PLA and PBAT Biodegradable Plastic Compounds

We can provide technical consultancy services for producing bio-degradable and compostable compounds based on PBAT and PLA blended with thermoplastic corn starch (TPS), mineral fillers, processing and functional additives. These compounds are used for (a) extrusion blowing of film for producing carry bags, shopping bags, bags for fruits & vegetables, garbage bags, agricultural mulch films etc. (b) Extruded sheet for producing thermoformed products like plates, thalis, bowls, cups etc. and (c) Injection moulding compound for producing cutlery like fork, spoon, knife, toys, pens and other disposable consumer products.

PBAT or polybutylene adipate terephthalate is a biodegradable random co-polymer (a co-polyester of adipic acid, 1,4-butanediol and terephthalic acid from dimethyl terephthalate). Main advantage of PBAT is that it is a fully biodegradable alternative to LDPE, having similar properties including high flexibility and toughness, allowing it to be used for various packaging applications. Biobased content in the polymer can be as high as 50% if 1,4-butanediol (BDO) from renewable sources is used.

Basic production process

PBAT is synthesized from the polymer of 1,4-butanediol and adipic acid and the polymer of dimethyl terephthalate (DMT) with 1,4-butanediol. Adipic acid and 1,4-butanediol are polymerized to create their polyester (along with water). DMT and 1,4-butanediol are also reacted to form their polyester (along with methanol). This polyester is then added to the butylene adipic acid polyester by using tetrabutoxy titanium (TBOT) as a transesterification catalyst; an overabundance of 1,4-butanediol influences chain lengths. The result is a random co-polymer of the two previously prepared polymers.

Usage

PBAT is blended with thermoplastic corn starch to increase bio-based content, increase compostability and to reduce cost. PBAT is also compounded with mineral fillers to reduce cost. PBAT is also compounded with PLA to increase flexibility of the compound. Uses are single use carry bags, fruit and vegetable packaging, food packaging, agricultural mulch films, coating for paper cups and plates etc.

PLA or Polylactide (also known as Polylactic Acid, Lactic acid polymer) is a versatile commercial biodegradable thermoplastic based on lactic acid. Lactic acid monomers can be produced from 100% renewable resources, like sugarcane molasses, corn and sugar-beet starch etc. PLA is produced by formation of lactide monomer first and the formed lactide is then put through ring-opening- polymerization using metal alkoxides as catalysts resulting in high molecular weight polyester – PLA.

Most commercial L-PLA products are semi crystalline polymers with a high melting point ~180°C and having their glass transition temperature in the range of 55 – 60°C

- PLA is a high strength and high modulus thermoplastic with good appearance
- It has high stiffness and strength at room temperature
- Less energy is required in its production when compared to other plastics

However, there are some disadvantages associated with the polymer:

- Its glass transition temperature is low (Tg ~ 55°C)
- Its poor ductility, low impact strength and brittleness limits its ussage
- It has low crystallization rate and processing results mainly in amorphous products
- It is thermally unstable and has poor gas barrier performance
- It has low flexibility and requires long mold cycles
- It is relatively hydrophobic and slow degradation rate

Usage

PLA is blended with thermoplastic corn starch to increase bio-based content, increase compostability and to reduce cost. PLA is also compounded with mineral fillers to reduce cost. PBAT is also compounded with PLA to increase flexibility of the compound.

- PLA is compounded with PBAT and TPS to produce extrusion blown films for carry bags, fruit and vegetable packaging, food packaging, agricultural mulch films, coating for paper cups and plates etc.
- PLA is compounded with PBAT and / or mineral fillers to produce extruded sheets for thermoformed products like plates, thalis, bowls, cups, glasses etc.
- PLA is compounded with PBAT and / or mineral fillers to produce injection moulded products like cutlery (spoon, fork, knife), toys, single use disposable consumer products like (shaving stick, pens), blister packaging etc.

