Measuring and predicting the burst properties of perfume capsules to improve complex formulated products

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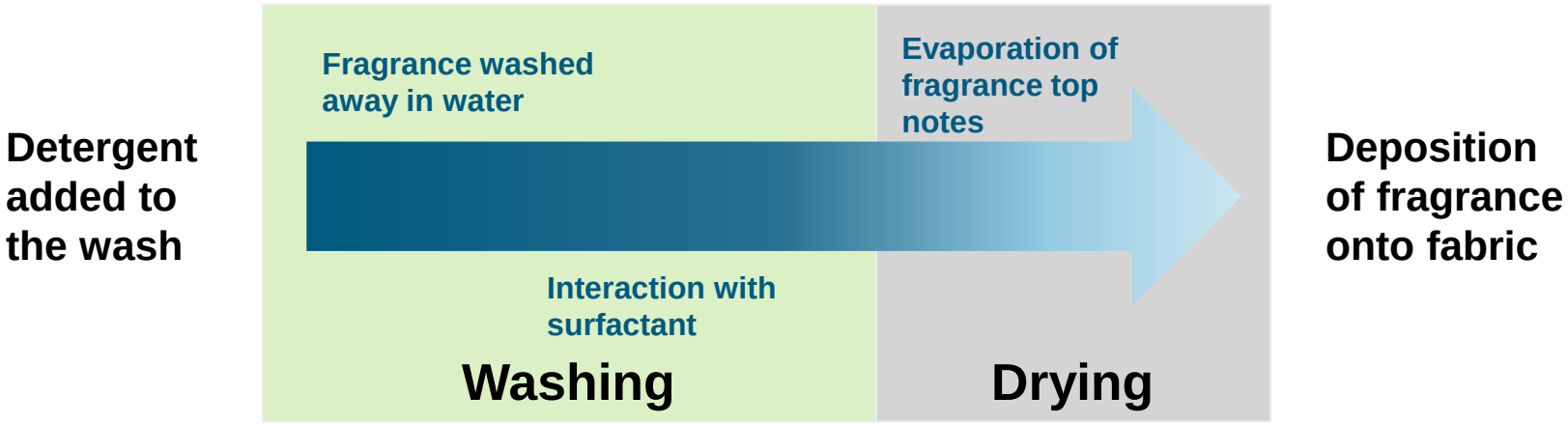
Presentation layout

- Background: Capsules as perfume delivery agents in laundry products
- Testing capsule performance in real-world washing applications
- Quantification of capsules embedded in fabrics in a washing machine
- Improving capsule deposition on fabrics
- Conclusions and future work

Traditional formulated laundry products

- Fragrance is a key driver for successful laundry products



- Small fraction of Perfume oil input is retained in the fabric at the end of the wash

  I. Not cost-effective
  II. Lower consumer perception of wash success

Use of capsules in laundry products

- Capsules break through mechanical force applied by consumer
- Promotes greater deposition on fabric per dosage of perfume

