

# A combined numerical-experimental approach to characterize delamination in polymer coated steel

**Citation for published version (APA):**

Bosch, van den, M. J., Schreurs, P. J. G., & Geers, M. G. D. (2005). *A combined numerical-experimental approach to characterize delamination in polymer coated steel*. Poster session presented at Mate Poster Award 2005 : 10th Annual Poster Contest.

**Document status and date:**

Published: 01/01/2005

**Document Version:**

Publisher's PDF, also known as Version of Record (includes final page, issue and volume numbers)

**Please check the document version of this publication:**

- A submitted manuscript is the version of the article upon submission and before peer-review. There can be important differences between the submitted version and the official published version of record. People interested in the research are advised to contact the author for the final version of the publication, or visit the DOI to the publisher's website.
- The final author version and the galley proof are versions of the publication after peer review.
- The final published version features the final layout of the paper including the volume, issue and page numbers.

[Link to publication](#)

**General rights**

Copyright and moral rights for the publications made accessible in the public portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

- Users may download and print one copy of any publication from the public portal for the purpose of private study or research.
- You may not further distribute the material or use it for any profit-making activity or commercial gain
- You may freely distribute the URL identifying the publication in the public portal.

If the publication is distributed under the terms of Article 25fa of the Dutch Copyright Act, indicated by the "Taverne" license above, please follow below link for the End User Agreement:

[www.tue.nl/taverne](http://www.tue.nl/taverne)

**Take down policy**

If you believe that this document breaches copyright please contact us at:

[openaccess@tue.nl](mailto:openaccess@tue.nl)

providing details and we will investigate your claim.

# A combined numerical-experimental approach to characterize delamination in polymer coated steel

M.J. van den Bosch, P.J.G. Schreurs, M.G.D. Geers

Netherlands Institute for Metals Research  
Eindhoven University of Technology, Department of Mechanical Engineering

## Introduction

Polymer coated metal sheet is developed by Corus to reduce production costs of e.g. aerosol and food cans.



Figure 1 Examples of applications for polymer coated metal sheets.

During forming processes the coated sheets may be damaged, as shown in figure 2:

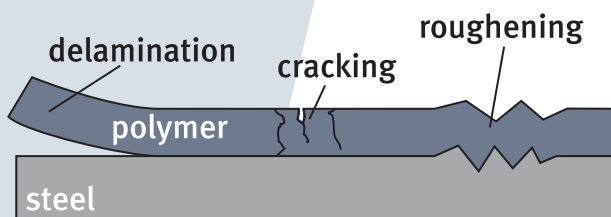


Figure 2 Delamination, cracking and surface roughening of the polymer layer after a forming process.

## Objective

Predict the occurrence of coating delamination during industrial forming processes.

## Methods

A Finite Element model is used to simulate industrial forming processes, such as bending and deep-drawing. Between the polymer layer and the metal substrate interface elements are present to simulate the delamination of the polymer layers. Experiments are needed to determine parameters for the simulations.

## Results

Delamination experiments are conducted inside a Scanning Electron Microscope (SEM). The delamination front is observed (see figure 3) and the force is measured.

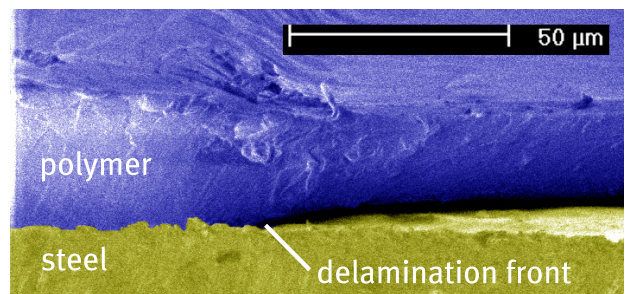


Figure 3 Micrograph of a delamination experiment in the SEM.

The interface parameters are determined by simulating the experiments and fit the results (see figure 4). This approach requires accurate material models and parameter values for both the polymer and steel.

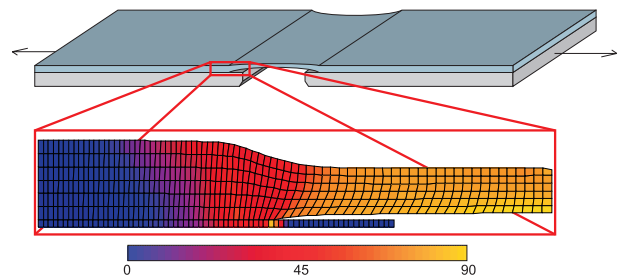


Figure 4 Schematics of a zero degree delamination experiment with the result of a simulation. The colors indicate the equivalent von Mises stress [ $\text{Nmm}^{-2}$ ].

## Future work

The interface parameters can be determined with the combined experimental/numerical procedure. In the future the influence of pre-deformation on the interface parameters will be investigated.

## References:

- [1] B. BOELEN, H. DEN HARTOG, H. VAN DER WEIJDE *Product performance of polymer coated packaging steel, study of the mechanism of defect growth in cans*, Pro. org. coat. 50, 2004
- [2] B.F. SØRENSEN, T.K. JACOBSEN *Determination of cohesive laws by the J integral approach*, Eng. Frac. Mech. 70, 2003
- [3] M.J. VAN DEN BOSCH, P.J.G. SCHREURS, M.G.D. GEERS *An improved description of the exponential Xu and Needleman cohesive zone law for mixed-mode decohesion*, Eng. Frac. Mech., submitted
- [4] M.J. VAN DEN BOSCH, P.J.G. SCHREURS, M.G.D. GEERS *A cohesive zone model with a large displacement formulation accounting for interfacial fibrillation*, in preparation