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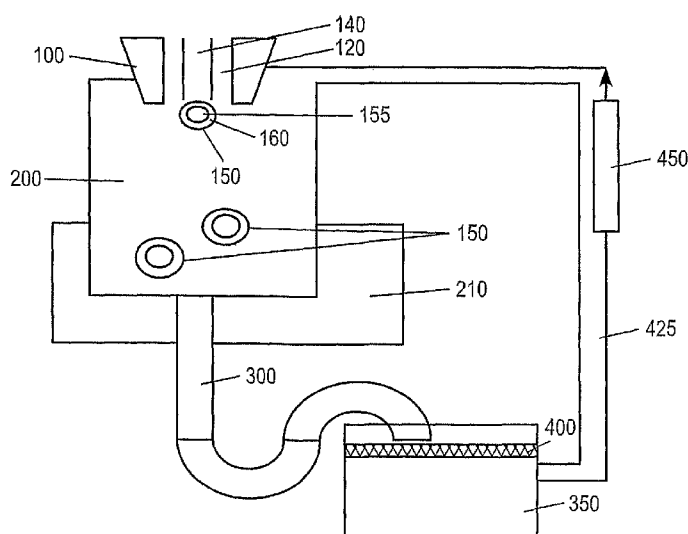


FIG. 2

(57) Abstract: Provided is a method for cooling wax after coextrusion to create wax capsules 150. The method includes immersing a concentric nozzle 100 of a coextruder in a container of heated alcohol 200. The container of heated alcohol sits in a water-ice bath 210 to create a temperature gradient. A core material 155 having a wax coating 160 is extruded through a concentric nozzle to form a capsule. The capsule enters the container of hot alcohol where the wax coating is solidified. In an embodiment, the method is a continuous method including a capsule and solvent transfer system 300, 350, 400, 425, 450.

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WAX CAPSULES CONTAINING HYDROPHILIC CORES

This application claims priority from U.S. provisional Application No. 60/924,816, filed on May 31, 2007, the entire content of which is incorporated herein by reference.

5 BACKGROUND

Flavors and other active ingredients have commonly been encapsulated for ease of working with the enclosed flavor or ingredient.

In addition, encapsulation techniques have been employed to preserve the enclosed product and increase shelf life.

10 Wax capsules, which can be fabricated by co-extrusion techniques, are good structures to hold hydrophilic cores for a long period of time. Exemplary encapsulation methods for creating wax capsules include spray drying and coextrusion techniques. Because the density of wax is lower than that of water and solidification of melted wax occurs quickly, special cooling equipment is needed to solidify the wax after coextrusion. One such cooling device is a cooling
15 tower, which is expensive to purchase and complicated to use.

Thus, there remains a need in the art for a simple and inexpensive cooling system for solidifying the wax coating after coextrusion.

SUMMARY

20 Provided is a method for forming wax capsules. Also provided is a method for cooling wax during the formation of wax capsules.

In a preferred embodiment, the method of forming core material containing capsules includes coating a core material with a wax to form a core/shell droplet. The core/shell droplet is then contacted with hot alcohol. Preferably, the capsules are spherical.

25 Preferably, a temperature gradient is created in a container of hot alcohol by placing the container of hot alcohol in an ice water bath. The temperature at the top of the container is preferably above the melting point of the wax. The temperature of the alcohol gradually decreases towards the bottom of the container. As the core/shell droplets pass from the top of the container to the bottom of the container, the wax shell solidifies to form a capsule. The
30 capsules fall to the bottom of the container where the capsules may later be collected.

In another embodiment, the method for making wax capsules includes immersing a concentric nozzle of a coextruder in a container of a hot ethanol. Wax from the outer nozzle coats the core material flowing through the inner nozzle to create core/shell droplets that fall from the concentric nozzle into the hot ethanol. The container of hot ethanol is placed in a
35 water-ice bath to create a temperature gradient. As the core/shell droplets descend in the container of hot ethanol, the wax shell solidifies to create capsules.

Preferably, the method for making wax capsules is a continuous method, wherein the capsules and solvent exit the container via a capsule transfer tube. The capsules and solvent then fall into a container that includes a sieve for catching the capsules and a container leading to a solvent transfer tube. The solvent transfer tube includes a heater that heats the solvent as the solvent travels back into the container into which the concentric nozzle sends the core/shell droplets.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is an illustration of a setup of a wax solidification cooling unit including a coextruder.

