# Failure modeling in PC/ABS blends


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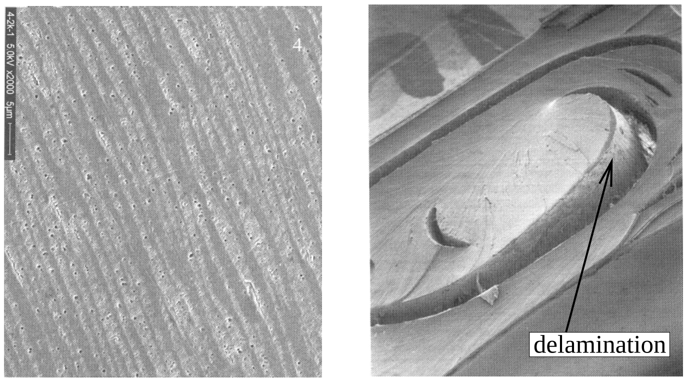
## 1. Introduction

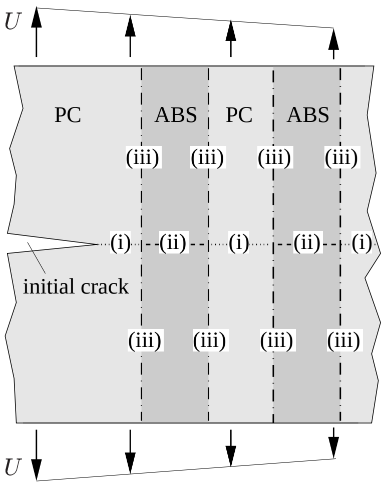
Polycarbonate (PC) is frequently blended with ABS in order to improve the fracture toughness. At an ABS volume fraction of about 50%, the blend microstructure displays a co-continuous (lamellar) morphology. ABS is itself a blend of SAN and small rubber particles, and the ability to toughen PC is known to depend strongly on its composition. Fracture experiments performed on co-continuous PC/ABS blends indicate an optimal rubber content in ABS of 10-15%. In this range of composition, delamination along the PC/ABS interface is observed. Its role for enhancing the toughness is not yet fully understood.
The aim of this study is to gain basic understanding of failure mechanisms in PC/ABS blends and their dependence on microstructural parameters.



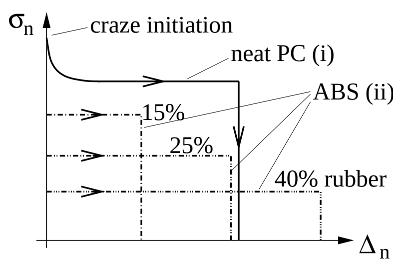

(from: Inberg, J.P.F. (2001), PhD thesis, University of Twente)

## 2. Modeling

A numerical study is performed on the competition between plastic deformation, crazing and delamination. The blend model consists of layers of PC and ABS perpendicular to an initial crack. Loading is specified as macroscopically non-uniform uniaxial straining. Based on the assumption that the rubber particles cavitate, ABS is modeled in a homogenized sense as porous SAN showing plastic dilatancy with a porosity dependent yield stress. Large strain viscoplastic deformations are accounted for in both phases.



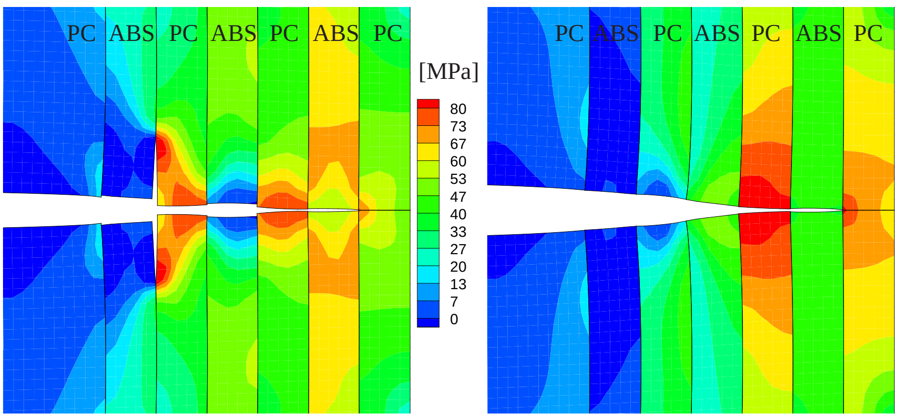

Cohesive surface models are employed to describe crazing inside PC (i) and ABS (ii) as well as interface delamination (iii). The properties of the respective cohesive surface constitutive laws, between the normal stress $\sigma_{\max}$ and the separation $\Delta_n$, are different and for ABS depend on the rubber content (porosity).




Mixed-mode interface failure takes place when a combination of normal and tangential stress reaches a critical value. The specific work of separation of the PC–ABS interface (iii) is much smaller than that of PC or ABS.

## 3. Results

The distribution of stress in the direction of applied loading, shown below for two different blends at the same amount of crack advance, illustrates how the mode of local failure may change with the rubber content in ABS. In case of a low rubber content (stiff ABS) failure in ABS takes place earlier than in PC. This leads to high stresses along the interface which cause delamination – mainly under shear.




10% rubber in ABS 25% rubber in ABS

Interface delamination leads to a relief of stress parallel to the crack and hence a lower hydrostatic stress ahead of the crack tip. As a consequence, failure of PC by crazing is delayed. The average stress $\Sigma$ vs overall deformation $U$ in case of the blend with low rubber content in ABS displays a transition from a brittle to a more ductile behavior (arrows) after delamination has taken place. However, the total fracture energy of the two blends (area under curves) does not differ significantly.