

Article

Prediction of Residual Curing Capacity of Melamine-Formaldehyde Resins at an Early Stage of Synthesis by In-Line FTIR Spectroscopy

Regina Seidl ^{1,2}, Stephanie Weiss ^{1,2}, Rudolf W. Kessler ³, Waltraud Kessler ³, Edith M. Zikulnig-Rusch ¹ and Andreas Kandelbauer ^{2,4,5,*} 

- ¹ Kompetenzzentrum Holz GmbH, Altenberger Straße 69, 4040 Linz, Austria; c/o WDC, Klagenfurter Straße 87–89, 9300 St. Veit an der Glan, Austria; r.seidl@wood-kplus.at (R.S.); s.weiss@wood-kplus.at (S.W.); e.zikulnig-rusch@wood-kplus.at (E.M.Z.-R.)
 - ² Department of Material Science and Process Engineering, Institute of Wood Technology and Renewable Materials, BOKU–University of Natural Resources and Life Sciences, Konrad Lorenz Strasse 24, 3430 Tulln, Austria
 - ³ Kessler ProData GmbH, 72762 Reutlingen, Germany; rudolf.kessler@reutlingen-university.de (R.W.K.); waltraud.kessler@reutlingen-university.de (W.K.)
 - ⁴ Center for Process Analysis & Technology (PA&T), School of Applied Chemistry, Reutlingen University, Alteburgstrasse 150, 72762 Reutlingen, Germany
 - ⁵ Reutlingen Research Institute (RRI), Reutlingen University, Alteburgstrasse 150, 72762 Reutlingen, Germany
- * Correspondence: andreas.kandelbauer@reutlingen-university.de or andreas.kandelbauer@boku.ac.at; Tel.: +49-7121-271-2009



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Abstract: Melamine-formaldehyde (MF) resins are widely used as surface finishes for engineered wood-based panels in decorative laminates. Since no additional glue is applied in lamination, the overall residual curing capacity of MF resins is of great technological importance. Residual curing capacity is measured by differential scanning calorimetry (DSC) as the exothermic curing enthalpy is integral to the liquid resin. After resin synthesis is completed, the resulting pre-polymer has a defined chemical structure with a corresponding residual curing capacity. Predicting the residual curing capacity of a resin batch already at an early stage during synthesis would enable corrective measures to be taken by making adjustments in the reaction conditions. Thereby, discarding faulty batches could be avoided. Here, by using a batch modelling approach, it is demonstrated how quantitative predictions of MF residual curing capacity can be derived from inline Fourier Transform infrared (FTIR) spectra recorded during resin synthesis using partial least squares regression. Not only is there a strong correlation ($R^2 = 0.89$) between the infrared spectra measured at the end of MF resin synthesis and the residual curing capacity, but also the inline reaction spectra obtained already at the point of complete dissolution of melamine upon methylation during the initial stage of resin synthesis are also well suited for predicting final curing performance of the resin and a valid regression model ($R^2 = 0.85$) can be established using information obtained at a very early stage of MF resin synthesis.

Keywords: melamine formaldehyde (MF); inline spectroscopy; process analytics; batch modelling; decorative laminates

1. Introduction

Melamine-formaldehyde (MF) resins have been widely used in the wood-processing industry as glues, binders and coatings for many decades due to their outstanding properties [1]. Exceptional resistance against hydrolysis and chemicals as well as remarkable mechanical properties such as high scratch and abrasion resistance make MF resins indispensable for most engineered wood products [2–5].

Since the 1950s, much research has been conducted to understand melamine-formaldehyde resins and to develop MF resins for special applications. The fundamentals are already well

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first star and three new restaurants received a second star

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web jan 25 2021 find the entire selection of restaurants of the michelin guide great britain and ireland 2021 on these platforms the michelin guide great britain ireland 2021 at a glance 7 restaurants awarded 1 of which 2 are new 20 restaurants awarded 2 of which 3 are new 158 restaurants awarded 3 of which 17 are new

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web mar 27 2023 today the michelin guide announced its 2023 awards for great britain and ireland returning to its pre pandemic format of an in person ceremony also streamed online

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web oct 31 2023 the michelin guide and streetsmart the michelin guide and charity streetsmart are once again partnering to help raise funds to tackle homelessness across the uk streetsmart s 2023 campaign kicks off on wednesday 1st november

marking 25 years of the charity's vital work and we want to encourage as many people as possible

the full list of michelin star restaurants in the great britain - Apr 02 2023

web feb 16 2022 on february 16th the prestigious michelin stars were unveiled for this year's michelin great britain ireland guide what follows is a list of every michelin star restaurant in the guide both new and retained 8 restaurants awarded three michelin stars of which 1 is new 22 restaurants awarded two michelin stars of

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celebrating 47 years of the michelin great britain ireland guide - Oct 08 2023

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