# Optimizing the Crosslinking Process of Citric Acid-based Polyesters

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The development of bio-based polymers is regarded as a crucial step towards a more sustainable chemical industry by reducing the environmental challenges that come along with traditional petroleum-based plastics. Among a variety of bio-based alternatives, polyesters derived from citric acid, stand out as particularly promising. Citric acid can be industrially produced through fermentation of molasses or corn starch, both of which are renewable resources that reduce the dependence on fossil fuels. These citric acid-based polyesters offer significant advantages over traditional materials, including enhanced recyclability and biodegradability.

Crosslinking of functional polyester precondensates forms a three-dimensional polymer network, which improves mechanical properties and thermal stability. Traditional options such as crosslinking via unsaturated building blocks negatively affect biodegradability by forming very stable C-C bonds. Using the additional carboxylic acid group of citric acid for crosslinking instead provides a network exclusively based on ester bonds which are cleaved during (bio)degradation.  Our research aims to optimize this cross-linking process for sustainable polyesters using a variety of different crosslinking agents. By systematically varying reaction parameters such as temperature, reaction time, and oven setup, we obtained materials with different properties and tackled challenges arising during upscaling  of the batch process.

Analytical methods, such as Gel Permeation Chromatography (GPC), are used to monitor the reaction progress in the early stages of crosslinking, before obtaining insoluble networks (Fig. 1c). Furthermore, Differential Scanning Calorimetry (DSC) and Infrared Spectroscopy (IR) are employed to obtain a deeper knowledge of the crosslinking reaction. Since citric acid-based polyesters are suitable for various biomedical applications [1], investigating additional parameters such as the gel content, porosity and degradability is essential.


**Figure 1: a) Monomers used for polyester synthesis. b) Products of crosslinking condition screenings. c) GPC allows good comparison of polyester crosslinking conditions before obtaining insoluble networks.**

**Keywords:** polyester, crosslinking, bio-based

## References

[1] Salihu, R.; Abd Razak, S. I.; Zawawi, N. A.; Abdul Kadir, M. R.; Ismail, N. I.; Jusoh, N.; Mohamad, M. R.; Mat Nayan, N. H. Citric Acid: A Green Cross-Linker of Biomaterials for Biomedical Applications. Eur. Polym. J. **2021**, 146, 110271.