Figure 2 is an illustration of a setup of a wax solidification cooling unit including a coextruder and a capsule transfer system with solvent return.

DETAILED DESCRIPTION

Provided is a method for manufacturing wax capsules for the encapsulation of hydrophilic substances.

In a preferred embodiment, the method for forming core material containing capsules includes coating a core material with molten wax to form a core/shell droplet.

Preferably, the core/shell droplet is formed by a coextruder having a concentric nozzle 100 with an inner nozzle 140 and outer nozzle 120 as seen in Figure 1. The core material flows through the inner nozzle 140, while molten wax flows through the outer nozzle 120 resulting in a coating being applied to the core material. The flow is broken up to form core/shell droplets exiting out of the concentric nozzle 100. As the core/shell material exits the concentric nozzle 100, surface tension causes the core/shell material to break into droplets.

The size of the resulting core/shell droplets 150 depends on the size of the coextruder nozzle used. The choice of a coextruder nozzle may rely on the type of wax capsules being manufactured and the intended use. In a preferred embodiment, the wax capsules have a diameter of about 0.1mm to about 5.0mm (e.g., about 0.1mm to about 2mm, about 1mm to about 3mm, about 2mm to about 4mm or about 3mm to about 5mm).

Preferably, the concentric nozzle is placed into a container filled with a hot solvent so that the capsules pass through the nozzle 100 directly into the hot solvent. Preferably, the solvent is a hot alcohol 200.

Preferably, the core material is a hydrophilic substance. In a preferred embodiment, suitable core materials include, without limitation, pure water, aqueous solutions of flavors or other active ingredients, propylene glycol, glycerin, honey, combinations thereof, and the like.

Preferably, the wax is natural or synthetic. Suitable waxes include, without limitation, beeswax, carnauba wax, candelilla wax, castor wax, polyethylene waxes, petroleum based waxes, combinations thereof, and the like. Preferably, paraffin wax is used.

Suitable hot alcohols include, without limitation, methanol, ethanol, propanol, combinations thereof, and the like. In a most preferred embodiment, ethanol is used. The alcohol may be reused for multiple cooling processes.

Preferably, the chosen alcohol has a density that is lower than the density of the chosen molten wax. Other solvents that are not miscible with wax and have a lower density than wax may be used.

In a preferred embodiment, the capsules 150 are in liquid form when they exit the concentric nozzle 100. Preferably, the temperature of the hot alcohol at the top of the container, where the nozzle comes into contact with the hot alcohol, is about 2°C to 5°C higher than the melting point of the wax being used. If the temperature of the alcohol at the top of the container is too high, then the wax will break and the coating will not properly form. If the temperature of the alcohol at the top of the container is too low, then the nozzle may clog or the wax may solidify so quickly that the capsules aggregate. Preferably, the capsules sink in the heated alcohol.

In a preferred embodiment, the alcohol may be heated with a heating tape located in the container, placed against the container, and/or surrounds the outside of the container. Other heaters such as cartridge heaters, heating coils, etc. located inside or outside the container may also be used alone or in combination with each other or with a heating tape. Accurate control over the temperature can be maintained by using a temperature controller.

Preferably, the container of hot alcohol is placed in a cooling bath 210 to create a temperature gradient from the top of the container to the bottom of the container. Preferably, the temperature of the alcohol at the bottom of the container is about 0°C. The cooling bath may be an ice water bath.

As the capsules 150 fall through the container of alcohol 200 the wax 160 gradually solidifies over the core material 155 resulting in capsules 150 with a hard, outer wax shell 160. The capsules may later be collected from the bottom of the alcohol container.

In another embodiment, the method for making wax capsules includes immersing a concentric nozzle of a coextruder in a container of hot ethanol. The container of hot ethanol is then placed in a cooling bath, such as a water-ice bath, to create a temperature gradient. A core material and a wax are passed through a concentric nozzle of a coextruder to form a coated capsule. The capsule is then passed into a supply of hot ethanol to solidify the wax.

Once the container is filled with capsules, the capsules can be harvested out of the container. The remaining alcohol can be used again to form additional capsules.

