 Waste treatment methods

Product: Burn in a chemical incinerator equipped with an afterburner and scrubber but exert extra care in igniting as this material is highly flammable. Offer surplus and non-recyclable product to a licensed hazardous waste disposal company. Any material used to control spillage must be disposed of in the same way.

Packaging: Empty contaminated packaging thoroughly. This can be recycled after thorough and proper cleaning. Packaging that cannot be cleaned is to be disposed of in the same manner as the product.

14. Transport information

14.1 UN number

UN Number: 1325

14.2 UN proper shipping name

Name: Flammable solid, Organic, n.o.s,

(Solid Ethanol Fuel Blocks)

14.3 Transport hazard class(es)

ADR/RID/ADN: Class 4.1; Flammable solid

IMDG: Class 4.1; Flammable solid

IATA/IACO: Class 4.1; Flammable solid

Packing label:

14.4 Packaging group

ADR/RID/ADN: 3

IMDG: 3

IATA/IACO: 3

14.5 Environmental hazards

ADR/RID: No

IMDG: No

IMDG Marine pollutant: No

14.6 Special precautions for the user

Precautions: No data available

14.7 Transportation in bulk according to Annex II MARPOL 73/78 and IBC code

IMDG: Not applicable

15. Regulatory Information

This safety data sheet complies with the requirements of Regulation (EC) No. 1907/2006.

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

Regulations: Regulation (EC) 1272/2008

Control of Substances Hazardous to Health Regulations 2002

Other regulations: Directive 92/85/EEC: Health and safety of pregnant workers.

Directive 94/33/EC: Protection of young people at work.

Workplace Exposure Limits 2005 (EH40)

15.2 Chemical safety assessment

Assessment: No chemical safety assessment was carried out for this product.

16. Other information

Revision Date: 01/05/2015

Revision Number: 5

Reason: Minor updates to information.

Key literature references: This safety data sheet was compiled using data from suppliers and the "Database of registered substances" of the European Chemical Agency (ECHA).

Evaluation method(s): In accordance with Article 9 of Regulation (EC) No. 1272/2008, this product was evaluated with respect to the physical state of the product being supplied and its reasonable intended use as specified in Section 1.2. For criteria where data was directly available, this data was included. For criteria where no or inadequate data for the product was held, bridging principles were applied.

Full text of R-phrases:

R11	Highly flammable
R36	Irritating to eyes
R67	Vapours may cause drowsiness and dizziness

Full text of H-statements:

H228	Flammable solid
H319	Causes serious eye irritation
H336	May cause drowsiness or dizziness

The information in this Safety Data Sheet should be provided to all who will use, handle, store, transport or otherwise be exposed to this product. This information has been prepared for the guidance of plant engineering, operations, management and for people working with or handling this product. This information is believed to be reliable and correct at the Revision Date, and represents the best information currently available and known by BCB International Ltd. However, BCB International Ltd makes no guarantee or warranty, express or implied, with respect to such information and we assume no liability and anticipated used and is for the material without chemical additions or alterations. Users should make their own investigations to determine the suitability of the information for their particular purposes. It is the responsibility of the user to undertake a suitable risk assessment/COSHH assessment prior to using the material.

20. FireDragon Gel - Safety Data Sheet

Fire Dragon Safety Data Sheet (SDS)

Revision Date: 01/05/2015

Revision Number: 4

Replaces all previous versions.

1. Identification of the substance/mixture and of the company/undertaking

1.1 Product identifier

Product Name: Fire Dragon Green & Clean Gel Fuel

Company product code: FD336G

1.2 Relevant identified uses of the substance or mixture and uses advised against

Identified Uses: Substance is a gelled alcohol fuel.

Intended for use as a firelighter and/or cooking fuel.

1.3 Details of the supplier of the safety data sheet

Company / Supplier: BCB International

Address: Unit 21

Stradey Business Park

Llanelli

SA14 8YP

	United Kingdom
Telephone:	+44 (0)1554 823824
Fax:	+44 (0)1554 820493
E-mail:	info@bcbin.com

1.4 Emergency telephone number

Telephone:	+44 (0)1554 823824 (08:00 – 17:00 Mon-Fri only)

2. Hazards identification

2.1 Classification of the substance or mixture

Classification (EC) No. 1272/2008:

Physical and Chemical Hazards:	Flam. Sol. 1 – H228
Human Health:	Eye Irrit. 2 – H319
	STOT Single Exp. 3 – H336
Environmental:	Not classified

Classification 1999/45/EEC: F, R11; Xi, R36; R67

The Full Text for all R-Phrases and H-Statements are displayed in Section 16.

