Spray drying and fluidized bed agglomeration used to encapsulate oils in powder

Identification

Key words  oil; emulsion; encapsulation; spray drying; agglomeration; oxidation
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How does it work?

Primary objective  The main objective is to build a barrier between the component in the particle and the environment (against oxygen, water, light; avoid contact with other ingredients), and to stabilize particles by water content reduction. Moreover, less is known about the reactions in more complex food systems, where it is possible that interactions with matrix and catalysts may cause different oxidation reactions.

Working principle  An emulsion is formed in which the oil is well dispersed in the solid matrix dissolved in water and. In the case of emulsions, the wall material acts as a stabilizer and the spray-dried emulsion is able to disperse again in water. Encapsulation of oil drops into a solid matrix (by spray drying of a formulated emulsion, whether or not combined with agglomeration) is regarded as an efficient protection method and a means of formulating liquid compounds in a solid dosed form (free flowing powders with oil in a support of matrix used and a small percentage of the total oil on the surface). When spray drying is followed by agglomeration of the small particles with water (under a controlled temperature of the fluidized bed) the combination is successful and lead to agglomerates.

Images

Additional effects  The wetting properties in general are good for the agglomerated powder, but the flowability still has to be improved as well as the mechanical resistance of the agglomerates.
To agglomerate fine particles of several micrometers, the difficulty is to find an equilibrium: to avoid particle sticking due to a too high water flow rate, on the one hand, and to prevent no sticking due to intensive drying, on the other hand. In the last case, particles should be dried before colliding and no liquid bridge between particles can be built.

Important process parameters  Important parameters are temperature and humidity during processing and during the storage, on the one hand, and the end-use properties on the other.
It is very important to determine the operating conditions to produce a powder with specific properties such as particles with a regular shape and the largest diameter possible, a good flowability, low water content, and the same composition as the initial emulsion. The main parameters are: the inlet and outlet air temperatures, the dry matter content and flow rate of the emulsion, and the ratio of solid matrices.
What can it be used for?

**Products**
- Flowing powders with oil (Oil encapsulated in powder), Agglomerated powder containing oil

**Operations**
- Stabilizing: Optimize homogenization conditions, which may affect oxidative stability of the final food product.

**Solutions for short comings**
- Efficient way of preparing formulations containing encapsulated oil in a support of matrices with reduced oil losses. The agglomerated powders have suitable properties of flowability and wettability. Agglomeration is not changing oil encapsulation properties of the spray-dried powder but considerably improved its wettability.

What can it NOT be used for?

**Products**
- As an example, the addition of methylcellulose causes a significant reduction and narrowing of the particle size of all basic oil in water (o/w) emulsions. According to special properties of modified cellulose it may also act as a good coating material for oil microencapsulation.

**Operations**
- Is necessary to investigate the effect of different oil phases on spray-dried emulsions and particularly oil encapsulation efficiency and emulsion structure after reconstitution. In the emulsions with larger droplets, the droplet size increased considerably after spray drying and reconstitution and, in contrast, in emulsions with smaller droplets, the emulsion structure was well preserved after drying and reconstitution.

**Other limitations**
- The disadvantage of this technology is the high temperature conditions necessary for drying and access to air. Parts of the product during drying may adhere to the surface of the capsules, which presents potential for oxidation and changes in the flavor balance of the finished food products.

**Risks or hazards**
- Not known

Implementation

**Maturity**
- Already used and available from lab to industrial scale.
- The most popular technique employed in the industry is spray drying. It is still the most economical and widely used method of encapsulation.

**Modularity**

**Consumer aspects**
- No negative effects

**Legal aspects**
- Not known

**Environmental aspects**
- Not known

Facilities that might be interesting for you
Further Information

Institutes
CSIRO, University of Kiel, FRIP, ENSIA, Warsaw University of Life Sciences

Companies
Büchi, Glatt, The Procter & Gamble, CENTIV, FrieslandCampina Kievit, Micap PLC, Capsulæ, Nisco

References

Source: