Floreon

Floreon 100
GENERAL PURPOSE

Floreon 500
STRETCH BLOW MOULDING

Floreon 200
SHEET EXTRUSION / PRINTING

Floreon 600
THERMOFORMING

Floreon 300
EXTRUSION BLOW MOULDING

Floreon 700
3D

Floreon 400
FILM

Floreon 800
INJECTION MOULDING

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World's most versatile bioplastic

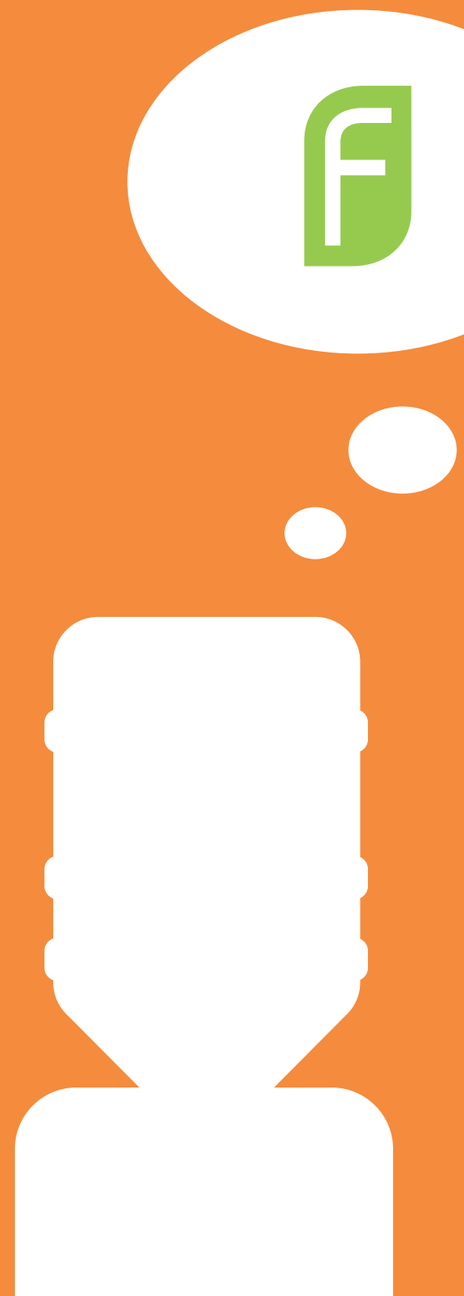
Floreon was created from a desire for a greener, safer form of plastic water bottle for office water coolers.

Unhappy with the options available, we decided to develop our own...

"The possibilities for Floreon are endless. We've gone far beyond the original remit of replacing the traditional water bottle, or even replacing PET plastic and other plastic derivatives. I believe it has the potential to transform both packaging and the way we think about plastic."

Shaun Chatterton
Founder

Shaun started his own business (CPD plc) in 1988 and it soon became one of the UK's largest independent distributors of cleaning and hygiene products. He is the founder and Chief Executive of Floreon.



This is how it all started

A knowledge transfer partnership with the University of Sheffield was formed with the aim to develop a green circle of life-compostable bioplastic using corn starch based polylactic acid blends (PLA).

However, standard PLA does not have the toughness needed for water bottle applications and Floreon was born.

The University Of Sheffield.

Floreon was born out of passion to innovate.

> Our goal was to transform the way we think about plastic and the impact we have on the environment. Our approach is simple. Make it fast and make it right. We took an existing bio-based polymer (PLA) with beautiful material properties and added our own technology to make it work better than all the alternatives.

Alma Hodzic
Prof. of Advanced Materials Technologies at The University of Sheffield

Alma was one of the original inventors of Floreon. After completing her PhD in Science of Engineering Materials she was a research fellow in Department of Applied Chemistry at RMIT University and lectured at both The University of Sheffield and James Cook University.