The most important adverse effects:

Physical and Chemical:	See Section 9 for physicochemical information
Human Health:	See Section 11 for toxicological information
Environmental Effects	See Section 12 for environmental information

2.2 Label elements

Labelling according to Regulation (EC) No 1272/2008

Hazard pictograms:

Signal word: Danger

Hazard statements:	H228	Flammable solid.
	H319	Causes serious eye irritation.
	H336	May cause drowsiness or dizziness.
Precautionary statements:	P101	If medical advice is needed, have product container, or label at hand.
	P102	Keep out of reach of children.
	P103	Read label before use.
	P210	Keep away from heat, hot surfaces, sparks, open flames and other ignition sources. No smoking.
	P240	Ground/bond container and receiving equipment.
	P241	Use explosion-proof electrical/ventilating/light/equipment.
	P261	Avoid breathing vapours.
	P264	Wash hands thoroughly after handling.
	P271	Use only outdoors or in a well-ventilated area.
	P280	Wear protective gloves/protective clothing/eye protection/face protection.
	P304 + 340 +P312	IF INHALED: remove victim to fresh air and keep at rest in a position comfortable for breathing. Call a POISON CENTRE or doctor/physician if you feel unwell.
	P305 + 351 + 338	IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.
	P337 + 313	If eye irritation persists get medical advice/attention.
	P370 + 378	In case of fire: Alcohol resistant foam, Dry Powder, Carbon Dioxide, Water Fog, Sand.

P501	Dispose of container/packaging in accordance with local regulations on waste disposal.
EUH066	Repeated exposure may cause skin dryness or cracking.

2.3 Other hazards

This product is highly flammable, with container open explosive vapour/air mixtures may be formed even at normal room temperatures.

In high concentrations vapours and spray mists are narcotic and may cause headache, fatigue, dizziness and nausea.

3. Composition/information on ingredients

3.2 Mixtures

Hazardous Components	Amount (%)	Classification (Regulation (EC) No 1272/2008)		Classification (67/548EEC)
		Hazard Class	Hazard Statement	
Completely denatured alcohol (CDA) Index No.: 603-002-005 CAS No.:64-17-5 EC No.: 200-578-6 Registration No.: 01-2119457610-43-xxxx 01-2119457558-25-xxxx 01-2119457290-43-xxxx	80 - 90	Flam. Liq. 2 Eye Irrit. 2	H225 H319	F, R11; Xi, R36

The Full Text for all R-Phrases and H-Statements are displayed in Section 16.

4. First aid measures

4.1 Description of first aid measures

General advice: Rest, warmth and fresh air. Do not give victim anything to drink if unconscious. Seek medical attention if any discomfort continues. Show this safety data sheet to the doctor in attendance.

Inhalation: Remove to fresh air and rest. If symptoms persist, seek medical attention.

Skin contact: Immediately remove contaminated clothing. Wash off promptly and flush contaminated skin with water. Promptly remove clothing if soaked through and flush skin with water.

Eye contact: Flush with sterilised water for at least 10 minutes. Remove any contact lenses and open eyes wide apart. Avoid washing chemical from one eye into the other. If irritation persists, seek medical attention

Ingestion: Immediately rinse mouth and drink plenty of water or milk. Keep person under observation. Do not induce vomiting. If vomiting occurs, keep head low. Transport immediately to hospital and bring this safety data sheet.

4.2 Most important symptoms and effects, both acute and delayed

Symptoms: See Section 11 for more detailed information on health effects and symptoms

Effects: See Section 11 for more detailed information on health effects and symptoms

4.3 Indication of any immediate medical attention and special treatment needed

Treatment: Treat symptomatically.

5. Firefighting measures

5.1 Extinguishing media

Suitable Extinguishers: Alcohol resistant foam, dry powder, carbon dioxide, water fog, and sand.

Unsuitable extinguishers: Do not use high pressure water jets.

5.2 Special hazards arising from the substance or mixture

Specific hazards: The product will ignite upon contact with sources of ignition and will continue to burn after removal of ignition source.

The vapour may be invisible, heavier than air and spread along the ground. Vapours may form explosive mixtures with air. Flash back possible over considerable distance. During combustion/fire hazardous decomposition products may be produced such as: carbon monoxide (CO), carbon dioxide (CO_2). Combustion with other materials may liberate toxic gases or vapours.

5.3 Advice for firefighters

Special protective equipment: In the event of fire, wear self-contained breathing apparatus. Wear appropriate body protection e.g. boots, overalls, gloves, eye/face and head protection.

Additional information: Keep surrounding closed containers cool with water spray. Heating of containers will cause an increase in internal pressure leading to a risk of bursting. Collect contaminated fire extinguishing water separately. The must not be discharged into drains.

