

Modelling the morphology of polydisperse polymer blends

Citation for published version (APA):

Wong, W. B., Hulsen, M. A., & Anderson, P. D. (2018). *Modelling the morphology of polydisperse polymer blends*. Poster session presented at Mate Poster Award 2018.

Document status and date:

Published: 01/01/2018

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

Take down policy

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

openaccess@tue.nl

providing details and we will investigate your claim.

Modelling the morphology of polydisperse polymer blends

Wing-Hin B. Wong, Martien A. Hulsen, Patrick D. Anderson

سابک
sabic

Introduction

A well-known method for producing polymer materials with specific properties is blending multiple existing polymers. Our aim is to quantitatively model the evolution of the morphology of immiscible disperse polymer blends (see Figure 1) during processing and implement this in a finite element framework.

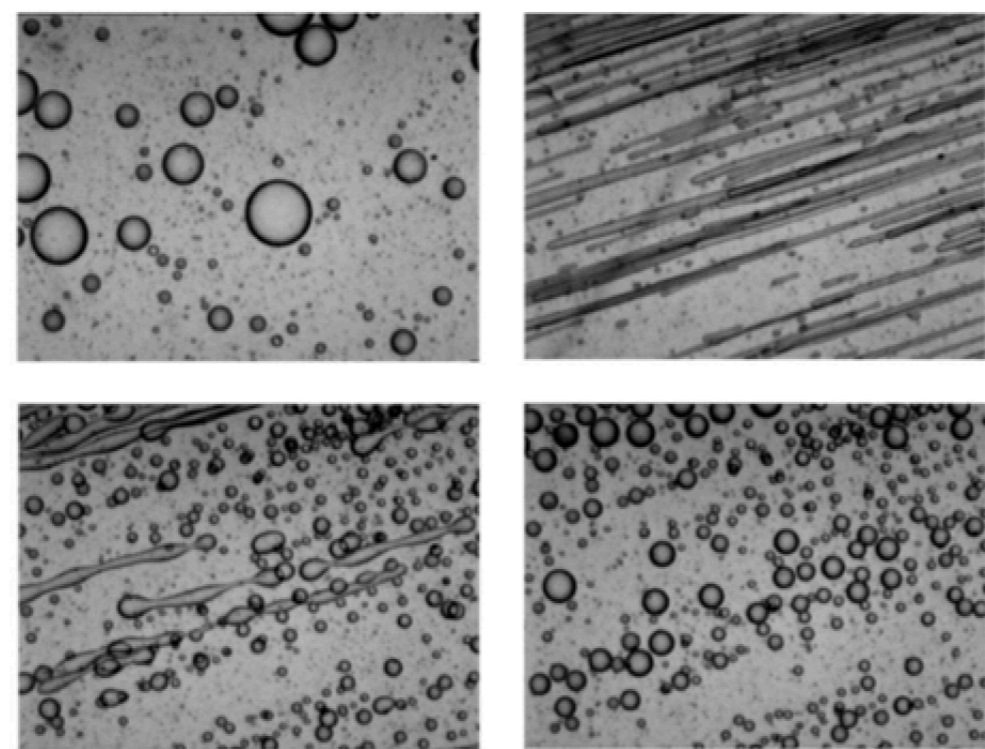


Figure 1. Drops of PIB inside a matrix of PDMS [1]. Deformation, break-up and coalescence of the drops occur during processing.

Constitutive model

Based on [2], we model the morphology as fields of polydisperse macroscopic droplet populations. Every population is described by an average unstretched droplet radius (defined as R_0), stretch ratio, orientation vector and the number of droplets, which undergo changes based on the background flow field (see Figure 2). We calculate the flow field according to the Stokes equations.