Problems associated with incorporating capsules in laundry products

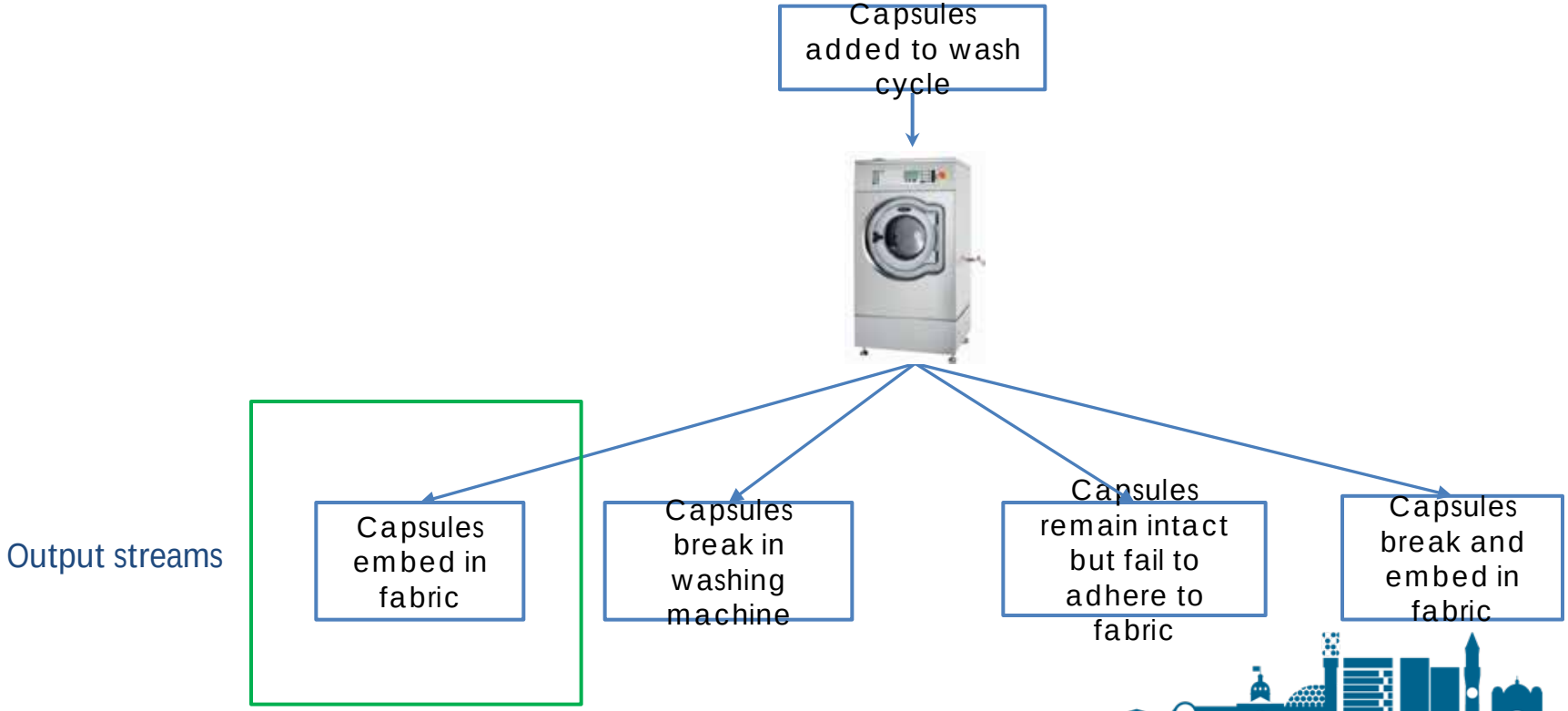
Capsules break in the wash

Capsules won't rupture through force applied by consumer

Need to understand parameters that affect the burst properties in order to refine formulation and maximise performance

Testing capsule performance in real-world applications

- The goal is to refine capsules to improve performance in a washing machine
- Need to have a method of quantifying capsules in each output stream in the wash process



Depositing capsules on fabric in washing machine - materials and methods

- Fluorescent dye (PM546, 500ppm) added to the core of melamine formaldehyde capsules, average size – 18.9 µm
- 3 kg of black polycotton for typical wash load to minimise background fluorescence, including eight 10 x 10 cm swatches.
- Programmable washing machines allows collection of samples at the end of each wash stage
- High stress and low stress wash cycles assess variation in capsule deposition at extremes of forces experienced in a washing machine

Imaging deposited capsules through fluorescence microscopy

- 10 x 10 cm sections of fabric (swatches) removed from washing machine at end of each stage and allowed to dry.
- 100 images taken of each swatch taken at random locations
- Images analysed using ImageJ to quantify and size the embedded capsules
- Capsules per image scaled up to cover total wash load surface area