Floreon was awarded the highest grade of "Outstanding" by the KTP Grading Panel

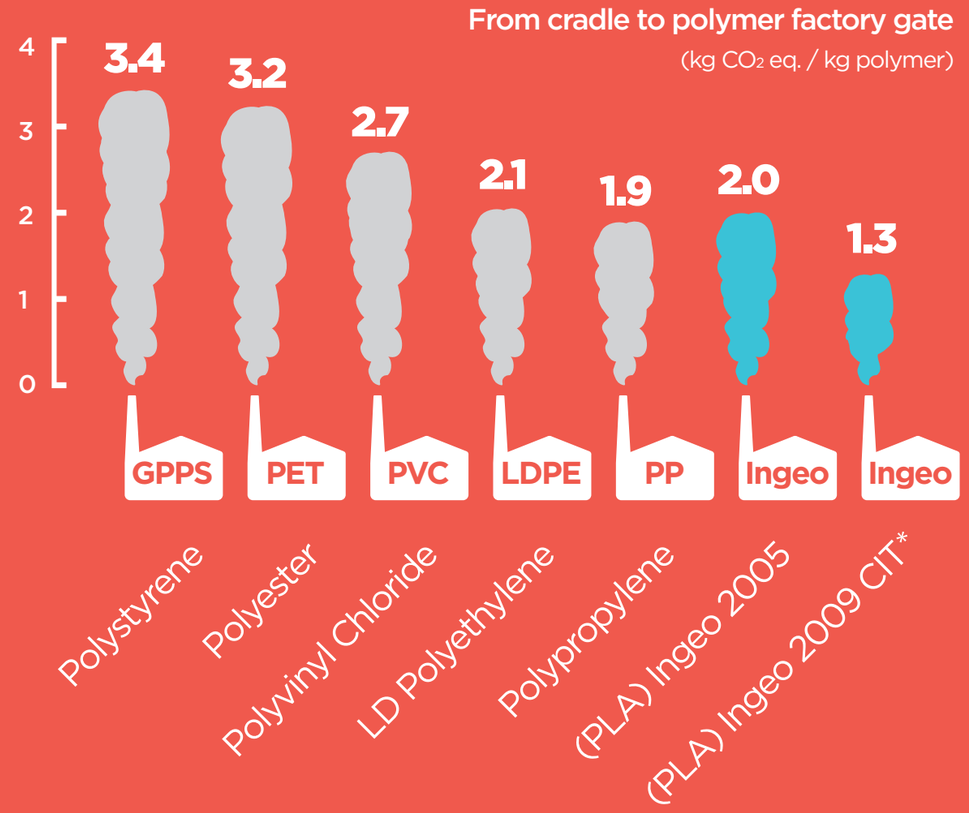
Floreon is a specially formulated compound which is added to standard PLA

Floreon is made from the world's first bioplastic performance material whose manufacture shows reduction in greenhouse gas emissions.

- Feedstock derived from abundant renewable sources
- Production emits fewer greenhouse gasses
- Recyclable
- Multiple end of life options, composting or recycling

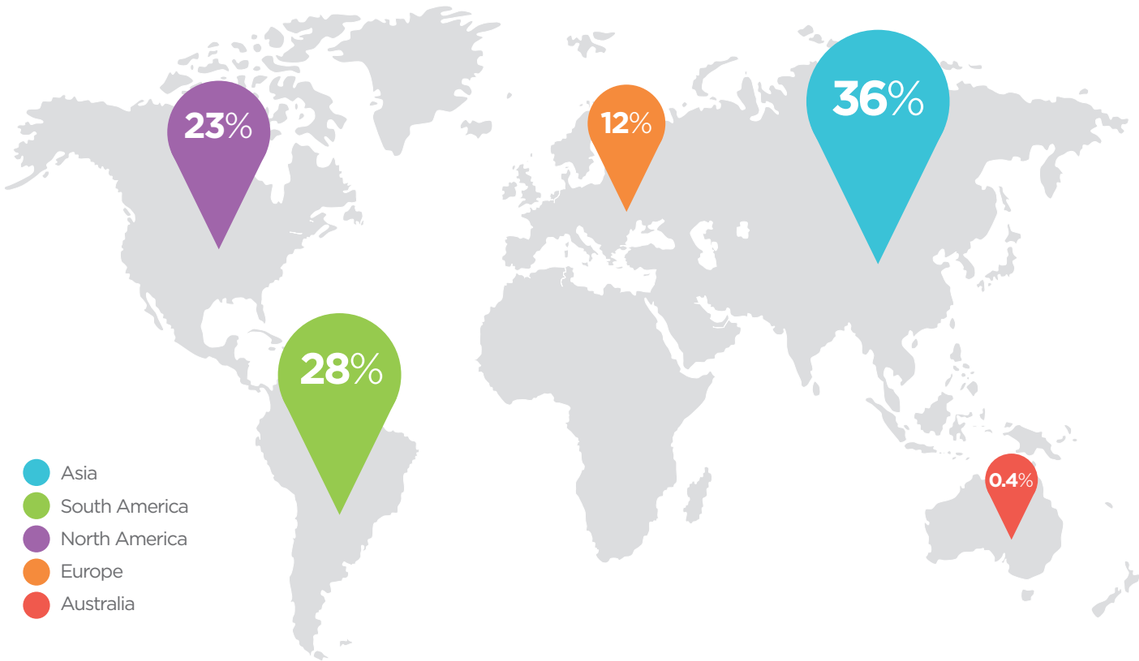
Made from plants not oil
and derived from abundant 100% annually renewable plant resources