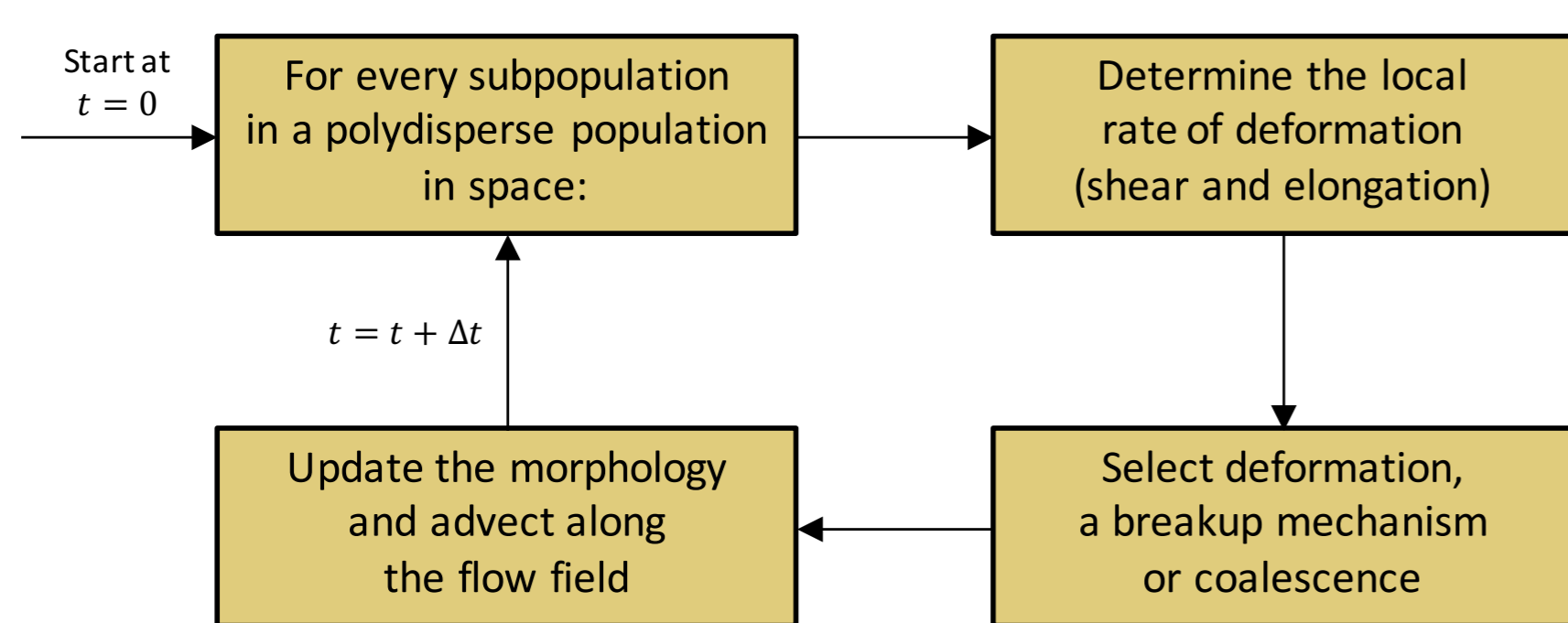


Figure 2. Schematic overview of the time-stepping procedure.

Numerical simulation

In this example (see Figure 3), we investigated the morphology development of a 10% PIB - 90% PDMS blend in an eccentric cylinder flow, where the outer cylinder rotates anticlockwise with an angular velocity of 1 rad/s. The initial droplet radius distribution consists of 100 populations distributed logarithmically between 10^{-7} m and 10^{-4} m. The histograms were extracted from a sample point located halfway in the gap below the inner cylinder.

