Isosorbide dimethacrylate synthesis' study: Production and application of a high T_g crosslinker

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8th - 9th Mar

List of contents

Isosorbide dimethacrylate introduction

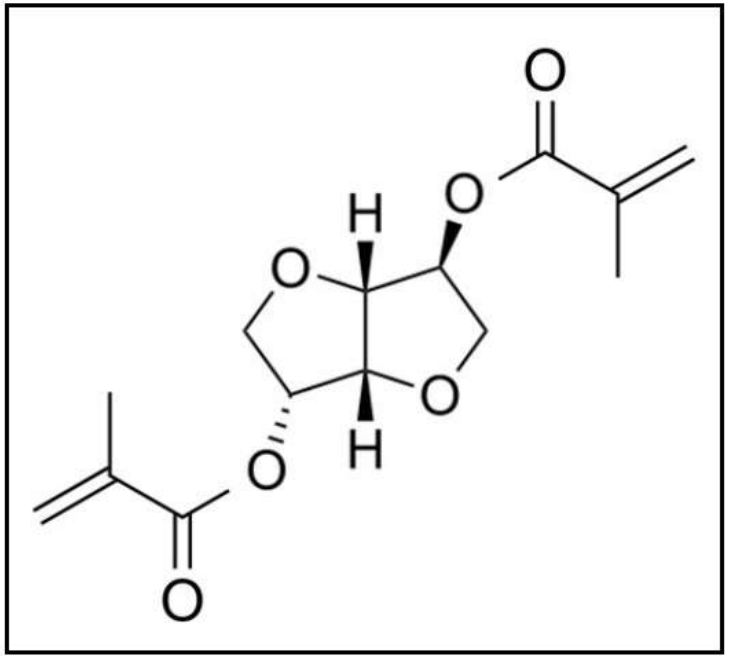
Synthesis study and **measured properties**

Summarization of **potential applications**

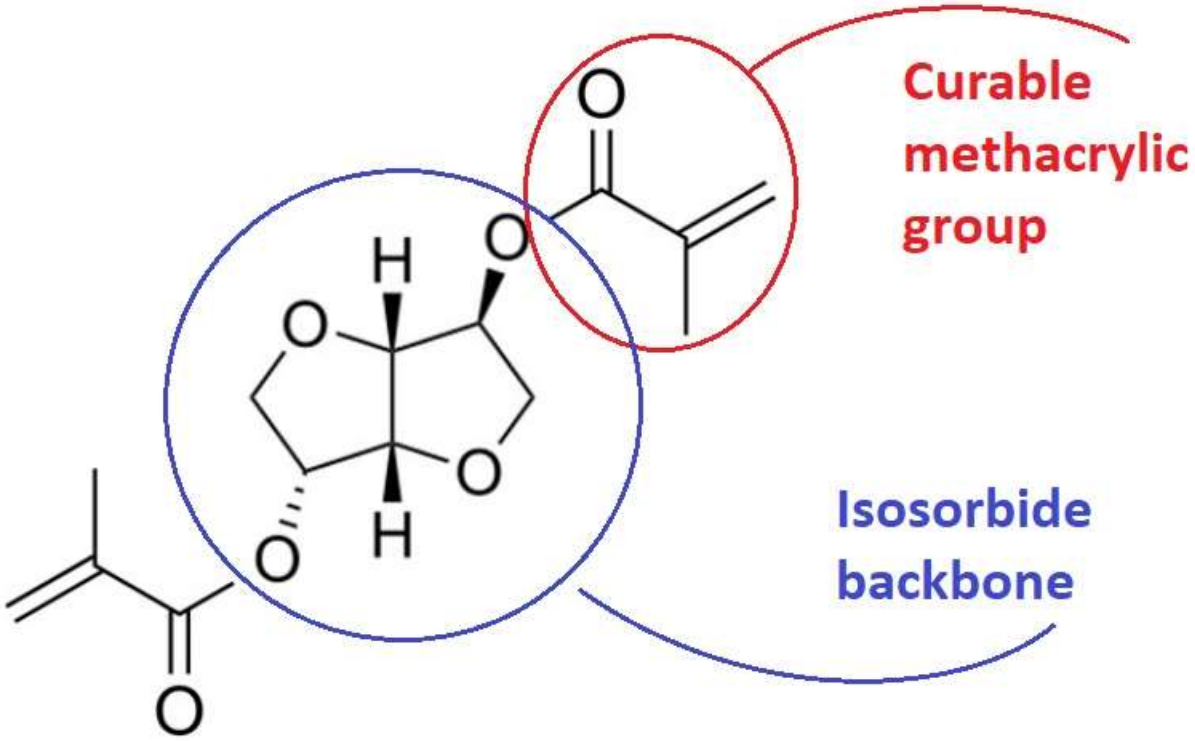
Isosorbide dimethacrylate introduction

Isosorbide dimethacrylate (ISDMMA)