Reduced carbon footprint
with PLA bioplastics

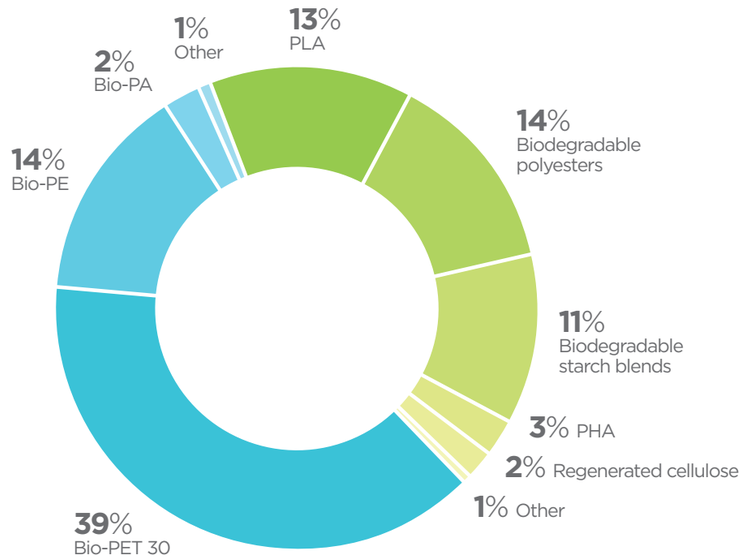


Source: NatureWorks LLC 2009 *CIT stands for "currently implemented technology"

Global production capacity of bioplastic



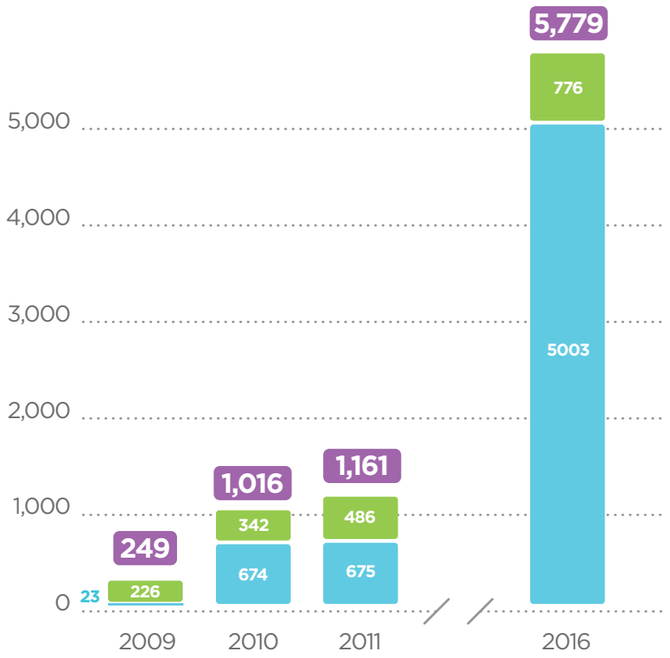
Bioplastics production by type



56.6%
Biobased/non-biodegradable

43.4%
Biodegradable

Capacity in 1,000 metric tonnes

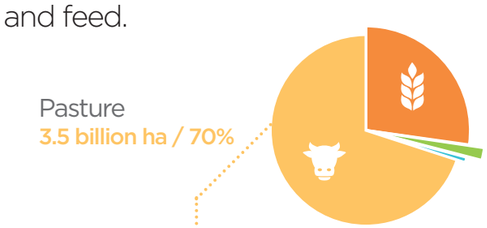


Biodegradable
Biobased/non-biodegradable
Total Capacity

Source: European Bioplastics | Institute for Bioplastics and Biocomposites (December 2013)

Land used for bioplastics (2011)

Bioplastics are not even close to being in competition to food and feed.