6. Accidental release measures

6.1 Personal precautions, protective equipment and emergency procedures

Personal precautions: Use personal protective equipment. Avoid breathing vapours, mist or gas. Ensure adequate ventilation. Remove all sources of ignition. Evacuate personnel to safe areas. Beware of vapours accumulating to form explosive concentrations. Vapours can accumulate in low areas. For personal protection see section 8.

6.2 Environmental precautions

Environmental precautions: Ensure waste and contaminated materials are collected and removed from the work area as soon as possible in a suitably labelled container. Do not flush into surface water or sanitary sewer system.

6.3 Methods and materials for containment and cleaning up

Cleaning directions: Contain spillage, and then collect with non-combustible absorbent material, (e.g. sand, earth, diatomaceous earth, vermiculite) and place in container for disposal according to local / national regulations (see Section 13). Collect waste absorbent with either an electrically protected vacuum cleaner or by wet-brushing. Wash area thoroughly with water after.

6.4 Reference to other sections

See Section 1 for emergency contact information.

See Section 8 for information on personal protective equipment.

See Section 13 for waste treatment information.

7. Handling and storage

7.1 Precautions for safe handling

Safe handling: Avoid spilling, skin and eye contact. Avoid inhalation of vapour or mist. Keep away from sources of ignition - No smoking. Take measures to prevent the build-up of electrostatic charge. If left exposed flammable and irritating vapours can be emitted. For precautions see Section 2.2.

7.2 Conditions for safe storage, including any incompatibilities

Storage: Store sealed in original container in a dry, cool and well-ventilated place. Keep away from direct sunlight and sources of heat. Do not store with oxidizing agents.

7.3 Specific end use(s)

End uses: Apart from the uses mentioned in Section 1.2, no other specific uses are stipulated.

8. Exposure controls/personal protection

8.1 Control parameters

Component	CAS-No.	Value	Control Parameters	Basis
Ethanol	64-17-5	TWA 8 hrs	1000 ppm 1920 mg/m^3	UK. EH40 WEL – Workplace Exposure Limits.
Note: Where no specific short-term exposure limit is listed, a figure three times the long-term exposure should be used.				

8.2 Exposure controls

Appropriate engineering controls: Provide adequate ventilation or local extraction appropriate to ensure the defined work place exposure limits (WELs) are not exceeded.

Personal protective equipment:

Personal protective equipment should never replace effective elimination, reduction or isolation risk control measures.

Eye and face protection: Contact lenses should not be worn when working with this product. Wear suitable safety glasses e.g. EN 166.

Hand protection: Wear suitable gloves. The glove material has to be impermeable and resistant to the product. As the product is a mixture of several substances, the durability of the glove material cannot be calculated in advance and should be tested before use. Protective gloves should be replaced is damaged or otherwise compromised through wear and tear. Protective gloves should comply with EN 374.

Respiratory protection:	No personal respiratory protective equipment is normally required in well ventilated areas. In case of insufficient ventilation, wear suitable respiratory aid equipment. A Type A filter is recommended.
Skin and body protection:	Impervious clothing, Flame retardant antistatic protective clothing,
Environmental exposure controls:	Prevent further leakage or spillage if safe to do so. Do not let product enter drains.

9. Physical and chemical properties

9.1 Information on basic physical and chemical properties

Appearance:	Gel, colourless, translucent.
Odour:	Alcoholic
Odour threshold:	No data available
pH:	8
Melting point (˚C):	Not applicable owing to gelled nature.
Boiling point (˚C):	78
Flash point (°C):	8 (Cleveland Open Cup; BS EN ISO 2592:2001)
Evaporation rate:	No data available
Flammability (solid, gas):	No data available
Upper explosion limit:	19% (V)
Lower explosion limit:	3.3% (V)
Vapour pressure:	5.85 kPa (20 ˚C)
Vapour density:	No data available
Relative density:	0.84 (20 ˚C)
Solubility:	Partially soluble in water.
Partition coefficient - n-octanol/water:	No data available
Auto-ignition temperature (˚C):	363
Decomposition temperature (˚C):	No data available
Viscosity:	No data available
Explosive properties:	Formation of explosive air/vapour mixtures is possible.

Oxidising properties: No data available

9.2 Other Information

Fire point (°C): 8 (Cleveland Open Cup; BS EN ISO 2000-36:2002)

Gross calorific value (MJ / kg): 29 (approximately)

10. Stability and reactivity

10.1 Reactivity

Advice: Stable under recommended storage conditions.

10.2 Chemical stability

Stability: No decomposition anticipated if stored sealed in original package. Product is stable under normal ambient conditions when storing or handling.

10.3 Possibility of hazardous reactions

Hazardous reactions: No data available

10.4 Conditions to avoid

Conditions to avoid: Heat, flames, sparks, extremes of temperature, and direct sunlight.

10.5 Incompatible materials

Materials to avoid: Alkali metals, ammonia, oxidising reagents, peroxides.