- **Bio-based backbone** obtainable from **cellulose or sorbitol**
- **Hydroxyl groups** modified by **methacrylate's**
- Exceptional **high glass transition temperature**



Isosorbide dimethacrylate (ISDMMA)



- **Acylation** (acylhalides anhydride)
- **Esterification** (carb. acid)

- Cellulose depolymeration/ **reduction**
- Sorbitol **dehydration**

Synthesis study and **measured data**

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Synthesis study and **measured data**

Published article

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A Study of Isosorbide Synthesis from Sorbitol for Material Applications Using Isosorbide Dimethacrylate for Enhancement of Bio-Based Resins

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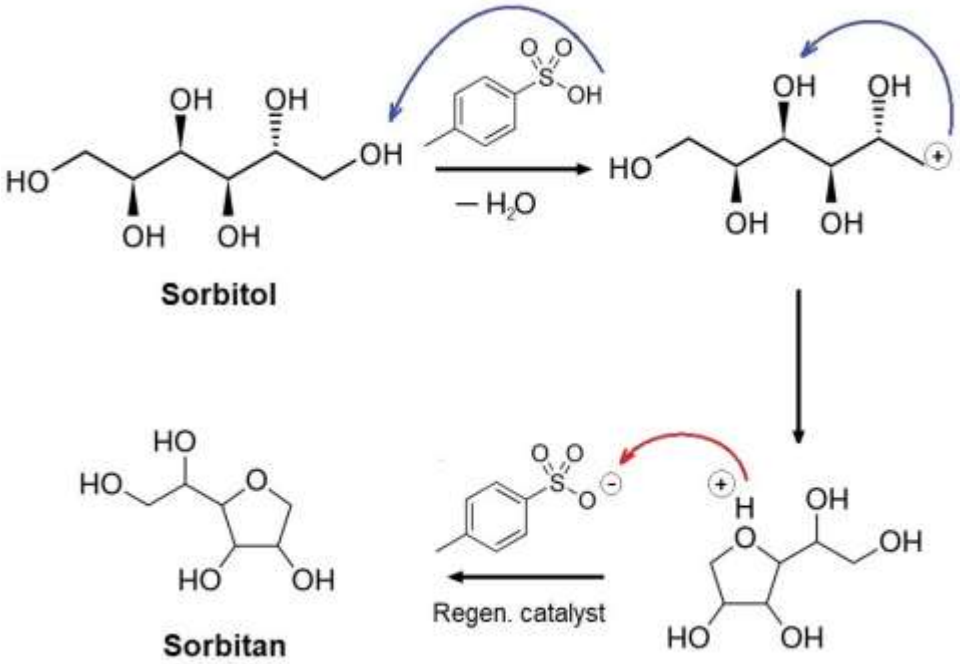
Isosorbide synthesis study

