

**SMS is The 1st TPS
Producer in Thailand**



**Achieve the Sustainable
World with **TAPIOPLAST®**,
the Versatile Thermoplastic
Starch and Compounds**



TAPIOPLAST® is the 1st Tapioca-based TPS
in Thailand Certified by Din Certco.

Solve the Global Plastic Waste Pollution by **TAPIOPLAST®**

“The Less Petroleum Plastic Waste, the More Sustainable World”

The waste of petroleum-based single-use plastics inevitably becomes environmental problems of the world. Due to the extremely slow degradation of the plastics, their end-of-life through decomposition is more than 400 years. A significant portion of plastic waste has been improperly disposed, contaminated the environment and harm marine lives.

In 2019, the total number of global plastics was 368 million tons⁽¹⁾ and it is forecasted to rise to 800 million tons in 2050. Each year, 8 million tons of plastic waste enter the ocean. Pieces of plastic were found inside the internal organs of marine animals. The contamination of plastic into the ocean dangerously disturbs the ecosystem.⁽²⁾ Waste management by incineration emits greenhouse gases (GHG) especially carbon dioxide to the atmosphere, resulting in global warming.

⁽¹⁾ www.european-bioplastics.org

⁽²⁾ <https://www.smscor.com/ebook/trend/Bio-plastic-trend/>



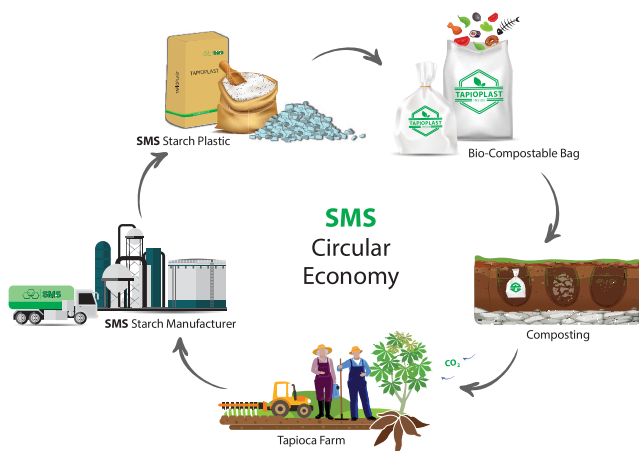


Therefore, the practice of Bio-Circular-Green Economy is the vital solution for sustainability. In this case, the replacements of petroleum-based with bio-based plastics promote the characteristics of “carbon neutral”⁽³⁾, leading to the reduction of carbon dioxide release.

TAPIOPLAST®TPS series, a versatile thermoplastic starch, is made from tapioca starch – a bio-based raw material from cassava trees. **TAPIOPLAST®TPS** promotes the use of biodegradable plastics by reducing their costs.

⁽³⁾ Biomass and Bioenergy 29 (2005) 331–335

TAPIOPLAST® Creates Circular Economy



Biodegradable plastics wastes are rapidly biodegraded when compared to traditional petroleum-based wastes. The products of the biodegradation are water and carbon dioxide. Plants naturally capture carbon dioxide through photosynthesis and produce carbohydrates which are the starting materials of biodegradable **TAPIOPLAST®**. The carbon atoms in **TAPIOPLAST®** are fully utilized in a closed loop of circular economy resulting in sustainability. There is no net carbon dioxide released into the atmosphere to negatively impact the environment like greenhouse gases. On the other hand, carbon atoms from crude oil are not utilized in circular because it takes millions of years for plastics to be degraded and eventually become crude oil again. Therefore, **TAPIOPLAST®** offers a direct path to the sustainable world.

TAPIOPLAST®TPS is Evaluated and Certified as a Compostable Material by International Standards

TAPIOPLAST®TPS is Thermoplastic Starch (TPS) derived from tapioca starch. TAPIOPLAST®TPS is easy to melt, process during heating, and compatible to other biodegradable and/or bio-based plastics.