Food & Feed
1.29 billion ha / 27%

Pasture
3.5 billion ha / 70%

Material Use
100 million ha / 2%

Biofuels
55 million ha / 1%

37%
Global Agricultural Area
5 billion ha

Bioplastics*
0.006%
2011 300.000 ha
0.022%
2016 300.000 ha

*In relation to global agricultural area

Floreon performance against PLA

"What makes Floreon unique is that we have significantly boosted the performance of PLA without adversely altering the nature of the material. Our additives are effective at very low addition levels maintaining a high level of biobased content (> 90%) and without compromising the compostability or safety of the material."

Dr. Andrew Gill
Technical Director

Andrew helped develop Floreon through a Technology Strategy Board sponsored Knowledge Transfer Partnership between CPD and the University of Sheffield. He is Technical Director of Floreon. BSc, Chemistry, MSc, Chemistry with Biochemistry, Doctor of Philosophy (PhD), Tissue Engineering.

Floreon is a specially formulated compound, which is added to standard PLA. So special that it makes it **4 times tougher.**

- Vastly increases the number of applications for PLA
- Excellent form, stiffness and rigidity, (Hard to achieve in a bioplastic)
- Excellent gloss and transparency
- Easy to blend, mold, shape, emboss and print
- UV stable
- Non-allergenic
- Food packaging compliant (EU 1935/2004)

	PLA	Floreon
Recyclable	✔	✔
Biodegradable	✔	✔
Biobased	✔	✔ (> 90%)
Process T (°C)	**180-220**	**160-220**
Toughness	Medium	Very Good
Stiffness	High	High

Floreon performance against PET.

"Instead of simply comparing Floreon with other bioplastics, independent testing has shown that Floreon can even outperform PET in terms of mechanical performance. Whilst we recognise the success story of PET recycling and respect that we won't replace PET in every application (such as soft drink bottles), it is clear that newly established bioplastics offer many more possibilities for the future in terms of both production, functionality and end of life options."

Dr. Andrew Gill
Technical Director

Floreon also offers significant **benefits over oil based PET** (polyethylene terephthalate) and other common fossil based plastics.

Environmental

- More stable feedstock price compared to volatility of world oil price.
- Less energy needed to produce
- Not from fossil fuel
- Oil based plastics do not compost easily - 100s of years required

Performance

- Higher strength than PET up to 15%
- Greater Modulus than PET up to 30%
- Greater toughness up to 85%
- Sits between PET and PC (polycarbonate) for performance

	PET	
Recyclable	✔	✔
Biodegradable	✘	✔
Biobased	30% max.	✔ (> 90%)
Process T (°C)	260-280	160-220
Toughness	Good	Very Good
Stiffness	Medium	High