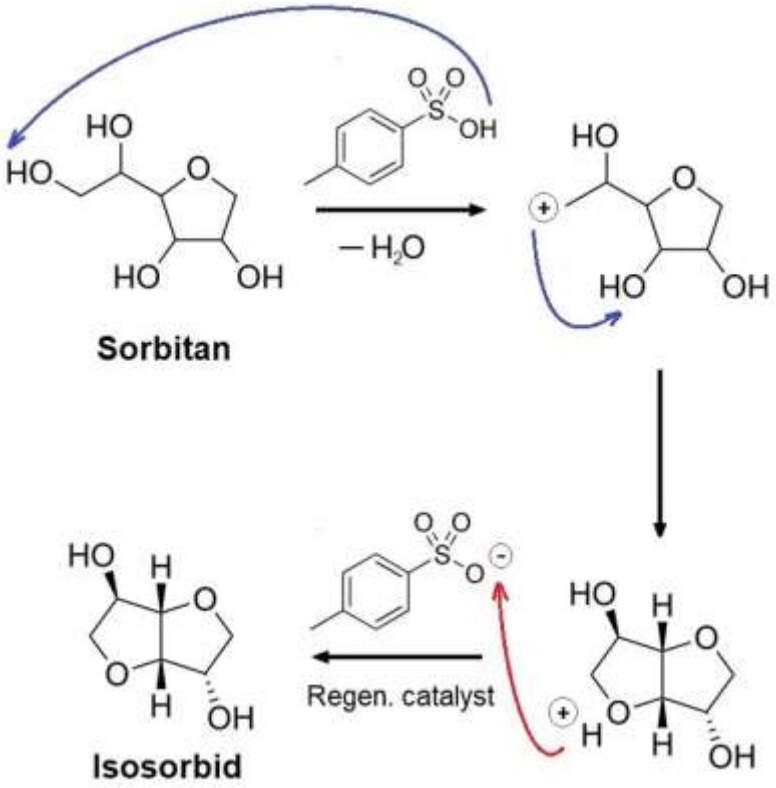
Synthesis from **sorbitol**

First step of the synthesis: **sorbitan formation**



Synthesis study and **measured data**

Isosorbide synthesis study

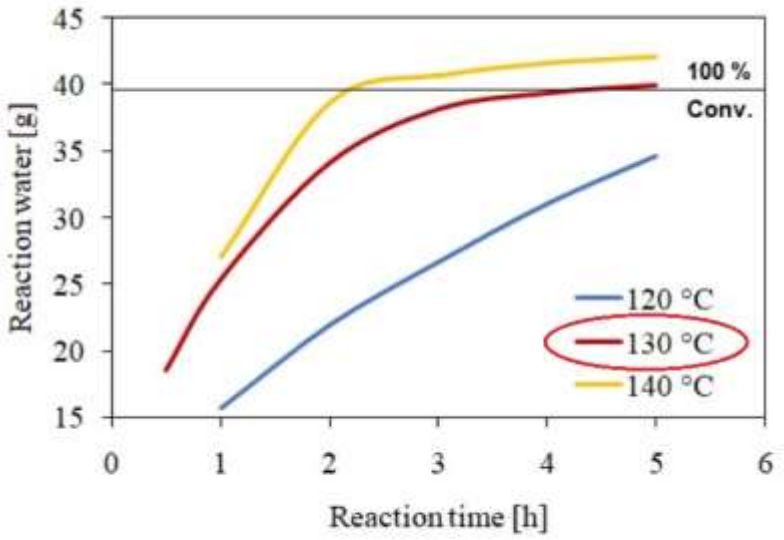


Additional dehydration of **sorbitan**

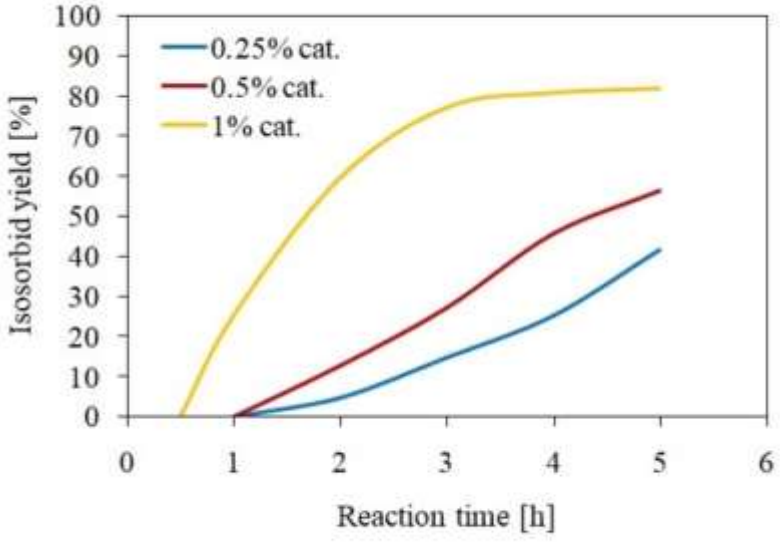
Eventual product **Isosorbide** separated via **distillation**

Synthesis study and **measured data**

Isosorbide synthesis study



(a)



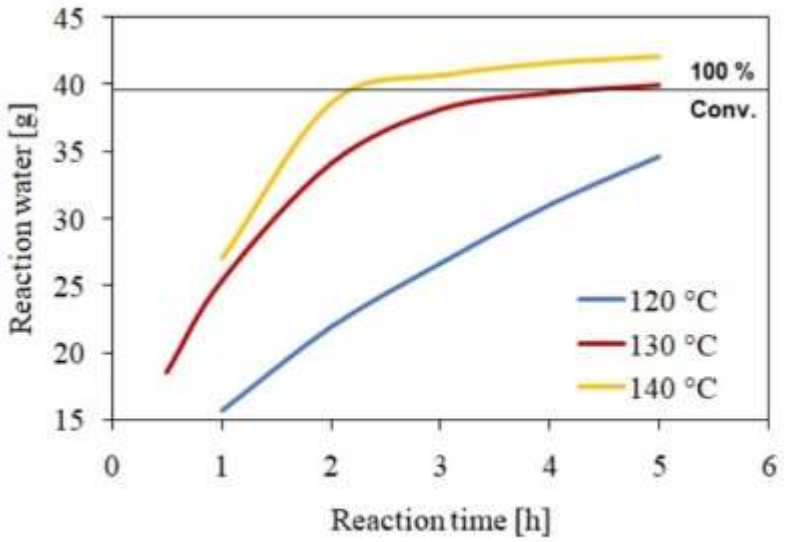
(b)