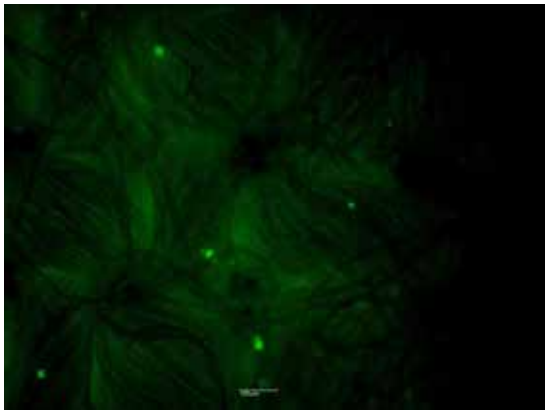


Figure 1: Example image of capsules deposited on fabric

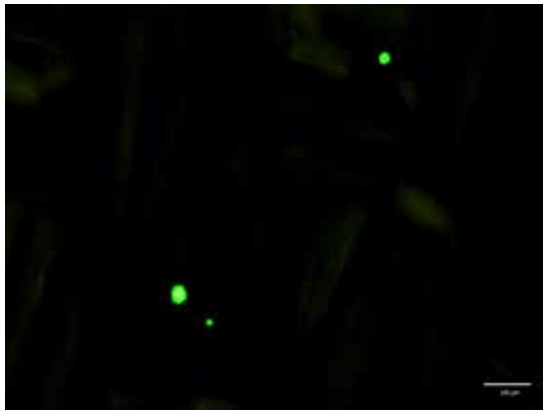


Figure 2: Example of image adjusted to minimise background fluorescence

Results from deposition analysis of capsules in a washing machine

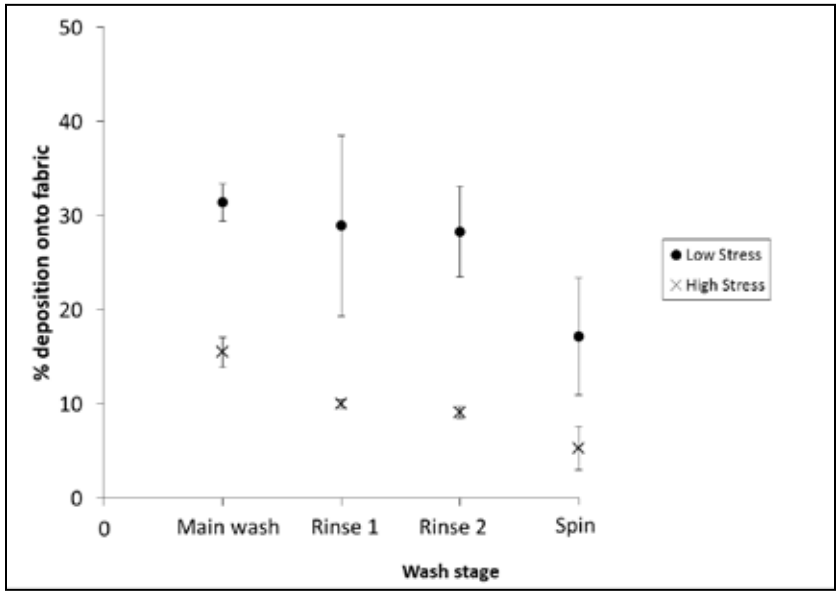


Figure 3: Percentage of capsules deposited on fabric at each wash stage

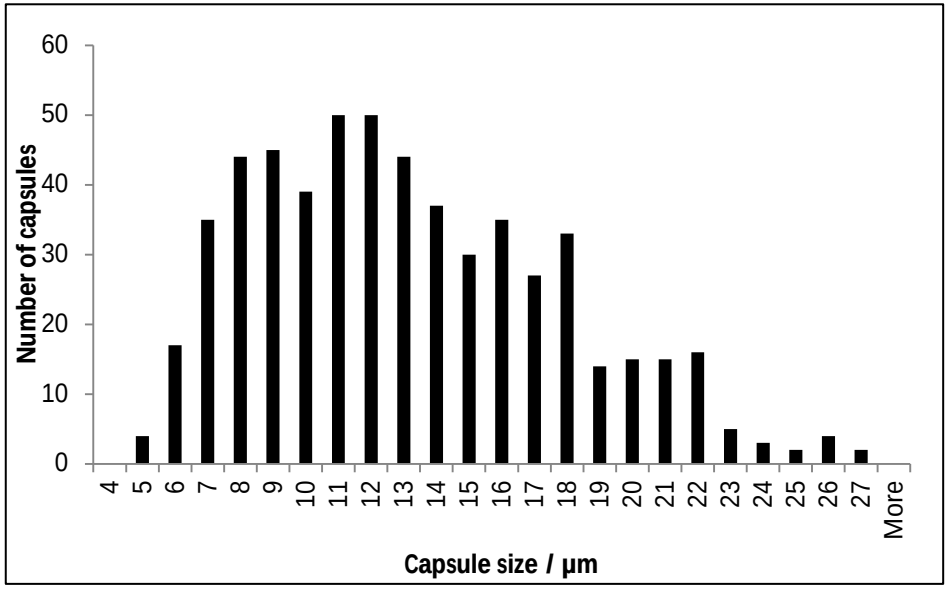


Figure 4: Distribution of capsule diameters from fluorescence microscopy images of all recovered swatches from trial runs

- A high stress wash cycle results in lower deposition of capsules on fabric
- Rinse 1 and spin cycles are main sources for depletion of capsule numbers on fabric
- Average size from fluorescence microscopy 12.7 um. Lower than the 18.9 µm input from capsule slurry

What can be done with these results and where next?

- Percentage deposition indicates the suitability of the capsule batch for application.
- This can be confirmed by performance analysis using olfactory measurement or headspace analysis of fabrics post-wash
- Sub-optimal deposition can be a result of two prevalent mechanisms:
  1. Rupture of capsules during the wash cycle
  2. Lack of adhesion between capsules and fabric
- There is a need to **complete the mass balance** to determine what mechanism is the most dominant

Conclusions

- A method of quantifying the deposition of capsules on fabric has been created using fluorescent capsules and fluorescence microscopy as a measurement technique
- The percentage deposition indicated that depletion of capsules, once embedded, occurred mainly during the first rinse and the spin cycle
- Effect of different extremes of stress in the wash has been investigated, showing that deposition was greater when lower forces were applied in the wash

Future Work

- Confirmation of percentage deposition by comparison with extraction of capsules from fabric and spectrophotometry of core
- Experiments using different batches and comparison with mechanical, structural and physico-chemical characterisation results

Zhang et al., (1991) A novel micromanipulation technique for measuring the bursting strength of single mammalian cells, *Appl. Microbiol. Biotechnol.* **36,** 208
Zhang et al., (1999) Mechanical strength of single microcapsules determined by a novel micromanipulation technique, *J. Microencap*, **16**, 117

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Thank you for listening