10.6 Hazardous decomposition products

Decomposition products: Thermal decomposition or combustion can liberate carbon oxides will be produced (e.g. carbon dioxide (CO_2) and carbon monoxide (CO)). Combustion with other materials can release other toxic gases or vapours. See Section 5.

11. Stability and reactivity

11.1 Information on toxicological effects

11.1.1 Mixture

Acute toxicity: Toxic Dose – LD_{50} > 2000 mg/kg (oral rat)

Toxic Concentration – LC_{50} > 20 mg/l (4hr mouse)

Irritation: Causes serious eye irritation.

Corrosivity: No data available

Sensitisation: No data available

Repeated dose toxicity: No data available

Carcinogenicity:	No data available
Mutagenicity:	No data available
Toxicity for reproduction:	No data available
Information on likely routes of exposure:	
Inhalation:	In high concentrations vapours may irritate the throat and respiratory system causing coughing.
Ingestion:	Gastrointestinal symptoms; nausea, upset stomach, vomiting
Skin contact:	Repeated exposure may cause skin dryness or cracking
Eye contact:	Irritating, and may cause redness and pain.
Other information:	To the best of our knowledge the chemical, physical, and toxicological properties have not been thoroughly investigated.

12. Ecological information

12.1 Toxicity

Toxicity:	LC_{50}: > 100 mg/l (96 hrs, Fish)
	EC_{50}: > 100 mg/l (48 hrs, Daphnia)
	IC_{50}: > 100 mg/l (72 hrs, Algae)

12.2 Persistent and degradability

Persistence:	No data available

12.3 Bioaccumulative potential

Bioaccumulation:	No data available

12.4 Mobility in soil

Soil mobility:	No data available

12.5 Results of PBT and vPVB assessment

Assessment results:	PBT/vPvB assessment not available as chemical safety assessment not required/not conducted

12.6 Other adverse effects

Other information: Will dissolve, and disperse in an aqueous environment.

Do not flush into surface water or sanitary sewer system. Avoid subsoil penetration.

13. Disposal considerations

13.1 Waste treatment methods

Product: Burn in a chemical incinerator equipped with an afterburner and scrubber but exert extra care in igniting as this material is highly flammable. Offer surplus and non-recyclable product to a licensed hazardous waste disposal company. Any material used to control spillage must be disposed of in the same way.

Packaging: Empty contaminated packaging thoroughly. This can be recycled after thorough and proper cleaning. Packaging that cannot be cleaned is to be disposed of in the same manner as the product.

14. Transport information

14.1 UN number

UN Number: 1325

14.2 UN proper shipping name

Name: Flammable solid, Organic, n.o.s.

(Ethanol Solid Fuel Gel)

14.3 Transport hazard class(es)

ADR/RID/ADN: Class 4.1; Flammable solid

IMDG: Class 4.1; Flammable solid

IATA/IACO: Class 4.1; Flammable solid

Packing label:

14.4 Packaging group

ADR/RID/ADN:	2
IMDG:	2
IATA/IACO:	2

14.5 Environmental hazards

ADR/RID:	No
IMDG:	No
IMDG Marine pollutant:	No

14.6 Special precautions for the user

Precautions:	No data available

14.7 Transportation in bulk according to Annex II MARPOL 73/78 and IBC code

IMDG:	Not applicable

15. Regulatory Information

This safety data sheet complies with the requirements of Regulation (EC) No. 1907/2006.

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

Regulations:	Regulation (EC) 1272/2008
	Control of Substances Hazardous to Health Regulations 2002
Other regulations:	Directive 92/85/EEC: Health and safety of pregnant workers.
	Directive 94/33/EC: Protection of young people at work.
	Workplace Exposure Limits 2005 (EH40)

15.2 Chemical safety assessment

Assessment:	No chemical safety assessment was carried out for this product.

16. Other information

Revision Date:	01/05/2015
Revision Number:	4

Reason:	Minor updates to information.
Key literature references:	This safety data sheet was compiled using data from suppliers and the "Database of registered substances" of the European Chemical Agency (ECHA).
Evaluation method(s):	In accordance with Article 9 of Regulation (EC) No. 1272/2008, this product was evaluated with respect to the physical state of the product being supplied and its reasonable intended use as specified in Section 1.2. For criteria where data was directly available, this data was included. For criteria where no or inadequate data for the product was held, bridging principles were applied.

