# Starch bioplastic recipes

**Starch is a white, tasteless, and odorless carbohydrate that is found in large amounts in plants, e.g. grains, potatoes, and corn, where it serves as the chief energy storage form. Starch is insoluble in cold water and is used in foods and industry for thickening, stiffening, and energy production. TIP: You can easily extract your own starch from potatoes, cassave or rice. See e.g. *this recipe*.**

## Material properties:

- *Water resistance:* Starch bioplastics tend to absorb moisture easily and have high water vapor permeability; their hydrophilic nature limits their performance in wet conditions unless additives or treatments are used.
- *Heat resistance:* Pure starch bioplastics can withstand moderate temperatures but generally exhibit poor heat resistance compared to conventional plastics; performance can be improved with mineral fillers such as clay or chalk, but they often deform or degrade at temperatures above 65C.

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## RECIPE #1: Flexible Corn Starch Foil

*This recipe works best when cast in very thin foils. the foil will shrink and condense in size as well as thickness, but it will be strong and durable. This recipe yields appr. 250 ml of material to be cast.*
Image credit: Tiare Ribeaux.


- Corn starch 30 gr
- White vinegar 60 gr
- Glycerine 50 gr
- Water 400 ml
- Two drops of essential oil

1. Prepare your casting surface or frame and measure out ingredients, and if you want the fillers and pigments. If you use natural dye, substitute part of the water amount with the dye.
2. Mix the main ingredients together until it is a homogenous mix. Feel free to try out different ratios - less starch makes the solution less thick and less glycerol makes it less flexible.
3. Optional: Add pigment or fillers in this phase, later the mixture may be too thick to distribute evenly.
4. Cook over medium heat and stir well for 10 minutes or longer - continue to heat even after solution is sirupy or viscous to dissipate more water and avoid shrinkage. After 10 minutes, or when large bubbles start appearing, bring it down to low heat. The mixture should be semi-transparent and paste-like by now.
5. Remove from heat for 30-60 seconds and get ready to spoon out almost immediately
6. Spoon a thin layer of mixture into a frame to create a thin, even surface, or cast and spread on a larger flat surface to create a spread out film. The thicker the layer, the more the starch bioplastic is prone to crack, so create as thin of a layer as possible - a silicone baking sheet gives the best, most even results. If your mixture is very thick, you can flatten it between folded parchment paper or silicone sheet, by pressing it with a heavy book or roller.

Drying / curing:
Let the material dry in a ventilated and dry room. If you used a frame, cut the edge of the starch bioplastic loose after 24 hours, to prevent it from breaking in the middle. If you have a thicker layer and you need it to be flat, consider pressing and drying every few hours alternatively. Let the material sit and let dry for at least three days, remove from the surface when it is no longer cold to

the touch.

## RECIPE #2: Walnut Potato Starch Composite

*!! One or two days before getting started with this recipe, you need to prepare the walnut shells. Wash them with water and dry them for two days in the open air, or one day in the food dehydrator at the lab. Then crush in an electric grinder and sieve according to the size of grains you want. In this example, grains are larger than 0.3 mm.*
*Image credit: Materiom.*

- Potato starch 15 gr
- walnut shells 250 gr
- Vinegar 7,5 ml
- Glycerine 7,5 ml
- Water 60 ml

1. Prepare your casting surface or frame and measure out ingredients, and if you want the fillers and pigments. If you use natural dye, substitute part of the water amount with the dye.
2. Mix the main ingredients together until it is a homogenous mix. Feel free to try out different ratios - less starch makes the solution less thick and less glycerol makes it less flexible.
3. Optional: Add pigment or fillers in this phase, later the mixture may be too thick to distribute evenly.
4. Cook over medium heat and stir well for 10 minutes or longer - continue to heat even after solution is sirupy or viscous to dissipate more water and avoid shrinkage. After 10 minutes, or when large bubbles start appearing, bring it down to low heat. The mixture

should be semi-transparent and paste-like by now.
5. Add the walnut shells to the mixture. Spoon the mixture in a mold, wait for it to dry to unmold, then put it in a dehydrator for 8 hours at 40 degrees Celsius.

TIP: You can use many other fillers aside from walnut, such as sawdust, cork particles or clay powder.

## RECIPE #3: Starch and Gelatine-based Rubber

*A rubbery bioplastic based on gelatin and potato starch. It's strong but flexible and is less stiff than the gelatine-based biosilicone for example. It has a sour smell from the vinegar, which slowly fades but does not disappear completely.*
*Image credit: Loes Bogers.*

- Potato starch 50 gr
- Gelatine powder 50 gr
- White vinegar 15 gr
- Glycerine 100 gr
- Water 100 ml + a bit

1. Add gelatine and glycerine to boiling water. Keep temp above 80 degrees, and stir very gently with a spoon until it is dissolved.
2. Dissolve the starch with vinigar in a separate bowl using a few tablespoons of hot water.
3. Only when the gelatine is completely dissolved, add the starch mixture and stir for another 5-10 mins at 80 degrees until you have a thick but somewhat liquid paste.

4. Use a spatula to smear the paste on the surface or in the mold.
5. Unmold after 24-48 hours and alternately dry and press to keep flat (if that is wanted).

## *Sources*

*Lab Pastoe https://labpastoe.gitbook.io/lab-pastoe*

*Loes Bogers: https://class.textile-academy.org/2020/loes.bogers/projects/outcomes/24_core_recipes/*

*Anastasia Pistofidou: https://issuu.com/nat_arc/docs/bioplastic_cook_book_3/s/159731*

*Materiom: https://materiom.org*

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