# Sustainable Biopolymers for Thermoforming

Compounds: PHACT™ CA1670P, CA1680P and CA1690P

## Target Applications

**Markets**
- Food & Beverage
- Food Serviceware

**End Products**
- Rigid packaging (food)
- Food trays/Cold cups/Lids

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PHACT

## PLA/PHA COMPOUNDS

**PHACT™ CA1670P, PHACT™ CA1680P, and PHACT™ CA1690P** are environmentally friendly semi-crystalline biopolymer compounds that improve functional performance and enable faster composting relative to polylactic acid (PLA). These grades are compounded resins based on PLA and amorphous PHA (aPHA) known as PHACT™ A1000P. The addition of aPHA to PLA increases flexibility and impact strength limiting breakage during production and distribution. These blends can also improve productivity during the thermoforming process. These compounds can reduce the thickness of final products by 12-15%, compared to PLA, resulting in cost savings. PHACT™ CA1670P is an opaque grade with low-temperature stability; the final products of this grade can be delivered and stored at low temperatures. PHACT™ CA1680P is suitable for semi-transparent applications. PHACT™ CA1690P is more transparent, and the aPHA content portion is lower than other compound grades. CA1690P grade is beneficial for cost reduction and ideal for food trays and stationery.

## PHACT™ CA1670P & CA1680P & CA1690P Features

- 100% bio content
- Industrial compostable
- High stability during distribution and storage
- FDA-approved for food contact(1)
- Relative to PLA:
  - Increased flexibility and impact strength
  - Improved processability and productivity; Reduction of the total input material

1) US FDA FCN2281, Korea FDA authorized substances (hydroxybutyl polyester (HBP), polylactic acid (PLA))



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## Mechanical Properties

| Compound Grades for Thermoforming | | | | | |
|---|---|---|---|---|---|
| **Properties** | **Units** | **ASTM** | **CA1670P** | **CA1680P** | **CA1690P** |
| Forms | - | - | Pellet | Pellet | Pellet |
| Specific Gravity | - | D792 | 1.26 | 1.23 | 1.23 |
| Hardness (Max /15s) | Shore D | D2240 | 76 / 73 | 81 / 79 | 90 / 88 |
| Tensile Strength at Peak(1) | MPa | D638 | 44 | 57 | 62 |
| Elongation at Break(1) | % | D638 | 70 | 25 | 11 |
| Flexural Strength | MPa | D790 | 28 | - | - |
| IZOD Impact Strength (Unnotched, RT) | $kJ/m^2$ | D256 | Non-Break | 29 | 24 |
| IZOD Impact Strength (Unnotched, -20°C) | $kJ/m^2$ | D256 | 45 | - | - |
| Heat Deflection Temperature / 0.455 MPa | ℃ | D648 | 50 | 53 | 56 |
| Melting Point(2) | ℃ | D3418 | 150 | 150 | 150 |
| Glass Transition Temperature(2) | ℃ | D3418 | -17, 57 | -15, 57 | -15, 57 |
| Melt Flow Rate (190°C, 2.16 kg) | g/10 min | D1238 | 5 ~ 8 | 4 ~ 5 | 4 ~ 5 |
| Mold Shrinkage(3) | % | - | 0.3 | 0.3 | 0.3 |

1) Injection specimens conform to ASTM D638. Crosshead speed 50 mm/min for tensile strength.
2) Differential Scanning Calorimeter (DSC), the peak of endotherm. Heating rate 10 ℃/min.
3) Injection mold temperature was 25 ℃.

## Recommended Processing Conditions

| Compound Grades for Sheet Extrusion | | | |
|---|---|---|---|
| Feed Zone | 20 ~ 40 ℃ | Nozzle | 165 ~ 190 ℃ |
| Melt Zone | 165 ~ 175 ℃ | Roll Temperature | 25 ~ 55 ℃ |
| Mixing & Conveying | 175 ~ 185 ℃ | Stored Temperature of Sheet | < 40 ℃ |

*Notes: The extrusion temperature condition should be mild (165 ~ 175 ℃) for reducing degradation and yellowing of the product.

| Compound Grades for Thermoforming | | | |
|---|---|---|---|
| Sheet Thickness | 0.45 mm | Heat Vent Time | 2.0 sec |
| Mold Temperature | 30 ~ 40 ℃ | Forming & Vent Time | 1.5, 2.0 sec |
| Heater Platen Temperature | 100 ℃ | Eject Delay and Eject Time | 0.2, 0.2 sec |

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## Drying Process Conditions

- Biodegradable materials are highly hygroscopic. Store in a dry condition.
- Recommended to use all once opened. If an opened bag must be stored for reuse, seal completely, avoid air exposal, and store at a dry, well-ventilated condition/place/location. Avoid long-term storing.
- PHACT Compounds must be dried under 60 ℃ for over 5 hrs. or caking can happen because the Tg of this compound is around 60 ℃.
- PHACT Compounds are preferable to dry with air below -40 ℃ dew point.
- When exposed to moisture, completely dry in a dehumidifying dryer before use.

## Purging Process Conditions (*Following PET, PA, HDPE)

It is critical to clean the material handling systems of PET, nylon, and high molecular weight HDPE to assure that these materials do not inadvertently feed into the extruder during or after the purging process.

1) Purge with low MFR (e.g., <1) transition resin at normal PET operating temperatures. PET and PHACT are temperature incompatible, so the transition resin is one that can be processed at the high temperatures of PET and the low temperatures of PHACT.
   Suggested transition resins include PP, crystal PS, and PETG. Purge for at least 7x average residence time, much of the time at the typical PET production rate (~30 minutes).
2) Let the system empty as much as possible. Clean out the hopper as much as possible.
3) Introduce higher melt flow transition resin (PP, PS, PETG) and change to normal PHACT operating temperatures.
4) Let the system empty as much as possible. Then transition to pure PLA resin or PHACT and purge, again, for a minimum 7x average residence time. Change the screen pack when it becomes obvious that primarily PLA (or PHACT) is exiting the die.
5) At the completion of run, purge all PHACT from the extrusion system, using low melt index PP or PS.

*Notes: It is critical that all drying and conveying/receiving systems be free of all PET and vacuumed to ensure there is no remaining polymer dust before adding PHACT. PET will not melt at PHACT operating temperatures and will block screens if it is present in the system.

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For additional information or specific recommendations for your intended applications, please contact us at:

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