



# PLA as a Packaging Solution



GreyB

# Introduction to PLA – Why it is being considered a potential material?

## What is PLA?

**Polylactic acid**, or **polylactide (PLA)** is a thermoplastic polyester formally obtained by condensation of lactic acid with loss of water (hence its name). PLA has become a popular material due to it being economically produced from renewable resources. In 2010, PLA had the second highest consumption volume of any bioplastic of the world. Widely used for filament material in 3D printing, it is now **considered in packaging applications, especially in** food packaging. And, it is anticipated that the growing consumption of packaged foods will further drive the packaging industry to use this as a primary biodegradable material over the coming years - **global market for PLA is expected to become more than US\$ 5 billion by 2020** [\[Source\]](#).



### BIODEGRADABLE

**PLA is biodegradable under certain circumstances** [\[source\]](#), as enzymes like Proteinase K, which can catalyze the hydrolytic degradation of PLA, are not available in the environment except on rare occasions. That is why there has been research on various blends of PLA to improve its biodegradability *[please refer to the subsequent slides for more information on this]*.



### GOOD BARRIER PROPERTIES

Good moisture barrier properties comparable to those of petroleum-based plastics, such as polyethylene terephthalate (PET) or polystyrene (PS) [\[Source\]](#)



### RENEWABLE

Being derived from plants, PLA is completely bio based i.e. the original materials are renewable. [\[Source\]](#)



### LOW COST

**GreyB Comment:** *The high market and research in PLA is a direct signal of it growing even bigger in future – thus, good chances are that it will also be popular as a packaging alternative. So, we can expect more number of technology suppliers entering this domain.*

# What are the hindrances to commercialize PLA solutions?

## WHAT IS STOPPING PLA?

Even after having a lot of positive sides of the PLA, it does not seem to be an easy answer for packaging applications.

Take a look at the following hindrances/weaknesses.



### CONDITIONALLY BIODEGRADABLE

**PLA is biodegradable under certain circumstances** [\[source\]](#), as enzymes like Proteinase K, which can catalyze the hydrolytic degradation of PLA, are not available in the environment except on rare occasions.



### LIMITED APPLICATION

PLA has a glass transition of about (57 °C) and so it is rigid and quite brittle at room temperature [\[Source\]](#). This disadvantage significantly limits the application of PLA in ductile products.



### LOW STRENGTH

PLA has low strength (fragility) and shelf-life [\[Source\]](#)



### OXYGEN BARRIER

It has poor oxygen barrier properties than PET or PS [\[Source\]](#)

*Apart from these, there are also*



### ENVIRONMENTAL THREATS

if there is no proper environment for composting, PLA can create methane, which is an environment hazard. [\[Source\]](#)



How can we help in overcoming these problems to build custom solutions for your products?

# What are the solutions to counter weaknesses of PLA?

## PROBLEM YOU SEE



### LOW STRENGTH

PLA has low strength (fragility) and shelf-life [\[Source\]](#)



### CONDITIONALLY BIODEGRADABLE



### OXYGEN BARRIER

It has poor oxygen barrier properties than PET or PS [\[Source\]](#)

## EXEMPLARY SOLUTIONS THAT WE CAN HELP DISCOVER

Total S.A., under the name of Fina Technology Inc. has filed couple of patents that seem to counter this particular weakness of PLA - [US10125249B2](#) and [US9796842B2](#) – **both these patents discuss a biodegradable polystyrene blend that is strong enough to be used in a wide variety of applications.** Although there isn't any explicit indication that this blend is in commercial use.