Full text of R-phrases:

R11	Highly flammable
R36	Irritating to eyes
R67	Vapours may cause drowsiness and dizziness

Full text of H-statements:

H228	Flammable solid
H319	Causes serious eye irritation
H336	May cause drowsiness or dizziness

The information in this Safety Data Sheet should be provided to all who will use, handle, store, transport or otherwise be exposed to this product. This information has been prepared for the guidance of plant engineering, operations, management and for people working with or handling this product. This information is believed to be reliable and correct at the Revision Date, and represents the best information currently available and known by BCB International Ltd. However, BCB International Ltd makes no guarantee or warranty, express or implied, with respect to such information and we assume no liability and anticipated used and is for the material without chemical additions or alterations. Users should make their own investigations to determine the suitability of the information for their particular purposes. It is the responsibility of the user to undertake a suitable risk assessment/COSHH assessment prior to using the material.

21. Ceram Soot Analysis Report

ceram
INNOVATION | SUSTAINABILITY | QUALITY

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Staffordshire, ST4 7LQ, UK

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fax: +44 (0)1782 412331
email: enquiries@ceram.com
web: www.ceram.com

PHYSICAL TESTING ANALYSIS REPORT

Description:	Soot Content
Test Method:	In House Method
Ceram Reference:	(131676)-8127
Client:	BCB International Unit 21 Stradey Business Park Llangennech Llanelli SY4 8YP
For the Attention of:	Mr Stephen Hughes
Date Logged:	09-Apr-2013
Date of Tests:	16-May-2013 to 20-May-2013
Report Date:	22-May-2013
Purchase Order No.:	0000021034

Please find attached the results for the sample(s) recently submitted for analysis.

Mr Simon Hall
Author

Ceram Reference: (1316756)-8127
Customer Reference: FD
Description: Fire Dragon

DETERMINATION OF SOOT INDEX
(Ceram In-house Method)

CALIBRATION OF LIGHT BOX

The light box was switched on and left for at least 30 minutes. An illuminance measurement without a glass plate was measured and noted down (E0). This should be at least 750 Lux.

A clean glass plate was placed in the light box and an illuminance measurement with the glass plate was measured and noted down (E1).

A calibration disc was placed on to the glass plate and an illuminance measurement with the glass plate and calibration disc was measured and noted down (E2).

The absorption of the inner surface of the light box (Ai) is calculated from the equation as follows:

$$Ai = E2/E1$$

This should not deviate by more than 10% of Ai value of the light box when new.

METHOD

A porcelain crucible was taken and 30g of the sample was weighed into the crucible. The crucible was placed inside a cage so that the top of the cage was 200mm above the crucible.

The sample was ignited and allowed to burn for a stabilisation period of 5 minutes.

After the stabilisation period a clean glass plate was placed on top of the cage so as to collect any soot from the burning sample and a stop watch started.

The sample was allowed to burn until the flame went out at which point the stop watch was stopped and the measuring time in hours noted down (T m).

The plate when cool was removed from the top of the cage and placed into a light box and the illuminance measured and noted down (E3). The plate was cleaned and the illuminance re-measured and noted down (E1).

The Soot Index (Si) is calculated from the equation below:

$$Si = 1-(E3/E1) \times 100$$

The Hourly Soot Index (Sih) is calculated from the equation below:

$$Sih = Si/Tm$$

Illuminance without a glass plate (E0)	1017 Lux
Illuminance with glass plate (E1)	818 Lux
Illuminance with the glass plate and calibration disc (E2)	760 Lux
Illuminance with the glass plate after burning time (E3)	818 Lux
Burning Time	0.75 Hours (45 minutes)

CALCULATIONS

Ai = E2/E1 = 0.93

Soot Index, Si = 1-(E3/E1) x 100 = 0.00

Hourly Soot Index, Sih = Si/Tm = 0.00

End of Test Report

22. Ceram Calorific Analysis Report

PHYSICAL TESTING REPORT

UKAS TESTING
0013

BCB International
Unit 21
Stradey Business Park
Llangennech
Llanelli
SY4 8YP

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tel: (switchboard) +44 (0)1782 764444
fax: +44 (0)1782 412331
email: enquiries@ceram.com
web: www.ceram.com

FAO: Mr Stephen Hughes

Report of Tests on: Fire Dragon
Your Reference: FD
Ceram Reference: (131676)-8127
Date Reported: 22-May-2013 **Order Number:** 0000021034
Date Logged: 09-Apr-2013 **Date(s) of Test(s):** 14-May-2013 **to** 16-May-2013

Determination of Net & Gross Calorific Value of Solid Recovered Fuels

By Bomb Calorimetry BS EN 15400:2011 & PT49

Test Results:

Sample Basis As Received
Gross Calorific Value: 27.8924 MJ/kg
Nitrogen: Default Setting as in E.4 of BS EN 15400:2011

Hydrogen values are used to calculate the net CV at constant volume. If the H content is not determined then the net CV is taken from the linear regression fit of the net CV as a function of gross CV.

Opinions and interpretations expressed herein are outside the scope of UKAS Accreditation.