TAPIOPLAST®TPS is engineered to lead the way to sustainability by providing fast biodegradation, bio-content, more affordable price than other biodegradable polymers. The fast biodegradation is stemmed from the fact that starch is a natural food source for living organisms. In the presence of oxygen and humidity, the microorganism growth is accelerated. As shown in Figures 1 and 2, TAPIOPLAST®TPS is completely biodegraded after 2 weeks and has a higher biodegradation rate than that of cellulose which is the prime natural reference.

To ensure that TAPIOPLAST®TPS is promptly applied as biodegradable materials, TAPIOPLAST®TPS has been evaluated according to EN 13432 and ISO 17088. TAPIOPLAST®TPS satisfies all the requirements for biodegradability, chemical composition, disintegration, and ecotoxicity. TAPIOPLAST®TPS is certified by DIN CERTCO with a compostable logo 'seedling' (registration no. 7W0435).



Bio-Content to Reduce GHG



Cost Benefit



Fast Biodegradation

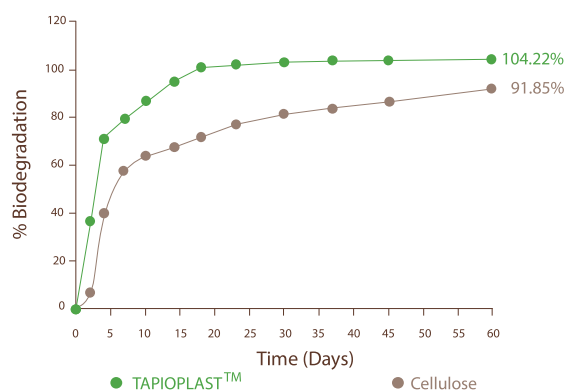


Figure 1. Biodegradation percentage of --- cellulose and --- TAPIOPLAST®TPS according to ISO 14855-1 for 60 days (the biodegradation percentage was calculated from the cumulative amounts of carbon dioxide evolved under the controlled composting conditions at 58 ± 2°C).

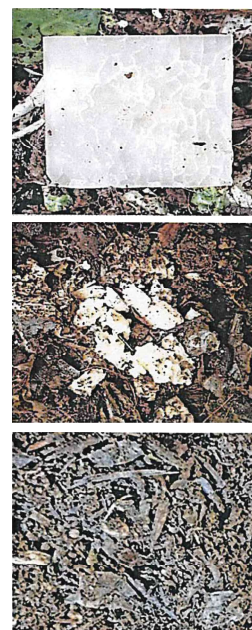


Figure 2. The appearance of TAPIOPLAST®TPS at (a) 0 day, (b) 7 days, and (c) 14 days, with the initial thickness of 3.39 mm (according to ISO 16929, disintegration test).

The Versatile Compatibility of TAPIOPLAST®TPS

Based on the unique TAPIOPLAST®TPS 's molecular features of hydrophobicity, plasticization and coupling abilities, it is versatile and compatible with polymer plastics (Figure 3) by applying heat and shear during processing.

The compatibility is a key factor to enhance the smoothness, maintain mechanical properties of compounded products, and keep constant processing. For example, TAPIOPLAST®TPS, polybutylene adipate-co-terephthalate (PBAT), and polylactic acid (PLA) were compounded and blown as film. The resulting thin film is suitable for single-use plastic bags with high modulus, good elongation, and satisfying strength which is comparable to benchmark biodegradable plastics (Table 1).