CJ CheilJedang Corp, a south Korean food company has a patent [\[US9328239B2\]](#) that talks about **a biodegradable blend of PLA containing polyhydroxyalkanoates, which improves reproducible mechanical properties for the overall composition.**

A Netherland based company called BioFutura has developed a proprietary crystalline PLA [CPLA] material that is a combination of PLA [70-80%] and chalk [20-30%] and other biodegradable additives. **According to the EN-13432 composting standard, CPLA products are 100% biodegradable and compostable – i.e. in an industrial composting facility under optimum conditions (oxygen, moisture and heat), this PLA will be fully composted in 8-12 weeks.**

There is a research paper by Carosio et al. [\[Source\]](#), which discusses a layer-by-layer deposition technique on commercially used PLA thin films (30 µm thick) **in order to increase their barrier properties to oxygen and water vapor.**

Unitika has filed quite a few patents on couple of different PLA blends [i.e. PLA + Wax in US7972669B2, KR1376642B1 and JP05264176B2; PLA + Silicate in KR1183260B1]. According to their patents, these blends will have excellent moisture and oxygen barrier properties. However, there is no indication that these blends are currently commercialized.



We can also showcase the business landscape in this domain. This can help in gauging competition as well as highlighting potential technology or manufacturing partners/supplier (based on your product).

# Which companies are making advances in this space?

Note that these are just exemplary companies. There are many more companies spread across the world. They can be thoroughly explored in a full-fledged study.

## Companies in USA

TAG Packaging

## Companies in Europe

Total S.A.

Carbiolice

M&H Plastics

## Companies in China

Vanjoin Hubei Industry Limited

Hefei Dahu Wire & Cable Technology Co

Zhejiang Agric Sci Acad

Shenzhen Jiangzhiyuan Ind Co Ltd

Foshan Plastic Technology Group Co Ltd

Zhejiang Hisun Biomaterials Co.,Ltd.

## Companies in Japan

UNITIKA

Toray Industries Inc.



# Which companies are making advances in this space?

## UNITIKA

Established 1889

[Contact Link](#)

**Presence:** USA, Germany, Brazil, China, Thailand, Indonesia, Hong Kong, Japan, Korea and Vietnam

## IP INNOVATION/TECH

M&H Plastics offers packaging solutions to various industries. They have recently started focusing on environmentally-responsive products and trialed PLA in various manufacturing processes.

### IDEAL FOR



Cosmetics Packaging

### Comment

*Unitika, being a functional material manufacturer seems to have good hold on advanced materials and their biodegradable blends. That must be why Shiseido Co. Ltd., a cosmetic company has partnered with them for research [they have filed a Korean patent in collaboration. **This indicates that in Shiseido's cosmetic products Unitika's custom PLA blends can appear in future.***

## Total S.A.

Established 1956

[Contact Link](#)

**Presence:** Africa, Asia-Pacific, Europe, Middle East, North and South Americas

## IP INNOVATION/TECH

Total S.A. is one of the major players when it comes to PLA – they filed couple of patents, US10125249B2 and US9796842B2 under the name of Fina Technologies [a subsidiary of Petrofina, and got merged with Total when it acquired Petrofina in 1999], which centers around blend of PLA with polystyrene. These blends claim to hold the mechanical properties of polystyrene while making overall composition biodegradable.

### IDEAL AS



A PLA supplier

### Comment

*In 2016, Total and Corbion entered into a Joint Venture to develop PLA based bioplastics. Two years after the collaboration, they successfully produced Luminy® PLA based resins that is 100% biodegradable and renewable [[Source](#)].*

***Now, it might be the case that they have protected these PLA resin using US'249 and US'842. Which might give them edge over the other suppliers.***



# Which companies are making advances in this space?

## M&H Plastics

Established 1973

[Contact Link](#)



**Presence:** Australia, USA, UK, Europe

## IP INNOVATION/TECH

M&H Plastics offers packaging solutions to various industries. They have recently started focusing on environmentally-responsive products and trialed PLA in various manufacturing processes.