Optimal reaction **temperature: 130 °C**

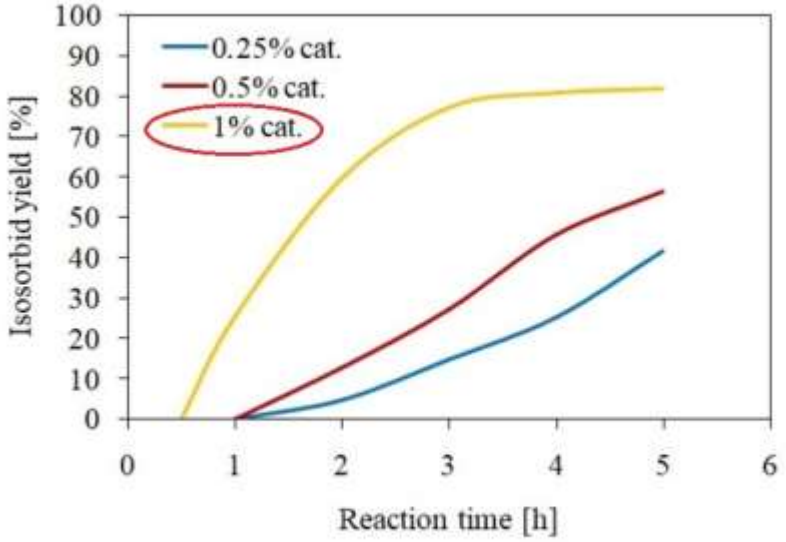
UHPLC-ESI-MS analysis

Synthesis study and **measured data**

Isosorbide synthesis study



(a)

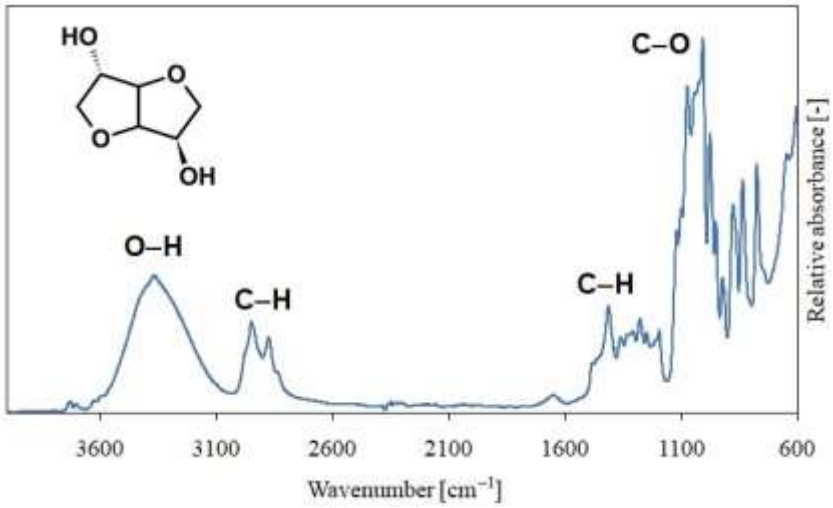


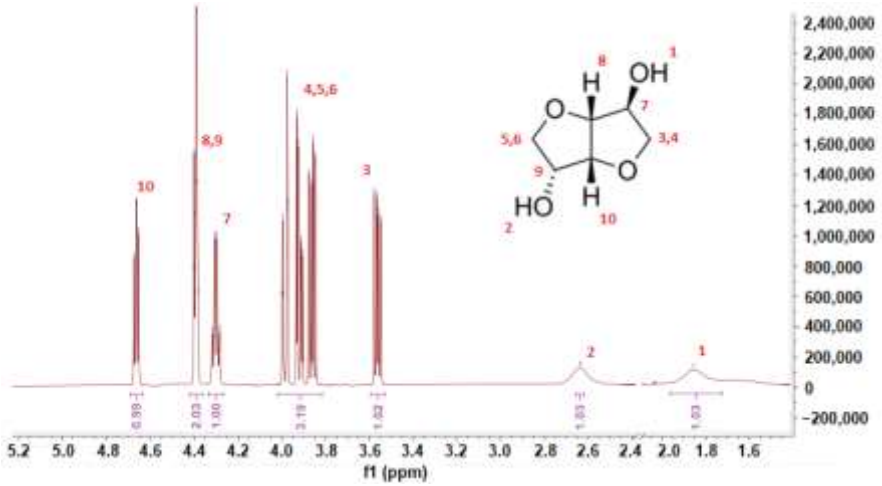
(b)

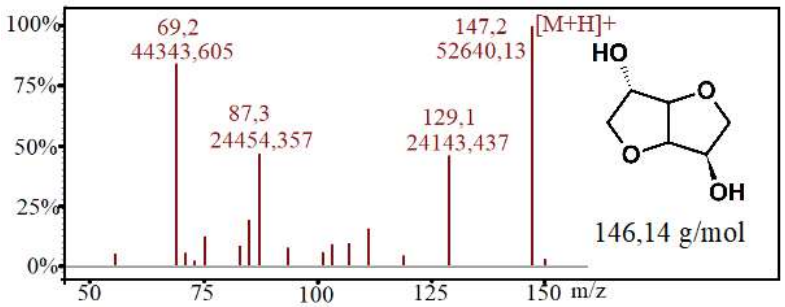
Optimal catalyst concentration**: 130 °C**

