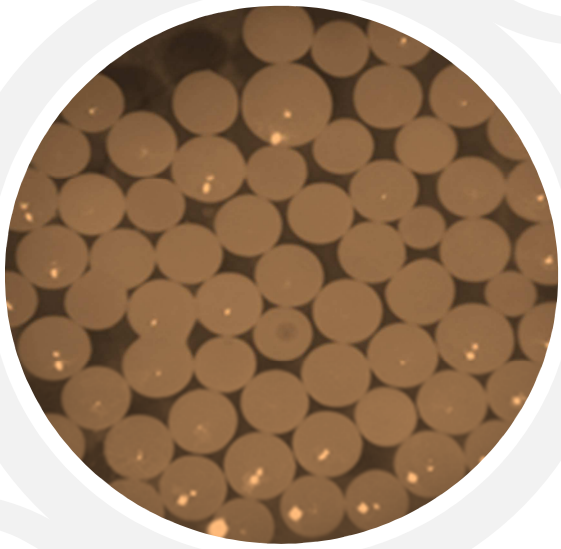
Application Note No. 146
Production of hard fat beads

Encapsulator B-390: Encapsulation of lipophilic and insoluble substances within hard-fat based beads



1. Introduction

Long chain triglycerides can be employed as a unique structural material to produce beads for the successful encapsulation and retention of lipophilic and insoluble substances. At temperatures below 40 °C these fats form solid structures which can entrap the material present. Above these temperatures the solid fats melt and release the encapsulated material or the fat is digested in the digestive tract.

The advantage of this method is that it has the ability to encapsulate a great variety of substances in beads. The following example substances can be encapsulated using this method:

- Perfume oils
- Cosmetics
- APIs (lipophilic or insoluble)
- Vitamins and minerals (lipophilic or insoluble)
- Flavors and fragrances
- Bioactive materials

This method enables the encapsulated substance (termed encapsulant) to be protected from many different environmental conditions such as oxygen, heat, pH etc., and can help prolong its shelf life. In addition encapsulation also enables the controlled release of the encapsulant.

2. Equipment

- Instrument: Encapsulator B-390
- Set up: Single nozzle system
- Pumping: Air pressure

3. Chemicals and Materials

Chemicals:

- Polymer: Vegetal fat with a melting point of 40 - 42°C
- Gelling solution: Ethanol maintained at 10 °C
- Encapsulant: Ibuprofen

4. Procedure and Parameters

Melt 200 g of fat with a heating plate and set the temperature of the fat solution to 55 °C. Maintain the fat solution at this temperature throughout experiment by placing the bottle containing the solution into a water bath. Add the active substance. Switch on the nozzle heater of the Encapsulator B-390 and set it to 60 °C. Wait until the nozzle has reached the temperature.

Pump the liquidized fat solution through the heated nozzle to form a liquid jet which is broken up into droplets by the vibrational frequency. After obtaining a stable droplet chain collect the beads in the gelling solution.

The distance between the tip of the nozzle and the surface of the cold ethanol should be at least 50 cm to allow the fat-based droplets to cool enough before landing in the cooling ethanol;

otherwise the droplets will lose their spherical shape or in some cases even burst open. The distance can be increased by using placing the Encapsulator or cooling bath on a height adjustable stand. The distance between the surface and bottom of the cooling ethanol should also be at least 15 cm to allow the bead to harden sufficiently before hitting the bottom of the vessel. Allow to harden for 30 minutes in the ethanol and make sure this liquid remains below 10°C during production process. After production remove excess ethanol by filtration.

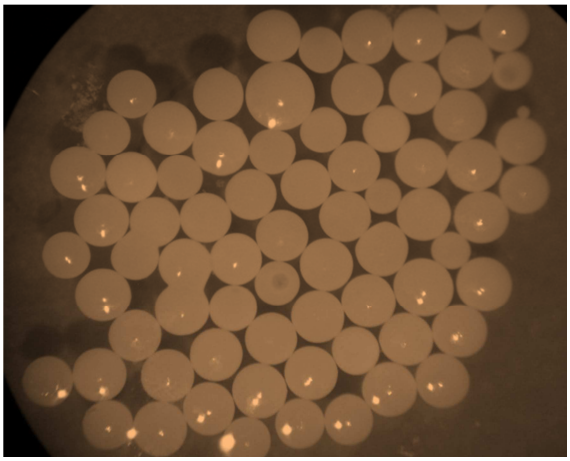
If oval or non-spherical beads are produced from the process, either further increase the distance between the nozzle tip and the cooling bath and/or reduce the initial temperature (55 °C) of the fat solution, until spherical beads are formed. Note: If the initial temperature of the fat solution is too far above the solidifying temperature (of the fat), the droplets won't cool down and hardening sufficiently before landing in the cooling oil - hence producing non-spherical beads.

Note: Ethanol was chosen as the gelling solution and not water as the density of ethanol is lower than that of the fat material used in this study. This ensures that the produced beads sink to the bottom of the vessel after entering. This prevents incoming droplets from colliding with beads, which may occur if beads float on top of the water surface. Beads should be stored under 30°C to prevent any melting and sticking.

4.1 Process parameters

- Nozzle size 300 µm
- Flow rate 7 - 9 mL/min
- Frequency 400 - 600 Hz
- Pressure 0.5 bar
- Amplitude 3
- Charge > 2000 V

5. Results



Picture 1: Image displaying the produced beads containing Ibuprofen. The beads have a size of between 550 to 800 µm.

6. Conclusion

The formation of hard fat based microbeads for the encapsulation of lipophilic and insoluble substances can be performed using the Encapsulator B-390 due to the temperature controlled nozzle, which helps maintain the temperature above the solidification point of the fat. With the different nozzle sizes available for the Encapsulator the bead size can be chosen in the range of 400 - 2200 µm.

7. References

This application was developed in-house by BÜCHI Labortechnik AG. For more information please contact www.buchi.com.