### IDEAL FOR



Cosmetics Packaging

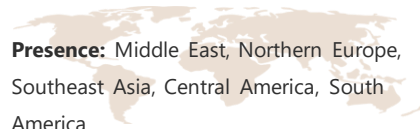
### Comment

*In 2010, hair care firm Philip Kingsley has used biodegradable solutions of M&H plastics for packaging of its products. The company (M&H) also claims that the material decomposes at a very fast rate and provides environmental benefits. **So M&H plastics already have some experience in handling packaging of products, and therefore, holds the possibility to be a potential supplier.***

## Vanjoin Hubei Industry Limited

Established 2006

[Contact Link](#)



**Presence:** Middle East, Northern Europe, Southeast Asia, Central America, South America.

## IP INNOVATION/TECH

Vanjoin Hubei Industry Limited makes PLA based bottle, jars, cups and straws for food and beverages. The company's PLA based material is biodegradable and it claims that their products can completely degrade in 80 days.

### IDEAL AS



A PLA Supplier

### Comment

*The company already exports PLA based products to Middle East, USA, Russia, Australia, Japan, Greece, Malaysia, Philippines, Colombia, Belgium [\[Source\]](#). **Because of its wide geographic reach, particularly in China and Southeast Asia [a large market], it can be evaluated as potential supplier option.***

# Which companies are making advances in this space?

## TAG Packaging

Established 2014

[Contact Link](#)



**Presence:** El Segundo, California

## IP INNOVATION/TECH

TAG Packaging produces 100BIO™, the world's first 100% compostable foam food packaging. The non-toxic product line that includes disposable tableware, bowls and fresh food trays completely biodegrade in a commercial compost in less than nine weeks. The packaging is made from polylactic acid (PLA), a plant-based bioplastic. After useful life, 100 BIO™ foam can be recycled, incinerated, composted, or even converted back into lactic acid.

## IDEAL FOR



Cosmetics Packaging



Electronics Packaging

## Comment

*The certified PLA is sourced from NatureWorks LLC, a company based in Minnesota. PLA foam has suitable material properties including cut, leak and heat and shock resistance. TAG Packaging also provides customized foam packaging for Electronics and Cosmetic Packaging. [\[Source\]](#) and may prove a suitable packaging partner.*

# Which universities are making advances in this space?

## Sun Yat-sen University

Established 1924

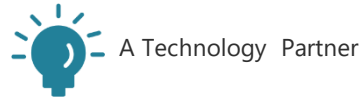
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### IP INNOVATION/TECH

This university, along with Jiangsu Southern Packaging Co Ltd., is researching on preparing a tailored composition of PLA that has excellent mechanical properties and easy to process They have filed this patent in China - CN106751625A in 2018.

### IDEAL AS



### Comment

*Jiangsu Southern Packaging Co Ltd., the partner of Sun Yat-sen university is one of the leading producers of rigid and flexible packaging products in China. **This signal indicates that the university can be a good partner for research work in China.***

## South China University

Established 1952

[Contact Link](#)



### IP INNOVATION/TECH

This university has researched on composition for biodegradable plastic using blend of Chitin and PLA – they filed a patent for it in 2018 – i.e. CN106221160A.

### IDEAL AS



### Comment

*Chitin is the second most abundant biopolymer on earth, and it can be easily obtained from the waste from the seafood industry – research indicates the huge possibility of using this resource [\[Source\]](#). **So, this PLA blend can be a cheap alternative as compared to others, and since the university is the sole proprietor, there is good chance that they might be willing to license this tech.***

# A bird's eye view of entities working in PLA innovations:

This slide gives an overview of the companies presented in this study. This show that for which purpose the associated companies can be approached.



## COSMETICS PACKAGING

Unitika

M&H Plastics

TAG Packaging



## PLA SUPPLIERS

Total S.A.

Vanjoin Hubei Industry Limited



## TECHNOLOGY PARTNERS

Sun Yat-sen University

South China University

CJ Cheil Jedang Corp

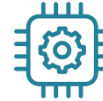
Carbiolice

Toray Industries Inc.

Dongyang P&S Co Ltd

Hefei Dahu Wire & Cable Technology Co Ltd

University Of Strathclyde



## ELECTRONICS PACKAGING

TAG Packaging



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