End of Test Report

Mr Simon Hall
Author

Page 1 of 1

23. Flash & Fire Point Analysis Report

EXPLOSION HAZARD TESTING LIMITED

DETERMINATION OF THE OPEN CUP FLASH POINT AND FIRE POINT OF A SAMPLE OF FDS001 AND ONE OF FDG002 USING THE CLEVELAND OPEN CUP METHOD, SAMPLES PROVIDED BY BCB INTERNATIONAL LTD.

EHT14120/RWL **1st September 2014**

BY

EXPLOSION HAZARD TESTING LIMITED.

Explosion Hazard Testing Limited, 16 Dalton Court, Astmoor Industrial Estate, Runcorn, Cheshire, WA7 1PU
Tel: 01928 576722 Mob: 07833468868 Fax: 44 01928 551937 E-mail: russ.littlejohn@explosionhazardtesting.co.uk
Registered in England No.07038097
Registered Office: Victoria House, 488 Knutsford Road, Warrington, Cheshire, United Kingdom, WA4 1DX

SUMMARY RESULTS

The samples tested produced the following corrected Open Cup flash point and Fire point results:

Material Under test	OC Flash Point	Fire Point
	°C	°C
FDS001	8	8
FDG002	8	8

EHT14120/RWL **2**

1. INTRODUCTION

Samples of FDS001 and FDG002 were provided by BCB International Ltd for the determination of their open cup flash point and fire point using the Cleveland open cup method.

2. SAMPLE DESCRIPTION

The sample of FDS001 was white jellified cake.
The sample of FDG002 was a colourless gel.

3. TEST METHOD

3.2 Cleveland Open Cup

The test method employed was based on that described in BS EN ISO 2592:2001, BS 2000-36:2002 "Determination of flash and fire points – Cleveland open cup method".

The test cup and all other parts of the apparatus were thoroughly cleaned and dried. Due to the nature of the materials the cup and samples were cooled to -16°C. The sample was then added to the cup, up to the level indicated by the filling mark. The thermometer was fitted, the test flame ignited and the diameter of the flame adjusted (to approximately 4mm). The heating rate was adjusted so that the cup would heat at between 5 and 6°C per minute. The test flame was then applied every 1°C. The test flame was applied by passing the applicator across the centre of the cup in a smooth, continuous motion, 2mm above the cup edge. The time taken for the flame to pass across the cup was approximately 1s.

The temperature at which a distinct flash was seen on the surface of the sample was recorded as the observed flashpoint.
The temperature at which the sample ignited and continued to burn for at least 5 seconds was recorded as the observed fire point.

The ambient barometric pressure was also recorded at the time of the test.

4 RESULTS

4.1 Cleveland Open Cup Flash and Fire point determination

Observed flash point	The lowest temperature that a flash was observed at during the actual carrying out of the test.
Observed fire point	The lowest temperature that ignition of sample was observed at and the sample continued to burn for at least 5 seconds after removal of the test flame.
Corrected flash and fire points	The test method states the corrections to be made if the barometric pressure is below 953mbar at the time of carrying out the actual test. In this instance no correction was required.

FDS001
The sample has an observed open cup flashpoint of 8°C with a fire point of 8°C

Ambient Barometric pressure: 1001mbar.

Testing carried out 28/8/14

FDG002
The sample has an observed open cup flashpoint of 8°C with a fire point of 8°C

Ambient Barometric pressure: 1001mbar.

Testing carried out 28/8/14

Both samples flashed and ignited at the same temperature.

FDS001
The sample has an observed open cup flashpoint of 8°C with a fire point of 8°C

Ambient Barometric pressure: 1003mbar.

Testing carried out 29/8/14

FDG002
The sample has an observed open cup flashpoint of 8°C with a fire point of 8°C

Ambient Barometric pressure: 1003mbar.

Testing carried out 29/8/14

Both samples flashed and ignited at the same temperature

24. MSL Bactericidal Efficacy Test Results

TEST REPORT
SUSPENSION TEST FOR EVALUATION OF BACTERICIDAL EFFICACY
BS EN 1040:2005

Customer	BCB International ltd.
Contact Name	James Wixey
Address	Clydesmuir Road, Cardiff, CF24 2QS
Email	jw@bcbin.com
PO Number	

Lab Ref	PR-22/15 (lab ref: 9284-1)
Report Date	18/03/2015
Period of Analysis	16/03/15 – 17/03/2015