This is how **Floreon** works

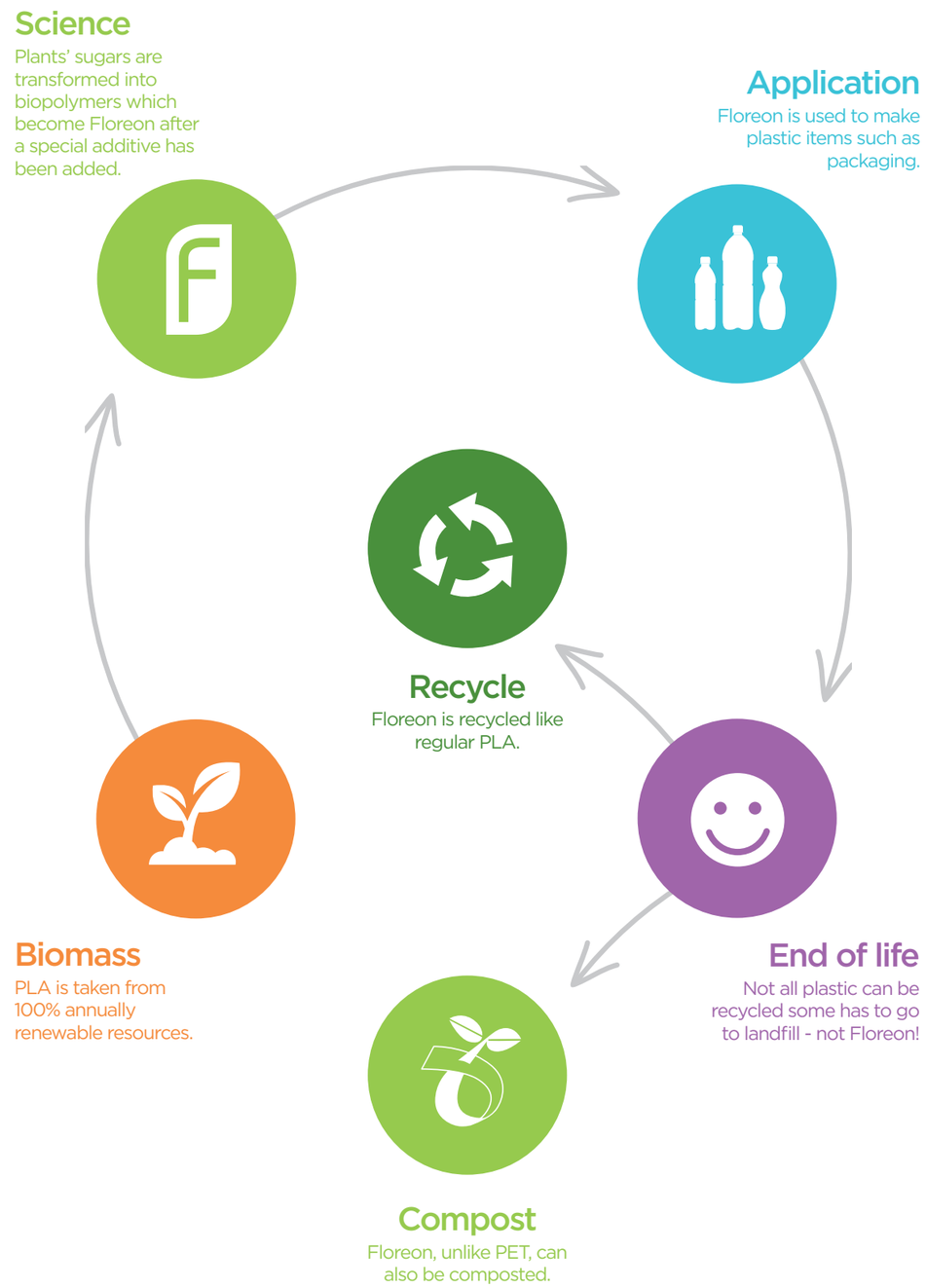
Floreon is biodegradable and fully recyclable. It can be converted back into feedstock in an energy efficient manner and re-polymerised back into virgin PLA.

"Typically pure polymers are often restricted in their applications and properties and require careful formulating to achieve the best results. This is obviously a normal approach in the conventional plastics industry but one which is only recently being pursued in the bioplastics sector.

Floreon is an excellent example of producing a range of plastics based on PLA which maximizes and enhances the properties of PLA and produces bioplastic products with a wide range of applications and functional benefits, in combination with positive environmental credentials."

Dr. John Williams
Non-Executive Director

John is a globally experienced technology manager and advisor in the field of renewable materials and sustainable technology. John is a Non-Executive Director at Floreon. BSc, Chemistry, PhD, Polymer Chemistry.



Floreon
Grades

Floreon 100
GENERAL PURPOSE

Floreon 100 is a versatile blend containing 90% polylactic acid combined with the optimal amount of two other biodegradable polyesters which enhance both the processability and impact resistance of the base polymer.

