

Thermoplastic Starch

Dr.S.S.M.Abdul Majeed

Professor & Head

Department of Polymer Engineering

*B.S.Abdur Rahman Institute
of Science and Technology*

Plasticizers

- Glycerol
- Pentaerythritol
- Polyols
- Poly(oxyethylene)
- Poly(oxypropylene)
- Non-ionic and anionic surfactants

Starch-Based Polymers

- Thermoplastic starch (TPS)
- Starchsynthetic aliphatic polyester blends
- StarchPBS/PBSA polyester blends
- StarchPVOH blends.



Thermoplastic Starch

- It has thermoplastic-like processability with temperature and shear
- Structures are more complex than those of synthetic thermoplastics
- TPS is similar to other polymers with linear and branched structures, molar mass, glass transition temperature, crystallinity, and melting temperature.
- In the presence of a plasticizer such as water, glycerin, sorbitol high temperatures and shearing, it melts and fluidizes

Thermoplastic Starch...

- By combining shear, temperature, and plasticization during extrusion, TPS melts similar to synthetic thermoplastic material
- Possibility of injection, extrusion, and blowing moulding
- By blending with other polymers, fillers, and fibers, properties of TPS can be dramatically improved

Polymers used with TPS

- Cellulose
- Zein (a protein from corn)
- Natural rubber
- Polyvinyl alcohol (PVA)
- Acrylate copolymers
- Polyethylene and ethylene copolymers
- Polyesters
- Polyurethanes
- Poly(lactic acid)
- Poly(ϵ -caprolactone)

Starch Synthetic Aliphatic Polyester Blends

- Approximately 50% of synthetic polyester is replaced with natural polymers, such as starch
- Polyesters are also modified by incorporating different functional groups such as hydroxyl, amine, and carbonyl groups.
- When starch is blended with degradable polyesters such as PCL, the resulting blend is fully biodegradable
- Typically, up to 45% of starch is blended with degradable PCL

Starch-based synthetic aliphatic polyester blends

- Starch PBS/PBSA polyester blends (polybutylene succinate adipate)
- Starch PVOH blends
- Starch by itself has poor mechanical properties.
- PBS and PBSA polyester blends are mixed with starch to improve material mechanical properties.
- A small amount of compatibilizer is added to impart phase stability to the starch-based polyester blends.
- Typically, 5% by weight of compatibilizer is sufficient to provide stability to starch-based blends.

StarchPVOH Blends

- Blending starch with biodegradable polyester results in phase separation and poor interfacial properties.
- Because PVOH degrades at high temperature when processed by melt processing, starch PVOH blend uses solution casting to produce films.
- Plasticizers like water and polyols are used to decrease the melting temperature of PVOH and increase the flexibility and workability of starch and PVOH.