Name of product	FireDragon solid fuel
Batch number	-
Manufacturer / Supplier	BCB International Ltd.
Storage Conditions	Ambient
Appearance of the Product	Clear solid block
Preservatives/Antimicrobials & Conc.%	Alcohol
Product Diluent recommended by manufacturer for use	Neat as supplied
Method	BS EN 1040:2005
Neutraliser	N3
Product diluent	N/A
Test Concentrations	Neat as supplied
Experimental Conditions	N/A
Interfering substances	N/A
Test Temperature	20^{0}C
Temperature of Incubation	Bacteria - 37°C ±1°C for 24hr to 48hrs
Identification of the Bacterial strains:	*Pseudomonas aeruginosa* ATCC 15442 *Staphylococcus aureus* ATCC 6538
Contact times	Bacteria - 5min ± 10s

Microbiological Solutions Ltd
Gollinrod
Walmersley
Bury, BL9 5NB

Tel: 0844 824 6003
Email: info@microbiologicalsolutions.com
Web: www.microbiologicalsolutions.com

Company Number: 4218514

Introduction

The standard method 1040 describes a suspension test method for establishing the basic bactericidal activity of chemical disinfectants and antiseptic products.

Outline of Test Method

A sample of the test product is diluted and added to a test suspension of bacteria. The mixture is maintained at 20°C for 5mins. At the end of the contact time an aliquot is taken and the bacterial / bacteriostatic activity is immediately neutralised or suppressed by the validated method. The numbers of surviving bacteria in each sample are determined and the reduction is calculated.
The test is performed using *Pseudomonas aeruginosa* and *Staphylococcus aureus* as standard organisms.

Acceptance Criteria

The product when tested as above shall demonstrate at least a 5 $\log_{10}$ reduction in viable bacterial counts.

Conclusion

The product **FIREDRAGON SOLID FUEL** has **PASSED** the test according to the acceptance criteria as outlined in the standard.

See raw data tables below for test results.

The sample will be retained for 1 month unless otherwise requested.

L Boneheyo

Microbiology Technician
Louise Boneheyo

Technical Project Manager
Carolyn Burney

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Gollinrod
Walmersley
Bury, BL9 5NB

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Email: info@microbiologicalsolutions.com
Web: www.microbiologicalsolutions.com

Company Number: 4218514

Test Results (bactericidal suspension test)

Product Name: Firedragon
Batch Number: -
Lab Ref: 9284

Validation and controls

Validation Suspension (Nv_0)			Experimental Conditions Control (A)			Neutraliser or Filtration Control (B)			Method Validation (C)		
$Vc1$	Ps.116 St.133	$\bar{x}$ = Ps.112.5 St.136	$Vc1$	Ps.111 St.126	$\bar{x}$ = Ps.92 St.134.5	$Vc1$	Ps.87 St.138	$\bar{x}$ = Ps.79 St.120	$Vc1$	Ps.61 St.111	$\bar{x}$ = Ps.62 St.120
$Vc2$	Ps.109 St.139		$Vc2$	Ps.73 St.143		$Vc2$	Ps.71 St.102		$Vc2$	Ps.63 St.129	
$30 \leq \bar{x}\ of\ Nv_0 \leq 160$? Yes / ~~No~~			$\bar{x}\ of\ A\ is\ \geq 0.5 \times \bar{x}\ of\ Nv_0$? Yes / ~~No~~			$\bar{x}\ of\ B\ is\ \geq 0.5 \times \bar{x}\ of\ Nv_0$? Yes / ~~No~~			$\bar{x}\ of\ C\ is\ \geq 0.5 \times \bar{x}\ of\ Nv_0$? Yes / ~~No~~		

Pre Test - Sample Sterility check		
AMB	<10cfu/ml	Pass
Y&M	<10cfu/ml	Pass

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Test Results

Test organism	$\bar{x}$ Inoculum Level	Inoculum Log	$\bar{x}$ V_c	Recovery after Contact Time Log	Log Reduction	Pass / Fail
Pseudomonas aeruginosa ATCC 15442	$6.3x10^8$	7.80	<10	<1.00	>5	Pass
Staphylococcus aureus ATCC 6538	$5.8x10^8$	7.76	<10	<1.00	>5	Pass

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Company Number: 4218514

TEST REPORT
SUSPENSION TEST FOR EVALUATION OF BACTERICIDAL EFFICACY
BS EN 1276:2009

Customer	BCB International ltd.
Contact Name	James Wixey
Address	Clydesmuir Road, Cardiff, CF24 2QS
Email	jw@bcbin.com
PO Number	1040/1276

Lab Ref	PR-22/15 (lab ref: 9284-1)
Report Date	18/03/2015
Period of Analysis	16/03/15 – 17/03/2015