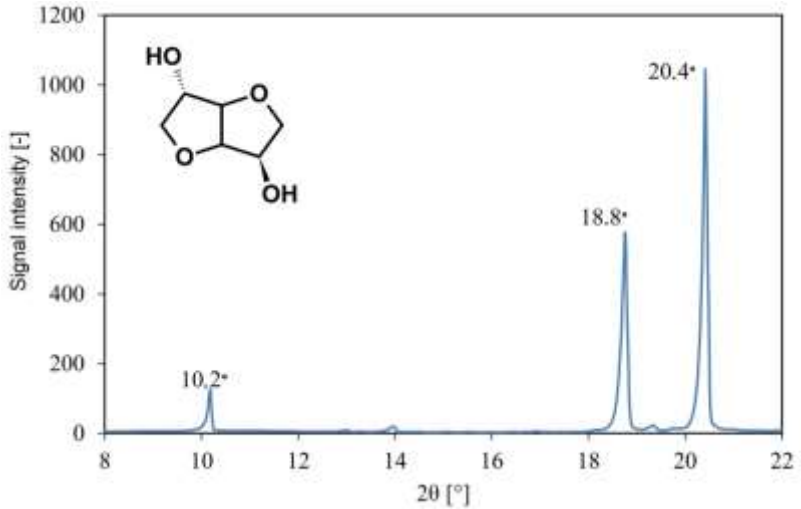
Complete **yield** of product**: 81.9%**

