Unravelling elution behaviour in hydrodynamic chromatography

Nino Milani1,2, Noor Abdulhussain1,Denice van Herwerden1, T.Adamopoulou1 Bob Pirok1, Peter Schoenmakers1,2, Ron Peters1,3

1: UvA, Science Park904, 1098XH Amsterdam

2: TI COAST, Science Park 904, 1098 XH Amsterdam

3: DSM, Sluisweg 12, 5145 PE Waalwijk

Hydrodynamic chromatography (HDC) is a size-based separation technique that has shown a lot of potential for the determination of reliable size distributions. It utilizes the parabolic flow profile that is associated with pressure-driven flow to separate particles based on exclusion from the slower streams due to the particles’ hydrodynamic radii in either a packed- or open tubular column.1 The current understanding of separation by HDC dates back to the early 1970s. However, all theory is based on separation in an open capillary.2–4 The assumption was made that the interstitial volume between particles in a packed column can be approximately described by the theory that was developed for capillaries.

In this project we revisit the existing HDC theory using Computational Fluid Dynamics (CFD) simulations in combination with experimental data to gain more understanding in the principles of this separation technique. Attention is focussed on the correction factor *C* that is currently employed to make the theory match reality. This factor is believed to correct for anything that jeopardizes the relationship between the volumetric flow and the migration velocity of the analyte.1 To the best of our knowledge, the dependence of *C* on parameters, such as the size of the packing particles and the size of the interstitial volume, is investigated for the first time using a unique combination of Navier-stokes-based computer simulations and experimental measurements.

# References

(1) Striegel, A. M.; Brewer, A. K. Hydrodynamic Chromatography. *Annu. Rev. Anal. Chem.* **2012**, *5* (1), 15–34. https://doi.org/10.1146/annurev-anchem-062011-143107.

(2) DiMarzio, E. A.; Guttman, C. M. Separation by Flow. *Macromolecules* **1970**, *3* (2), 131–146. https://doi.org/10.1021/ma60014a005.

(3) Dimarzio, E. A.; Guttman, C. M. Separation by Flow and Its Application to Gel Permeation Chromatography. *J. Chromatogr. A* **1971**, *55* (1), 83–97. https://doi.org/10.1016/S0021-9673(01)94920-9.

(4) Guttman, C. M.; Dimarzio, E. A. Separation by Flow. II. Application to Gel Permeation Chromatography. *Macromolecules* **1970**, *3* (5), 681–691. https://doi.org/10.1021/ma60017a610.