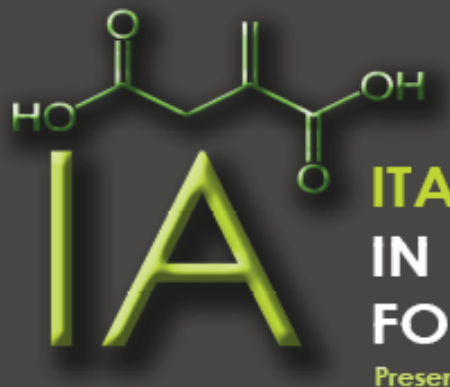

ITACONIC ACID IN UNSATURATED POLYESTERS FOR WOOD COATINGS

Presenting:
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Itaconic acid (IA) was investigated as a substitute for common unsaturated building blocks in polyesterification to yield binders for wood coatings with high renewable carbon content.

We identified synthetic strategies compatible with current industrial production processes and with other components

BACKGROUND

Unsaturated polyesters have been used for a long time in **redox and UV wood coatings.**
Bio-based raw material content in their formulation must be increased to improve environmental sustainability.

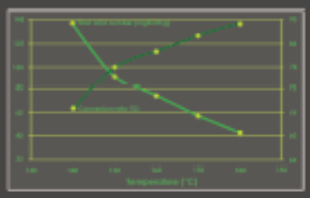
Unfortunately, whereas bio-based saturated glycols, acids and anhydrides are readily available, bio-based unsaturated building blocks for esterification are not.

We focused on IA,
currently the only bio-sourced unsaturated bicarboxylic acid available at industrially-suitable quantity and price

SAFE MODE

Branching, leading to the early gelation observed in polyesters containing large amounts of IA, might be due to thermally-induced radical reactions on the IA double bond, or to addition of water at high T onto that double bond (Ordelt reaction) making it tri-functional for esterification.

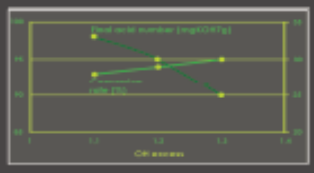
In order to define safe esterification conditions, IA was combined only with diethylene glycol (OH/COOH R=1.3) **and toluene as reflux solvent.**
Conversion rates and final acidity are shown as f(reaction T) at constant reaction time: **up to T=180°C no gelation was observed.**



BEYOND SAFE MODE

A few samples gelled overnight at RT, suggesting that **side reactions are not due to the Ordelt reaction,** only possible at high T. To confirm water formed during reaction was not to blame, the **higher T syntheses were repeated without solvent reflux,** with the same results.

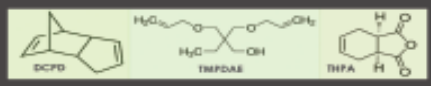
Moreover, **it was possible to push the reaction to higher conversion rates** by stripping with nitrogen. To get closer to normal industrial processes, OH/COOH ratio was lowered to R=1.1. **Once again, no gelation occurred.**



Conversion rate decreased, but stayed always consistent with stoichiometry.

REAL RESINS

The same synthetic conditions were applied to current resins, replacing maleic anhydride or fumaric acid with IA.



Thus, **compatibility between IA and different kinds of unsaturations,** such as in dicyclopentadiene, tetrahydrophthalic anhydride and trimetilolpropane diallylether, **could be confirmed.**

CONCLUSIONS

The use of IA proved to be less problematic than expected. Equivalents of current resins were prepared, obtaining similar viscosity, reactivity, molecular weight and stability.
^{14}C content was very high, up to 75%.
The performance of these resins in coating is still under investigation, but preliminary results are promising, especially in UV coatings.

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