CASE STUDY

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PBAT/STARCH(30/70)

PBAT/CaCo3 (60/40)

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Compounding Starch-based biomaterials for a sustainable world

In today's world, sustainability is the buzzword in every industry, especially those directly utilizing natural resources to serve the growing population's needs. While developing nations are still facing technology-related challenges to ensure that long-term initiatives relating to sustainability are successfully implemented, local innovation is emerging as key solutions. In the world of polymers, leading R&D companies are extensively exploring natural alternatives to plastics and have made significant progress. These alternatives have the potential to reduce our reliance on natural resources.

Biomaterials can help meet the rising expectations of the consumer markets, especially in populous countries and mature markets, and can be an effective alternative to non-degradable plastics. Bioplastics can be derived from multiple biomass sources. The primary source for Biopolymers is starch, a natural polymer, which can be assimilated into various petroleum-based polymers or biopolymers. These starch-based biopolymers can in turn be used in various materials and applications. Starch-based polymers are found to be cost-competitive compared to other biopolymers. Starch-based biopolymers exhibit various physical and mechanical properties, which are not found in other biopolymers. Impact strength and elongation at break are better in starch-based biopolymers. In addition, recycled biomaterials incorporate to starch.

The positive impact of using starch-based biomaterials is multifold - replace petroleum-based polymers with naturally occurring ones. Starch-based biopolymers are highly degradable, which means that they can be used alongside a compostable polymer without interfering with the degradation process. At STEER, creator of advanced materials platform technology that effectively transforms and functionalizes materials in the field of plastics, pharmaceuticals, food & nutraceuticals and biomaterials. we are constantly working towards evolving Starch-based biomaterials through innovative compounding methods using STEER Omega twin screw

extrusion.
Starch based biopolymers had several process-related challenges with standard bio-lobed technology with existing screw geometry, it is evident that shear-sensitive material like biopolymers cannot be processed effectively. The reasons can be many, prime among them being that peak shear rate results in degradation of biopolymers. In the process, the development of new materials is compromised. However, at STEER, we successfully overcame most of these challenges by adopting fractional geometry technology (FGT) in the extruder. The advantages are many – by controlling the peak shear, we can enable high output, lower melt temperature and high-speed operation.

We have worked with a wide set of materials, such as, carbohydrates (sugar, starch, cellulose), lignin, proteins & fats to develop biopolymers, such as, PBAT, PLA and Bio-polymers, which are environment-friendly in nature. We have overcome challenges relating to feeding (no choking of hopper), degradation (sensitive to temperature),

and foaming (sheer sensitive) by effectively balancing the starch component in PBAT (50%-80%) and PLA (20%-50%).
Consistent tests with Fractional geometry technology showed a higher concentration of starch with PBAT lead to higher mechanical properness and better miscibility in PBAT/Starch composite. The addition of wood powder to PBAT increased tensile strength and flexural modules. The addition of Lignin powder to PBAT increased the impact strength and flexural modules.

There is multiple bio-degradable starch-based applications in use today, such as containers, food packaging, compostable bags, starch foam, and colorants masterbatch. The opportunity for starch-based composting is immense considering that plastic consumption stands at 500 billion single-use plastic bags annually. The global thermoplastic starch market is expected to reach a value of 255.82 kilometric tons by 2025, at an estimated annual growth of 7% over 2020-2025.
The film segment is the major consumer of the thermoplastic starch market, with a share of more than 48%. The starch blended with the PLA segment holds more than 50% in the global Starch-based Bioplastics Films market. The Asia Pacific region is likely to dominate the thermoplastic starch market during the forecast period and witness the fastest growth.
The potential for use of biopolymers in South Korea is immense considering the amount of waste being generated. According to a report published by Korea Maritime Institute, every year, 200,000 tons of plastics are discharged into the ocean. The government in Korea is taking multiple initiatives to prevent plastics from entering the oceans and damaging the marine life.

However, the need of the hour is permanent fixes to end the use of harmful plastics by replacing them with bioplastics. Many countries across the world have banned the use of lightweight single-use plastic bags or have begun imposing taxes on them. Under the prevailing circumstances, it is imperative for the industry to move towards sustainable alternatives, such as bioplastics and STEER can help provide the technology support and intervention.