PBAT + TPS Compound

Thermoplastic Starch Compound

PLA + Thermoplastic Starch Compound

PBAT + PLA + TPS Compound

Polybutylene Succinate (PBS) is a biodegradable and compostable polyester, which is produced from succinic acid, 1,4-butanediol and a third monomer which is an organic di-acid. New biotechnological routes now allow the production of succinic acid based on renewable feedstocks, such as glucose, sucrose and biobased glycerol. The advantage of biobased succinic acid versus the conventional petrochemical route is a significant improvement of the material carbon footprint through the usage of renewable resources. New fermentation production routes now allow for a more cost-competitive production of succinic acid at larger scale. Due to these factors, the market for succinic acid is expected to grow substantially from 40,000 TPA in 2016 by over 10% CAGR over the coming years.

PBS is a crystalline polyester with a melting temperature exceeding 100°C, which is important for applications that require a high temperature range. PBS has a wide processing / temperature window. PBS grades of different melt flow index (MFI) are available that are suitable for extrusion, injection moulding, thermoforming, fiber spinning and film blowing. PBS processability can be further improved by several compounding strategies while maintaining properties regarding softness and brittleness.

Copolymers of PBS like PBST or Poly (butylene succinate - terephthalate) and PBSA or Poly (butylene succinate - adipate terephthalate) possess good biodegradability along with desirable physical properties. PBS is also blended with other biodegradable and / or bioplastics like PLA or PBAT to produce compounds. Apart from these, other created copolymers include the standard PBS monomers copolymerized with benzyl succinic acid, ethylene glycol, methyl succinic acid.

Unique selling points of PBS

- PBS shows excellent biodegradability, processability and balanced mechanical properties
- High flexibility and heat resistance
- A wide processing window, which makes the resin suitable for extrusion, injection moulding, thermoforming, fibre spinning and film blowing.
- PBS can also be readily compounded with other (bio)polymers to tune the performances of the material.

- PBS shows a good binding to natural fibres without any additional bonding agent
- Up to 100% biobased (when using bio-based succinic acid and bio-based 1,4-butanediol), enabling an improved material carbon footprint compared to alternatives based on fossil resources.
- Biodegradable under industrial conditions (EN13432)

Tamil Nadu to ban plastic coated paper cups from January 2019

Hindu Business Line – 26th July 2018

Tamil Nadu has decided to ban LDPE coated paper cups from January 2019. There are over 20 coating units and 500 cup manufacturers in Tamil Nadu only. The market size is estimated to be around 12,000 tons of cups per month in Tamil Nadu alone. The ban is expected to widen to other plastic coated and taken up by other progressive states. (This provides very good opportunity for a bio-degradable plastic like PLA, PBAT, PBS for coating on paper cups, disposable plates & cutlery drinking straws etc.)

As a first step we can prepare a Techno Economic Project Feasibility Report that will provide a realistic picture and help you to take an informed business decision, approach banks for project finance and government departments for statutory approvals. Typical contents of the project feasibility report are:

1.0 What are bio-degradable plastics, different types and end applications
2.0 PLA, PBAT & PBS plastics & their different types and usage
3.0 Other bio-degradable plastics – their advantages & disadvantages
4.0 Suggested production volume & project parameters
5.0 Production process & technology
5.1 Production flow diagram
5.2 Chemistry behind the production process
6.0 Main plant & machinery with basic specifications and indicative price
7.0 Utilities & Support facility with basic specifications and indicative price
8.0 Quality Control & Testing Lab with indicative prices
9.0 Estimated Project Cost
10.0 Manpower requirement & cost
11.0 Estimated Product Cost (raw material, additives, production, overheads)
12.0 Estimated Turnover, Profitability & Project Payback Period

13.0 Working Capital requirement
14.0 Factory area & building requirement
15.0 Product guiding specifications & test standards
15.1 Product pricing vis-à-vis commodity and other biodegradable plastics
15.2 Product characteristics vis-à-vis commodity and other biodegradable plastics
15.3 Key market segments and end applications
16.0 Market Scenario
16.1 Current global production & main players
16.2 Share of bio-degradable plastics in different end application sectors
16.3 Market potential and growth prospects of bioplastics
16.4 Key market segments – volume and growth prospects
17.0 Global process technology providers

One you decide to go ahead we can assist in selection and sourcing manufacturing know-how and develop pilot plant for proof of concept. Thereafter we can assist you to set-up full scale production plant – selection of plant & machinery, plant layout and design, selection of utilities and support equipment, commissioning of plant, sourcing of additives, quality control and testing systems, product technical qualification, target market segments, end application know-how, market intelligence etc.

Best regards,

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