Name of product	FireDragon solid fuel
Batch number	
Manufacturer / Supplier	BCB International Ltd.
Storage Conditions	Ambient
Appearance of the Product	Clear solid block
Preservatives/Antimicrobials & Conc.%	Alcohol
Product Diluent recommended by manufacturer for use	Neat as supplied
Method	BS EN 1276:2009
Neutraliser	N3
Product diluent	N/A
Test Concentrations	Neat as supplied
Experimental Conditions	Dirty
Interfering substances	0.3g/l Bovine Albumin
Test Temperature	20^0C
Temperature of Incubation	Bacteria - 37°C ±1°C for 24hr to 48hrs
Identification of the Bacterial strains:	*Pseudomonas aeruginosa* ATCC 15442 *Staphylococcus aureus* ATCC 6538 *Enterococcus hirae* ATCC 10541 *Escherichia coli* ATCC 10536
Contact times	Bacteria - 5min ± 10s

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Company Number: 4218514

Introduction

The standard method 1276 describes a suspension test method for establishing whether a chemical disinfectant or antiseptic has or does not have bactericidal activity in the fields described in the scope. The test takes into account practical conditions of application of the product, including contact time, temperature, test organisms and interfering substance, i.e. conditions which may influence its action in practical situations.
The conditions are intended to cover general purposes and to allow reference between laboratories and product types. Each utilization concentration of the chemical disinfectant or antiseptic found by this test corresponds to defined experimental conditions. However, for some applications, the recommendations of use of a product may differ and therefore additional test conditions may need to be used.

Outline of Test Method

A sample of the test product is diluted and added to a test suspension of bacteria in a solution of interfering substance. The mixture is maintained at 20°C for 5mins. At the end of the contact time an aliquot is taken and the bacterial / bacteriostatic activity is immediately neutralised or suppressed by the validated method. The numbers of surviving bacteria in each sample are determined and the reduction is calculated.
The test is performed using *Pseudomonas aeruginosa, Escherichia coli, Staphylococcus aureus* and *Enterococcus hirae* as standard organisms.

Acceptance Criteria

The product when tested as above shall demonstrate at least a 5 $\log_{10}$ reduction in viable bacterial counts.

Conclusion

The product **FIREDRAGON SOLID FUEL** has **PASSED** the test according to the acceptance criteria as outlined in the standard.

See raw data tables below for test results.

The sample will be retained for 1 month unless otherwise requested.

L Boneheyo

Microbiology Technician
Louise Boneheyo

Technical Project Manager
Carolyn Burney

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Company Number: 4218514

Test Results (bactericidal suspension test)

Product Name: Firedragon
Batch Number: -
Lab Ref: 9284

Validation and controls

Validation Suspension (Nv_0)			Experimental Conditions Control (A)			Neutraliser or Filtration Control (B)			Method Validation (C)		
$Vc1$	Ps.116 St.133 Ec.121 Ent.50	$\bar{x}$ = Ps.112.5 St.136 Ec.113.5 Ent.57	$Vc1$	Ps.111 St.126 Ec.88 Ent.34	$\bar{x}$ = Ps.92 St.134.5 Ec.72 Ent.32	$Vc1$	Ps.87 St.138 Ec.91 Ent.36	$\bar{x}$ = Ps.79 St.120 Ec.86.5 Ent.34.5	$Vc1$	Ps.61 St.111 Ec.72 Ent.31	$\bar{x}$ = Ps.62 St.120 Ec.72 Ent.32
$Vc2$	Ps.109 St.139 Ec.106 Ent.64		$Vc2$	Ps.73 St.143 Ec.56 Ent.30		$Vc2$	Ps.71 St.102 Ec.82 Ent.33		$Vc2$	Ps.63 St.129 Ec.72 Ent.33	
$30 \leq \bar{x}\ of\ Nv_0 \leq 160$? Yes / ~~No~~			$\bar{x}\ of\ A\ is\ \geq 0.5 \times \bar{x}\ of\ Nv_0$? Yes / ~~No~~			$\bar{x}\ of\ B\ is\ \geq 0.5 \times \bar{x}\ of\ Nv_0$? Yes / ~~No~~			$\bar{x}\ of\ C\ is\ \geq 0.5 \times \bar{x}\ of\ Nv_0$? Yes / ~~No~~		

Pre Test - Sample Sterility check		
AMB	<10cfu/ml	Pass
Y&M	<10cfu/ml	Pass

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Test Results

Test organism	$\bar{x}$ Inoculum Level	Inoculum Log	$\bar{x}$ V_ε	Recovery after Contact Time Log	Log Reduction	Pass / Fail
Pseudomonas aeruginosa ATCC 15442	$5.5x10^8$	7.74	<10	<1.00	>5	Pass
Staphylococcus aureus ATCC 6538	$5.3x10^8$	7.72	<10	<1.00	>5	Pass
Escherichia coli ATCC 10536	$9.6x10^8$	7.98	<10	<1.00	>5	Pass
Enterococcus hirae ATCC 10541	$3.6x10^8$	7.56	<10	<1.00	>5	Pass

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END