Isosorbide structure verification





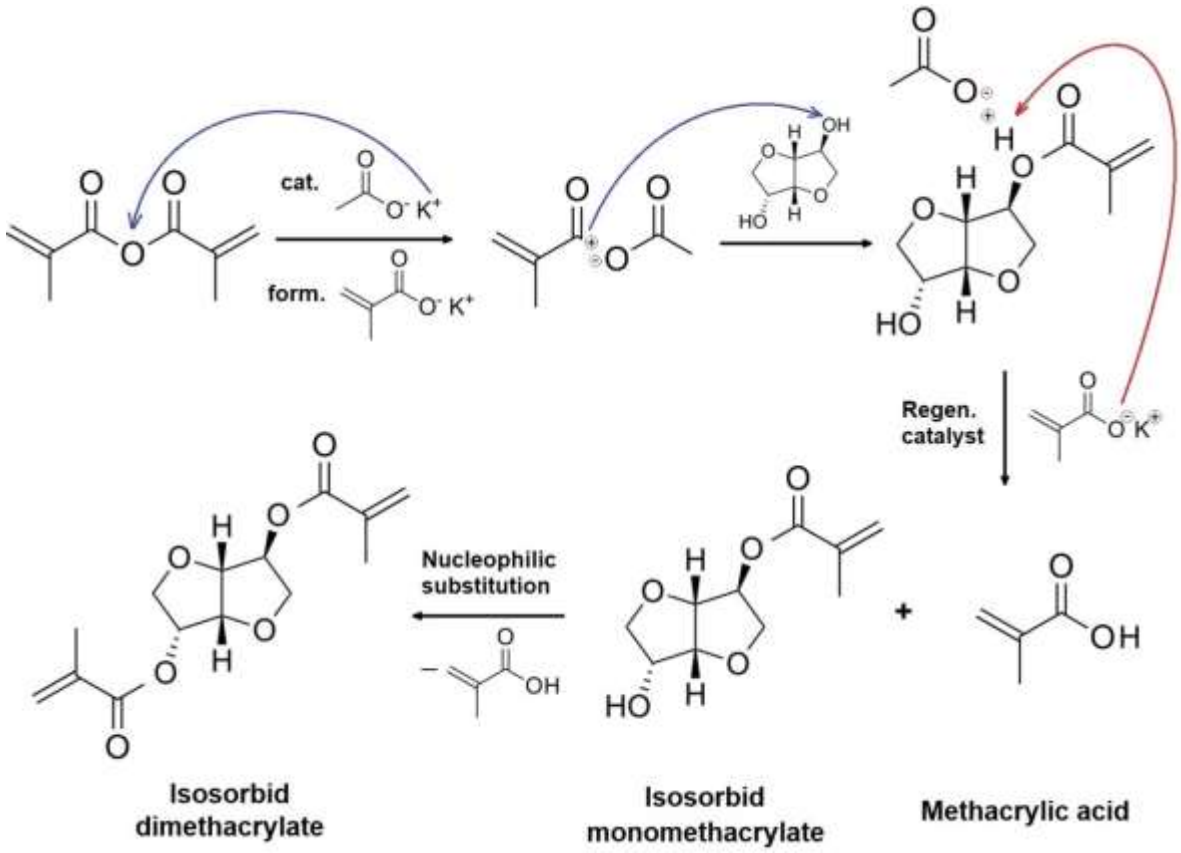




Isosorbide dimethacrylate synthesis study

Acylation with **anhydride**

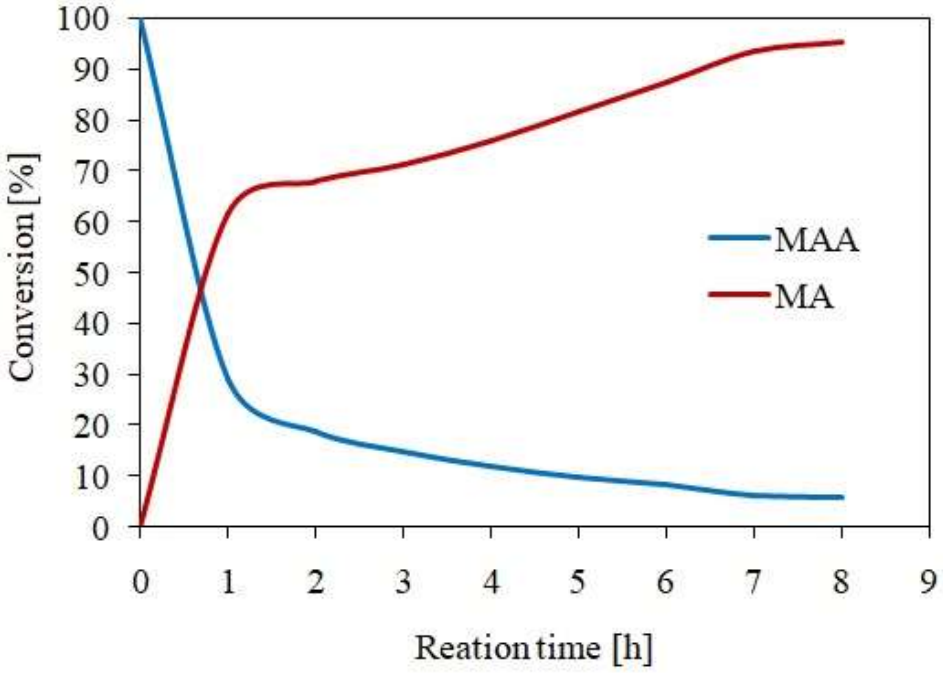
Methacrylic acid **neutralized or distilled**



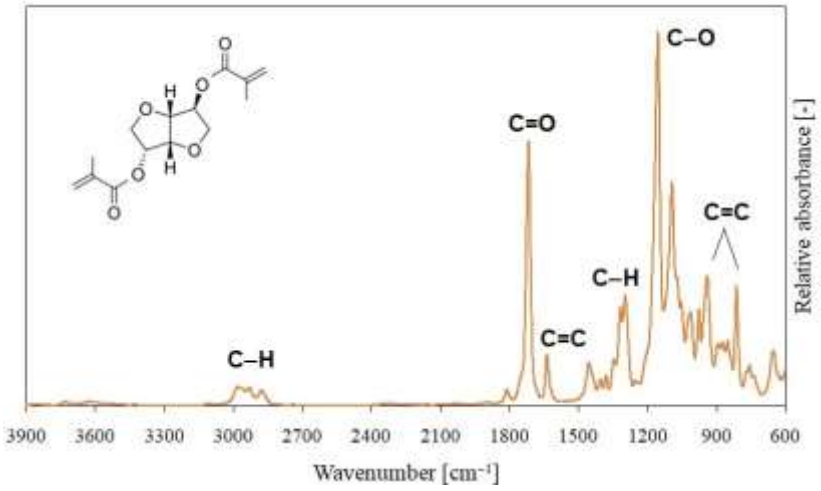
Synthesis study and measured data

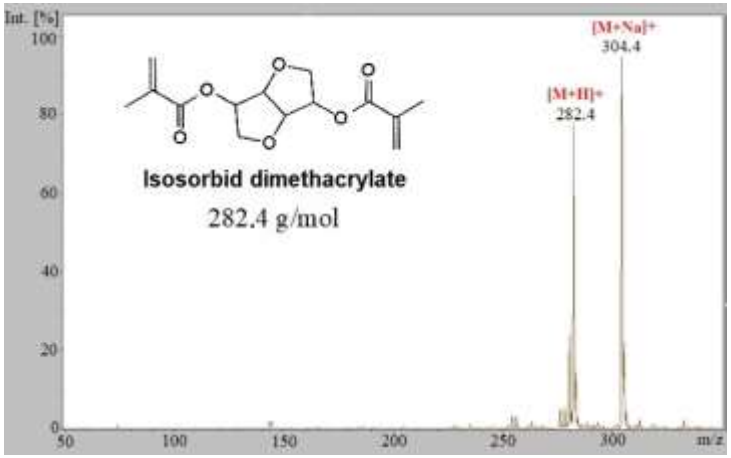
Isosorbide dimethacrylate synthesis study