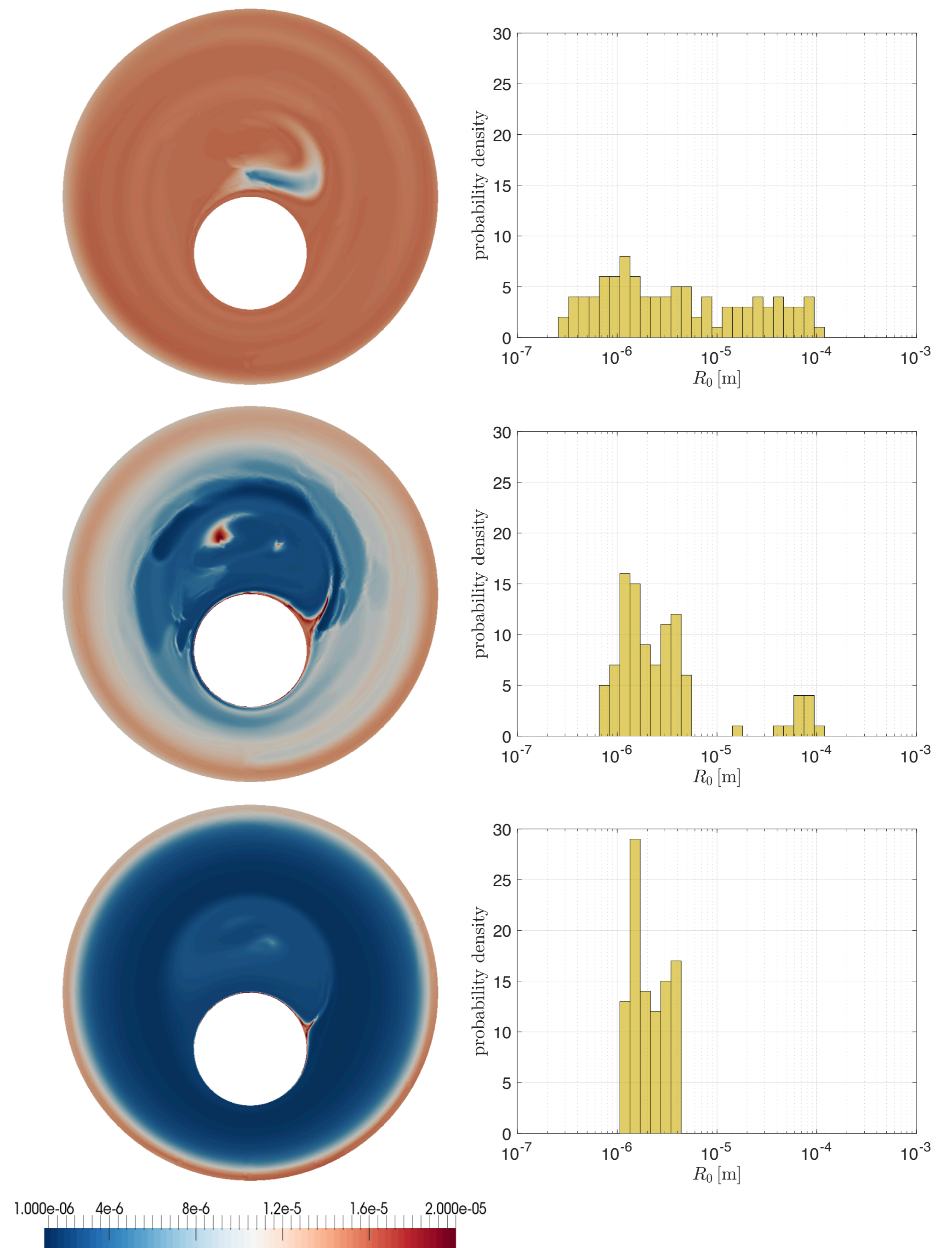


Figure 3. Mean R_0 in the flow geometry and the distribution of R_0 in the sample point. Top row: after 4 rotations. Middle row: after 8 rotations. Bottom row: after 12 rotations. At the early stages, the distribution is relatively wide. Over time, the distribution narrows, but larger droplets still need more time to break up. The final value is determined by the material properties and local rate of deformation.

Conclusions

We have developed a predictive tool for the morphology development of polydisperse blends under the influence of processing flow conditions and material properties. Points for future work are: (i) studying the morphology evolution in a three-dimensional industrial mixer flow and (ii) extending the model with viscoelasticity of the blend constituents.

References

- [1] M. Iza, M. Bousmina, *Journal of Rheology*, **44**, 1363-1384 (2000)
- [2] G.W.M. Peters et al., *Journal of Rheology*, **45**(3), 659-689 (2001)