- *Enhanced processability*
- *Increased impact resistance*

Floreon 200
SHEET EXTRUSION / PRINTING

Floreon 200 is an opaque white pigmented grade of Floreon specifically intended for sheet extrusion. The Floreon additive levels have been adjusted to enhance durability and processability, whilst also keeping the cost low.

- *Enhanced durability*
- *Cuts easily*
- *Good printability*

Floreon 300
EXTRUSION BLOW MOULDING

Floreon 300 is optimised for extrusion blow moulding (EBM). Floreon was designed for injection moulded applications requiring a high melt flow index, however by optimising the additives used the toughness of the base material can still be boosted whilst lowering the melt flow index and maximising melt strength.

- *Low melt flow index*
- *Improved toughness*

Floreon 400
FILM

Floreon 400 is a grade of Floreon optimised for film production.
The material has been optimised for melt strength, clarity and low temperature processing. The material is slightly softer than unmodified PLA.

- *Enhanced melt strength*
- *Improved clarity*
- *Lower processing temperature*

Floreon 500
STRETCH BLOW MOULDING

Floreon 500 is intended for injection stretch blow moulding, for the production of bottles. The blend contains at least 90% Ingeo PLA, combined with the selected Floreon additives to enhance the toughness of the finished items whilst also making them easier to process.

- *Enhanced toughness*
- *Improved processability*

Floreon 600
THERMOFORMING

Floreon 600 is a versatile blend containing 90% polylactic acid combined with the optimal amount of two other biodegradable polyesters which enhance both the processability and impact resistance of the base polymer.
The material is tougher than PLA across the temperature range.

- *Higher crack resistance in roll stage*
- *Increased impact resistance*
- *Improved processability*

Floreon 700
3D

Floreon 700 is a Floreon formulation designed to give stable extrusion (for uniform filament diameter) over a wider range of temperatures. The finished product is tougher than PLA allowing the creation of more resilient structures. The printability and finish is excellent making this a good choice for 3D printing applications. Colours and pigments can be added as required.

- *Good processing stability*
- *Stable (or uniform) filament diameter*
- *Improved mechanical performance*
- *Good printability*
- *Higher flexibility*

Floreon 800
INJECTION MOULDING

Floreon 800 is a compound containing around 90% polylactic acid developed for injection moulding. This formulation has a high melt flow index allowing new applications for PLA with smaller feature sizes. The mechanical properties of the resulting products are also substantially enhanced.

- *Higher elongation at break*
- *Higher impact resistance*
- *Higher melt flow index*
- *Easier moulding with lower inject pressures*

Floreon Comparison Table

(Our grades against oil based plastics)

	Floreon 100 GENERAL PURPOSE	Floreon 200 SHEET EXTRUSION / PRINTING	Floreon 300 EXTRUSION BLOW MOULDING	Floreon 400 FILM	Floreon 500 STRETCH BLOW MOULDING	Floreon 600 THERMOFORMING	Floreon 700 3D	Floreon 800 INJECTION MOULDING	PET (Polyethylene Terephthalate)	PP (Polypropylene)	PS (Polystyrene)	PE (Polyethylene)
3D printing	●						●	●	●			
Access cards		●								●		
Biro	●							●	●			
Bottle caps	●							●	●			
CD cases	●							●	●			
Clam shells						●						
Computer components	●							●	●			
Cutlery	●							●	●			
Disposable cups						●						
Disposable plates		●								●		
Film				●								
Food containers						●						
Food trays						●						
Heat seal film				●							●	
Keyboard	●							●	●			
Large water bottle			●		●							●
Light switch	●							●	●			
Medical packaging						●						
Microwaveable packaging	●							●	●			
Mouse	●							●	●			
Packaging foam			●	●							●	
Plant labels		●								●		
Plumbing pipes		●								●		
Small bottle					●							●
Soles of shoes	●							●	●			
Straws				●							●	
Telephones	●							●	●			
Textiles				●							●	
Utensils	●							●	●			

Patent Filings

UK	Pending	1104018.5
EU	Pending	12710776.1
US	Pending	14/003,557
Canada	Pending	2828190
Japan	Pending	2013-557174
China	Pending	201280012321.2
Australia	Pending	AU2012226557
New Zealand	Pending	614394

Standards

All components of Floreon satisfy the standard EN13432 (ASTM D6400 equivalent).