(PAID) DIPLOMA/MASTER THESIS

3-Drops collisions and capsules production

SCOPE OF THE PROJECT:

Drop collisions which are very common in sprays are responsible for changes in their Drop Size Distribution (DSD). This spray characteristic being crucial for most applications, binary drop collisions have been well studied over the past decades and several regimes have been clearly identified: bouncing, coalescence or fragmentation – often reported as stretching and reflexive separations. More recently, it was envisaged to use drops of two immiscible liquids to achieve the encapsulation of one liquid by the other one and produce well-defined capsules for specific drug delivery. Comparable regimes have been observed and modelling has been proposed to explain the transitions between them[1].

In this project, we aim to investigate 3-drops collisions and document the outcomes when a single liquid is used. As preliminary results have already been successfully obtained[2], we will focus on the comparison of the stability limits of the regimes with the ones classically found for binary collisions. Characterizing these transitions for 3-drops collisions will help us to better understand the fragmentation phenomena which are generally unclear and mainly empirically described for binary collisions. The second goal of this master thesis is to use immiscible liquids with the 3-drops configuration. In this case we will evaluate the relevance and efficiency of such configuration for drop encapsulation and compare it to the already documented 2-drops configuration.

This subject includes experimental work for which the set-up has been already successfully used as well as data treatment mainly consisting of image analysis. No specific pre-requisite is required; an education in chemistry, physics or engineering is welcome.

Binary droplet collisions:
oil (transparent) encapsulates an aqueous glycerol solution (dark).
Drop diameter is ~200µm.
From C. Planchette PhD thesis

Bouncing regime observed for 3-drops collision. Drops are made of aqueous glycerol solution, diameter is ~200µm.
From C. Planchette PhD thesis

References

1) C. Planchette, E. Lorenceau and G. Brenn *Journal of Fluid Mechanics*, 702 (2012), 5–25

2) C. Planchette "Asymmetric drops collisions", PhD thesis 2011

YOUR DUTIES AND RESPONSIBILITIES:

- Define a work plan to achieve the collection of a comprehensive set of data (Design Of Experiments)
- Perform the experiments: 3-drops collisions using successively a single liquid and 2 immiscible liquids
- Systematic study of the outcomes and stability limits via image analysis
- Tentative modelling to explain the obtained results

START: work may start from February 2014

We offer

- a multidisciplinary and dynamic research environment
- mentoring and on-the-job training by qualified and available staff (supervision by Dr. Planchette, RCPE and Prof. Brenn, Institute of Fluid Mechanics and Heat Transfer, ISW)
- an adequate payment as well as the chance for personal and technical development in the area of pharmaceutical engineering and fluid mechanics.

We look forward to receiving your application!

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