# How long does PLA last in water?

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**Abstract.** PLA showed no mass or strength loss after a year in 25 °C water in two lab studies. At 50 °C, PLA coupons lost all tensile strength within 57 days.

**Keywords:** pla, watertight, waterproofing

**Table 1.** The number

| Water | Sample | What happened | Time |
|---|---|---|---|
| 25 °C, fresh and sea water | Pressed PLA film, 0.32 mm thick | No mass loss | 1 year |
| 25 °C and 37 °C | Coupons cut from PLA packaging | No change in tensile strength or molecular weight | 1 year |
| 37 °C, phosphate-buffered saline | 3D-printed PLLA fibers, 0.1 mm, amorphous | Molecular weight halved in about 75 days; tensile strength fell from 46.5 to 7.7 MPa with no significant mass loss | 180 days |
| 50 °C, 70 percent humid air | 3D-printed PLA test bars | Tensile strength down 33 percent, to 20.9 MPa | 1344 h (56 days) |
| 50 °C, sterile compost or soil extract | Coupons cut from PLA packaging | All tensile strength gone | 54 to 57 days |
| 50 °C, phosphate-buffered saline | 3D-printed PLLA fibers, 0.1 mm | Molecular weight halved in about 15 days; white within 30 days; broken apart by day 100 | 100 days |
| 80 °C, phosphate-buffered saline | 3D-printed PLLA fibers, 0.1 mm | Molecular weight down over 95 percent in 24 h; 62 percent of the mass gone | 22 days |

## 1 How long does PLA last in water?

In cold or room-temperature water, PLA (polylactic acid) lasts at least a year without measurable damage: two lab studies at 25 °C found no mass loss and no strength loss after 12 months. Warm water cuts that to weeks. At 50 °C, PLA coupons in sterile compost extract lost all their tensile strength within 57 days.

### 1.1 The number

The film row comes from Bagheri and colleagues (Global Challenges, 2017) and the packaging-coupon rows from Karamanlioglu and Robson (Polymer Degradation and Stability, 2013). The fiber rows are from Malone, Best and Cameron (Frontiers in Bioengineering and Biotechnology, 2024). The humid-air row is from Bergaliyeva and colleagues (Polymers, 2022). None of them tested a full-size print sitting in plain water, so read each row for its sample.

The two 37 °C results disagree. Packaging coupons showed no change in a year, while 0.1 mm printed fibers of pure PLLA (poly-L-lactic acid, NatureWorks 2500HP) in buffered saline lost most of their strength in six months. A thin, amorphous fiber is a worst case. Still, body-warm water is where the evidence stops saying “no change”.

### 1.2 What happens to PLA in water

PLA does not dissolve. Prusa Research’s watertight tests found that in certain conditions it can swell and wick water. Damage then comes in stages:

1. **Water soaks in.** Malone’s printed PLLA, held 3 days in 37 °C fluid, had its glass transition (the point where it starts to soften) drop from 61.5 to 54.5 °C while wet. It recovered once dried.
2. **The chains break.** Water splits PLA’s ester bonds (hydrolysis). NatureWorks, the maker of Ingeo PLA, describes the same reaction in a compost pile: moisture and heat split the chains into smaller polymers and finally lactic acid. The rate depends on temperature, humidity and time.
3. **The part turns brittle.** Molecular weight falls first, and the part looks unchanged. At 37 °C Malone’s fibers stayed clear and intact for 180 days, yet turned brittle.
4. **It loses mass.** Material washes out only once molecular weight falls below about 20,000 g/mol. At 50 °C, Malone’s fibers turned white within 30 days but barely changed in mass for 50; by day 70 they had lost 4.2 percent.

So a PLA part can look fine and still snap. Weight and appearance are late signs.

### 1.3 Why temperature sets the clock

Hydrolysis speeds up with heat. In Karamanlioglu and Robson’s sterile-water runs, molecular weight and tensile strength held at 25 and 37 °C, started falling at 45 °C and fell fastest at 55 °C. The fiber rows in the table show the same climb: each step up in temperature cuts the time to half molecular weight.

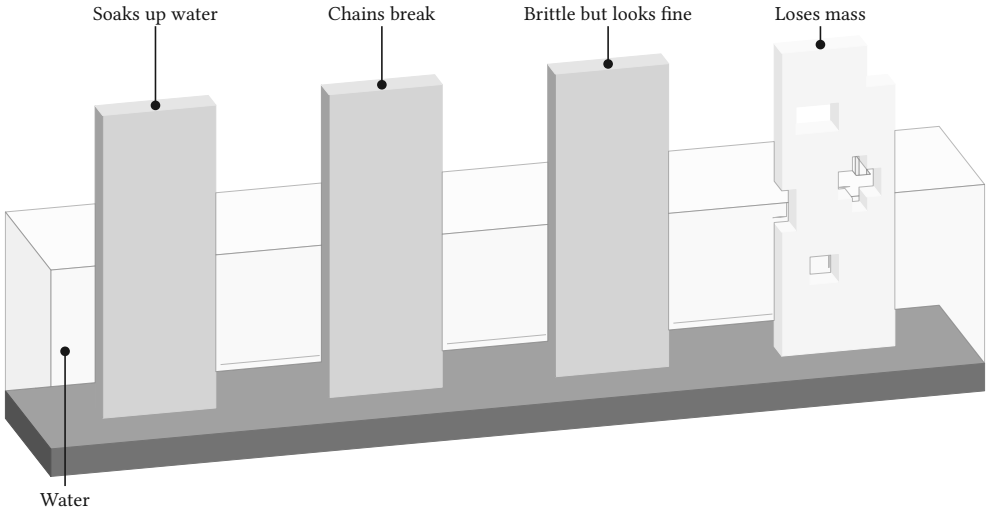



**Figure 1.** The strength goes first while the part still looks the same, so whitening and weight loss are late signs.

Softening caps it. The Prusa Knowledge Base says PLA gets soft and deforms above 60 °C, and step 1 above shows water lowers that point further. Hot tap water and the dishwasher are out. The limits are on PLA water containers.

### 1.4 Can PLA be used in water?

Yes, in cold water. Prusa's PLA flower pots showed no leaks over the company's long test period, and the room-temperature studies above found no change in a year. Typical uses:

- **Planters, vases and drip trays:** print 4 perimeters (Prusa's minimum for PLA) and test before use. The settings are on how many walls make a print watertight.
- **Aquarium decor:** an unheated tank matches the room-temperature rows; a heated one moves PLA toward the warmer rows. Material and coating questions are on aquarium-safe prints.
- **Outdoor water features:** a poor fit. The Prusa Knowledge Base says PLA degrades under UV light. PETG (glycol-modified PET) and ASA (acrylonitrile styrene acrylate) are compared on the waterproof filament page.

Keep PLA out of warm or hot water, and off load-bearing jobs that stay wet above room temperature.

### 1.5 How to check it on your own print

1. Print a thin spare strip in the same filament and settings as the part.
2. Put the strip in the same water as the part.
3. Bend the strip by hand whenever you check the part. Fresh PLA flexes before it breaks; degraded PLA snaps with little bend.
4. Check the part itself for whitening, the first visible change in the 50 °C fibers, and for cracks.
5. Replace the part when the strip snaps, or as soon as it whitens, cracks or leaks at a seam.

For a part that holds water, rerun the leak test after any change you see.

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