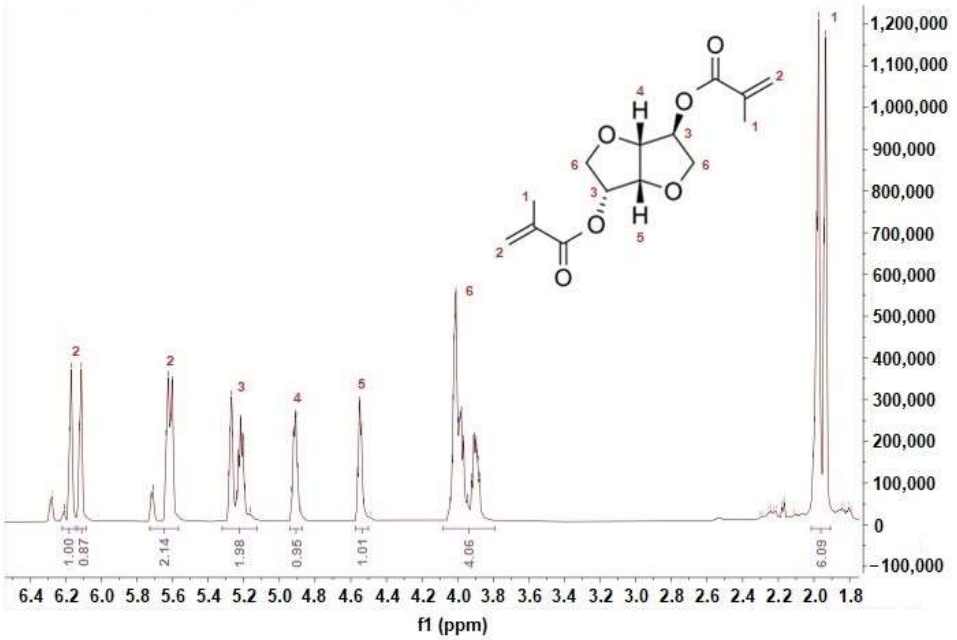
- **GC-FID** analysis
- **Anhydride decrease** connected to **acid increase**
- **ISDMMA yield** of **71%** after purification



Isosorbide dimethacrylate verification







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Summarization of **potential applications**

Enhancement of 3D printing resins

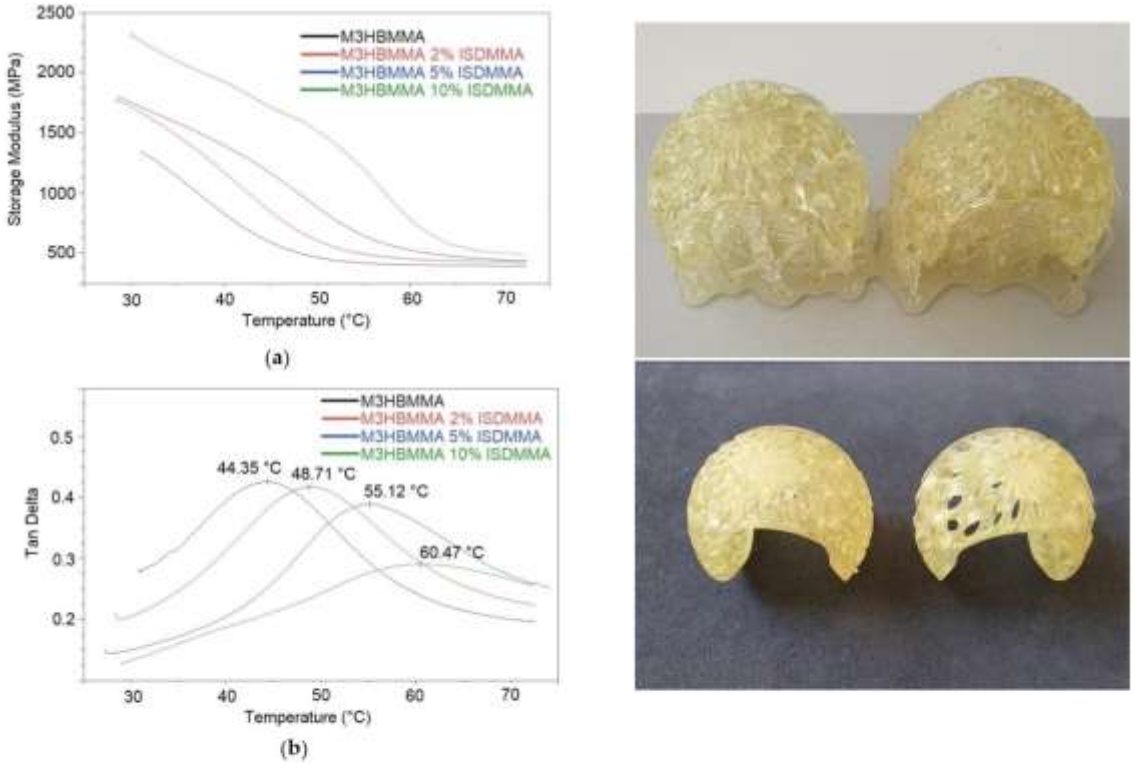
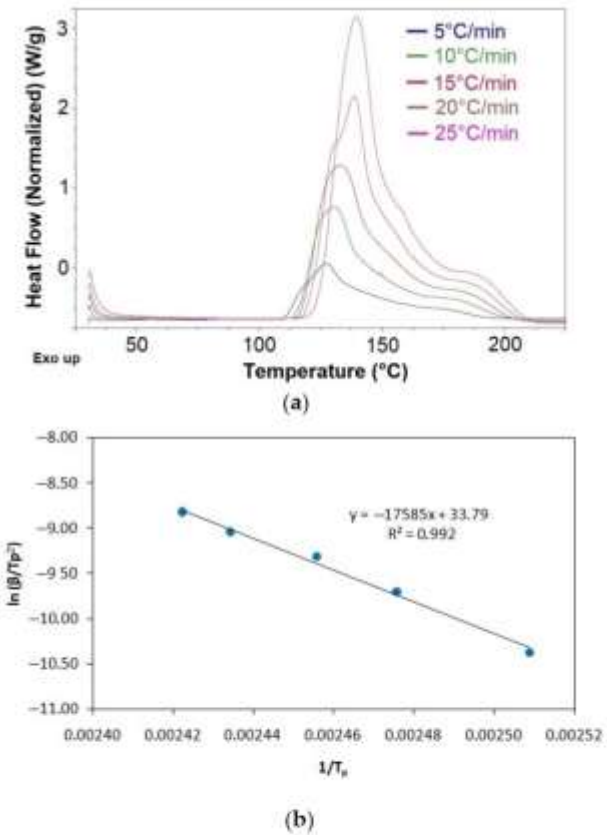