Preferably, the method is a continuous method. In an embodiment, the method includes connecting a transfer line 300, as seen in Figure 2, to the bottom of the container holding the solvent 200. As the capsules 150 fall to the bottom of the container, the capsules and solvent enter the transfer line 300. The transfer line 300 leads to a second container 350. A sieve 400
5 extends the length of the container 350 and catches the capsules 150 as they exit the transfer line 300 and pass into the container 350. The solvent passes through the sieve 400 and is processed through the solvent transfer system 425 back into the container 200 for reuse. Preferably the heated alcohol is reheated while it travels through the solvent transfer system. A heat exchanger 450 contacts the solvent transfer system 425 to heat the solvent prior to
10 reentering the container 200.

In an embodiment, the capsules are used in oral tobacco or non-tobacco products. Preferably, the capsules are mixed with tobacco and placed in a pouched product. In an embodiment, each capsule can be individually consumed as a snack. In another embodiment, the capsules can be used as a baking or cooking ingredient.

15 While the foregoing has been described in detail with reference to specific embodiments thereof, it will be apparent to one skilled in the art that various changes and modifications may be made, and equivalents thereof employed, without departing from the scope of the claims.

CLAIMS:

1. A method of forming core material containing capsules comprising:
coating a core material with a molten wax to form a capsule having a coating;
5 and
contacting said capsule with a heated alcohol to solidify said coating immediately after
coating said core material with said molten wax.
2. The method of Claim 1, wherein said wax is applied to said core material by a
10 coextruder having a concentric nozzle with an inner nozzle and an outer nozzle.
3. The method of Claim 2, wherein said core material flows through said inner nozzle of
said coextruder.
- 15 4. The method of Claim 2, wherein said wax flows through said outer nozzle of said
coextruder.
5. The method of Claim 2, wherein said concentric nozzle is immersed in a container of
heated alcohol.
20
6. The method of Claim 1, wherein said core material is a hydrophilic substance.
7. The method of Claim 6, wherein said hydrophilic substance is selected from the group
consisting of water, aqueous solutions of flavorants and/or active ingredients, propylene glycol,
25 glycerin, honey and combinations thereof.
8. The method of Claim 1, wherein said heated alcohol is selected from the group
consisting of ethanol, methanol, propanol, and combinations thereof.
- 30 9. The method of Claim 1, wherein said heated alcohol has a density lower than that of
said wax.
- 10 The method of Claim 5, wherein said container of heated alcohol is immersed in a
cooling bath to create a temperature gradient.
35
11. The method of Claim 10, wherein said temperature gradient runs vertically from an
upper level of the heated alcohol to a lower level of the heated alcohol.

12. The method of Claim 11, wherein the temperature at the upper level of the heated alcohol is about 2°C to 5°C hotter than the melting point of said wax.

5 13. The method of Claim 1, wherein said wax is selected from the group consisting of beeswax, carnauba wax, candelilla wax, castor wax, paraffin wax, polyethylene waxes, petroleum waxes, and combinations thereof.

10 14. The method of Claim 16, wherein the temperature of said heated alcohol is controlled by a temperature controller.

15. The method of Claim 1, wherein said core material containing capsules are substantially spherical and have a diameter of about 0.1 mm to about 5.0 mm.

15 16. The method of Claim 1, further including passing said capsule and said heated alcohol into a transfer line leading to a container including a sieve for collecting said capsule and a receptacle for holding said heated alcohol.