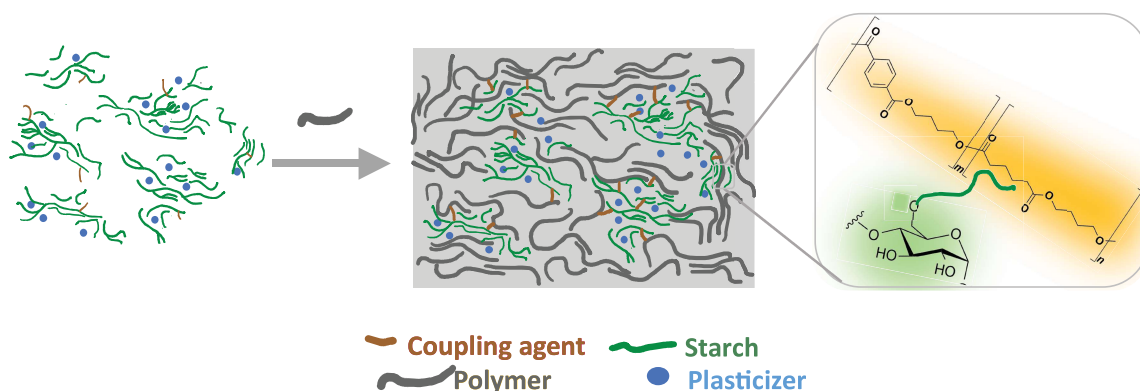


Figure 3. A schematic representation of compatibility between polymer and TAPIOPLAST®TPS, composed of starch, plasticizer, and coupling agent. This example shows the structure of PBAT as a polymer.

Resin Combination	Benchmark (PE)	Benchmark (Biodegradable Film)	TAPIOPLAST® TPS /PBAT/PLA
Thickness (µm)	30	50	35
Young's Modulus (MPa)	283	30	68
Tensile Strength (MPa)	24	15	15
Elongation at Break (%)	397	293	328

Table 1. Mechanical properties i.e., young's modulus, tensile strength, and elongation at break of films of PE benchmark at 30 µm, biodegradable benchmark at 50 µm, TAPIOPLAST® TPS compounded with PBAT and PLA at a ratio of 40:50:10 at 35 µm. The mechanical results were tested under ASTM D882.

TAPIOPLAST® Series with TAPIOPLAST® Inside



TPS

TAPIOPLAST®TPS
TAPIOPLAST®TPS 420
TAPIOPLAST®TPS FC



Starch Compound

TAPIOPLAST®CG41
TAPIOPLAST®CG41-D
TAPIOPLAST®CN44



Starch Plastic Film

Garbage bag
Shopping bag
Nursery bag
Packaging film



SMS offers a variety of thermoplastic starch for blending with other polymers. **TAPIOPLAST®TPS** and **TAPIOPLAST®TPS 420** provide smoothness with satisfying mechanical properties while producing higher throughput compared to the benchmark and could be dry blended. **TAPIOPLAST®TPS FC** is designed for food contact materials. The costs of the biodegradable plastic will be lowered while their biodegradability will be accelerated by blending with **TAPIOPLAST® TPS**.

Another series of **TAPIOPLAST** compound products are available to fulfill different needs of film-converter customers. **TAPIOPLAST®CG41** and **TAPIOPLAST® CG41-D** are for blown film extrusion into garbage bags, shopping bags, and packaging film. **TAPIOPLAST® CN44** is formulated for nursery bags. In addition, the finished film products made with **TAPIOPLAST® Inside** including garbage bags, shopping bags, nursery bags, and packaging films are available to end-users with a content of at least 30% **TAPIOPLAST® TPS**.





TAPIOPLAST® Inside for Industrial-Scale Blown Film Extrusion

TAPIOPLAST® Inside compounds were blown by a conventional blowing extruder under the processing temperatures of 165, 170, 175, 150, and 150 °C from feed zone to die zone. The resulting TAPIOPLAST® Inside garbage bags were evaluated for their mechanical strengths. As shown in Table 2, the tensile strength, the elongation at break, and especially the seal strength of the TAPIOPLAST® Inside garbage bags are higher than those of the standard set by Thai Industrial Standards.



Films	Thickness	Tensile strength (MPa)		Elongation at break (%)		Seal strength (Bottom) (N)
	mm	MD	TD	MD	TD	
Thai Industrial Standard (June 2019)	0.03	≥11.8	≥11.8	≥150	≥150	4.7
TAPIOPLAST® Inside Garbage Bag, Size 18x20 inches	0.03	18	16	155	227	19

Table 2. Tensile strength, elongation at break, seal strength of film controlled by Thai Industrial Standard and TAPIOPLAST® inside garbage bag.

“Let’s Move Toward
the Sustainable World
with
TAPIOPLAST® Innovations”



About SMS

The global leader of Non-GMO TAPIOCA STARCH AND MODIFIED TAPIOCA STARCHES from THAILAND is internationally certified with BRC, FSSC 22000, FDA, HACCP, ISO, HALAL, KOSHER.



Clean Label



Specialty



Thickening



Texturizing

SMS CORPORATION



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