Figure 13. (a) DMA storage modulus curves of enhanced methacrylated methyl 3-hydroxybutyrate (M3HBMMA) resins; (b) DMA damping factor curves of enhanced M3HBMMA resins.

Pultrusion bio-based resin



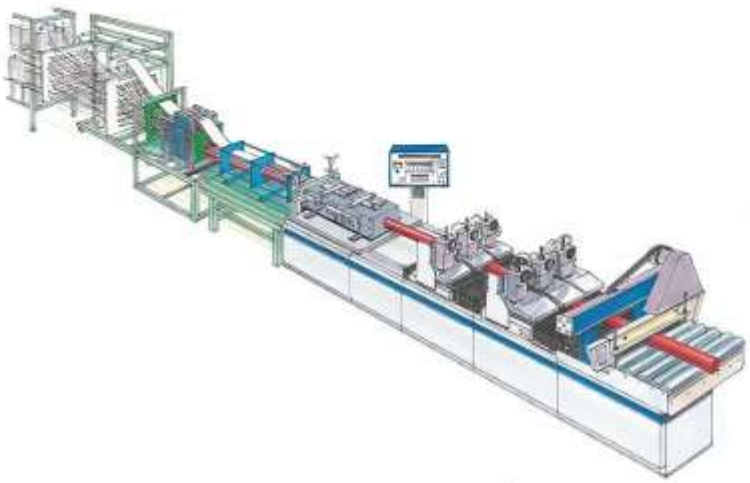
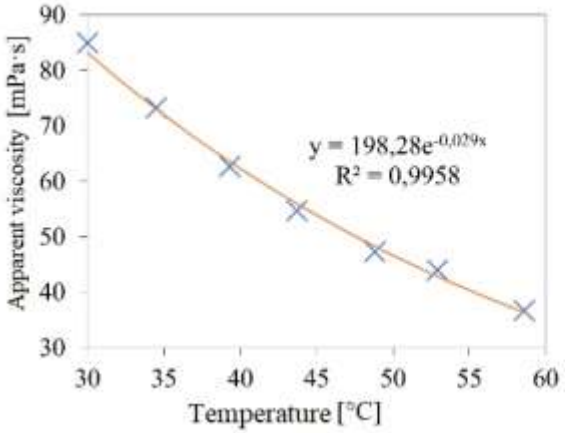
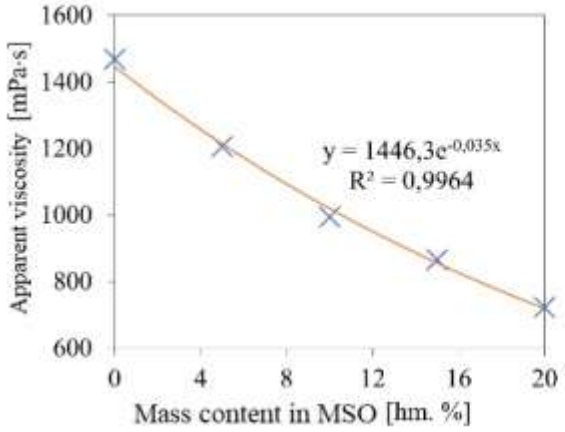


Figure 10. (a) DSC graphs comparing the exothermic polymerization enthalpy release of isosorbide dimethacrylate at different heating ramps; (b) graphical representation of Kissinger's theory of cured isosorbide dimethacrylate.

Viscosity modification





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