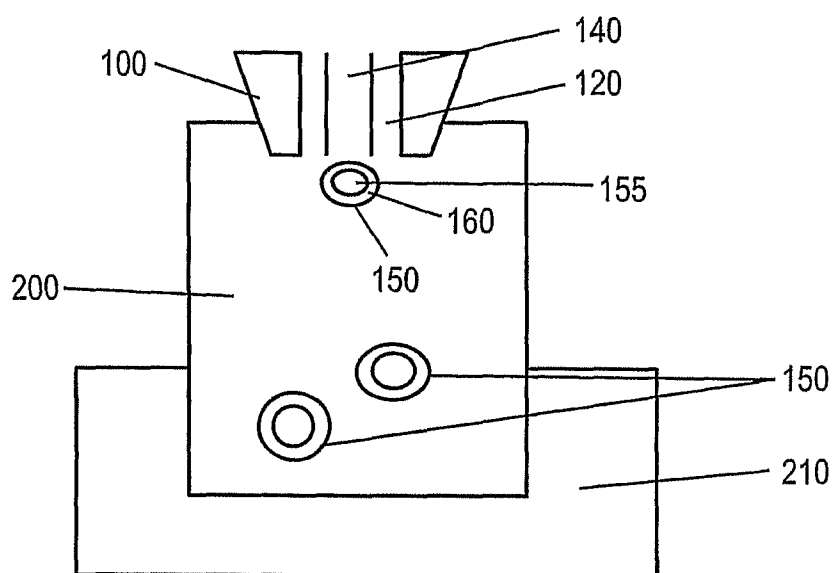


FIG. 1

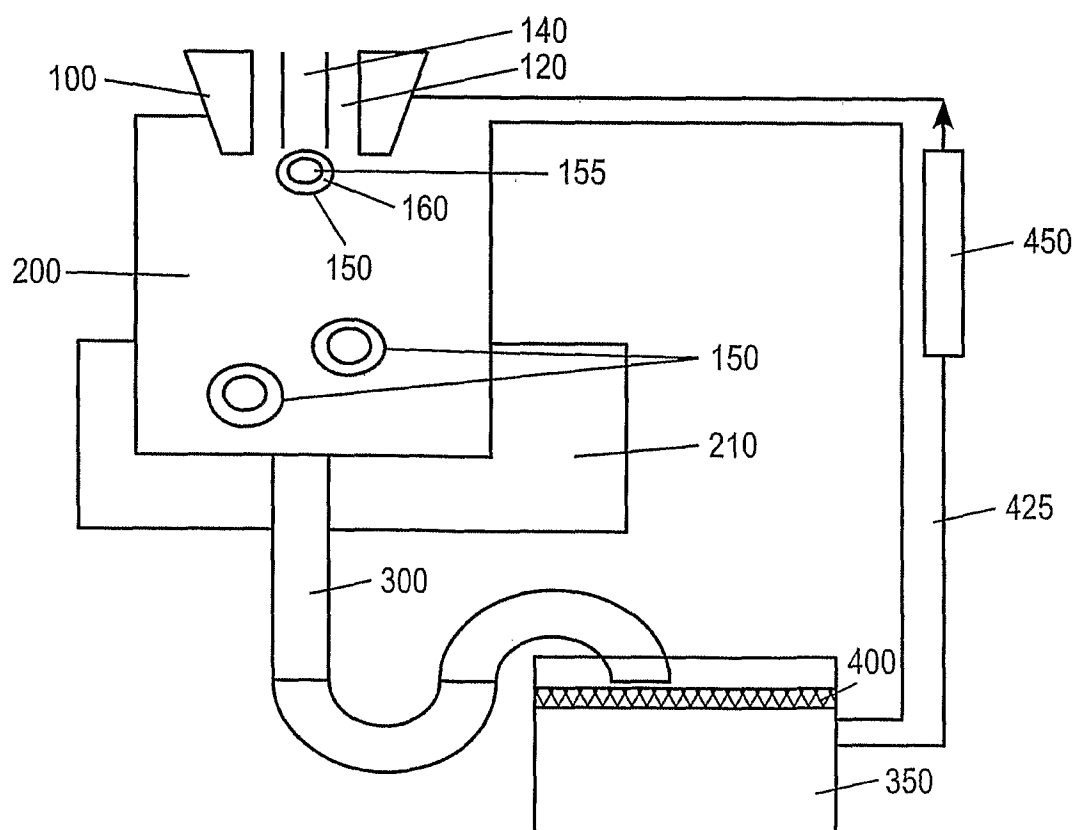


FIG. 2

INTERNATIONAL SEARCH REPORT

International application No

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A. CLASSIFICATION OF SUBJECT MATTER
INV. B01J13/04

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

B01J

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 0 595 263 A (FREUNT IND CO LTD [JP]) 4 May 1994 (1994-05-04) claim 1 page 3, line 35 - line 37 page 4, line 18 - line 20 -----	1-16
A	US 3 423 489 A (ARENS ROBERT P ET AL) 21 January 1969 (1969-01-21) the whole document -----	1-16
A	WO 03/018186 A (BIO DAR LTD [IL]; BLATT YOAV [IL]; PINTO RIKI [IL]; SAFRONCHIK OLEG [I] 6 March 2003 (2003-03-06) the whole document -----	1-16
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Further documents are listed in the continuation of Box C.



See patent family annex.

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A document defining the general state of the art which is not considered to be of particular relevance

E earlier document but published on or after the international filing date

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P document published prior to the international filing date but later than the priority date claimed

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Y document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

8 document member of the same patent family

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INTERNATIONAL SEARCH REPORT

International application No

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C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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INTERNATIONAL SEARCH REPORT

Information on patent family members

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