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GASIFIED CONFECTION AND METHOD OF MAKING THE SAME

Leon Kremzner, Upper Saddle River, and William A. Mitchell, Lincoln Park, N.J., assignors to General Foods Corporation, White Plains, N.Y., a corporation of Delaware

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This invention relates to a technique for enclosing a gas within a solid matrix and to the gas-containing solid so prepared.

The most common techniques for storing gases involve the use of containers wherein the gases are maintained under pressure. As is well known to those skilled in the art, effective use of this technique requires high pressures and accordingly strong containers. Typically, for example, gas containers are made of steel, and they may have a pressure therein of anywhere from e.g. 700 to 2000 p.s.i. Alternatively, it is possible to store gases by liquification or solidification, but these techniques are unsatisfactory in that they require low temperature, typically with accompanying high pressure.

It is an object of this invention to provide a technique for enclosing gas within a solid matrix. Other objects will be apparent to those skilled in the art on inspection of the following description.

According to certain aspects of this invention, it is possible to prepare a gas-containing solid which is substantially stable at room temperature for extended periods of time comprising a solidified fusible sugar containing therewithin a gas. Under preferred conditions, this product may be obtained by gassing a fused fusible sugar and cooling the said gasified fusible sugar below its fusion temperature.

According to certain preferred aspects of this invention, a gas may be enclosed within a solid matrix by the process which comprises fusing a fusible sugar, contacting said fusible sugar with gas at a pressure of 50–1000 p.s.i.g. for time sufficient to permit adsorption in said sugar of 0.5–15 ml. of gas per gram of sugar, maintaining the temperature of said sugar during said adsorption above the solidification point of said fused sugar, and cooling said sugar under pressure to a temperature less than its fusing temperature thereby obtaining a gas-containing solid.

The fusible sugars which may be employed in carrying out the process of this invention will preferably be those which fuse under the condition of operation at a temperature at least slightly above room temperature, so that they may readily be fused or melted to form a liquid which may readily be converted to a solid on return to and maintenance at room temperature.

Although the terms "fuse" or "melt" will be herein employed, it will be apparent to those skilled in the art that the fusion or melting point need not be a fixed precise point at which the material fuses or melts, but rather that these terms embrace a range or even a situation where the materials have no melting point at all in the strict physicochemical sense. The terms include the passage from a solid state to a liquid state and also the formation of a solution-liquid phase by the dissolving of solid in any water which may be present.

Included among the preferred fusible sugars are those which, on cooling, pass from the liquid phase to the solid phase by supercooling. Although we do not wish to be limited by this mode of description, it does appear that some of the preferred sugars exist in solid form as supercooled liquids with no sharp melting point.

It will be apparent that those fusible sugars which may be employed have a melting or fusion point below their

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decomposition temperature, and that no substantial decomposition occurs at the melting or fusion temperature which would interfere with fusion, melting, or solidification on cooling.

Although as will be apparent from this disclosure, the fusible sugars which may be used in the practice of this invention include those which have a melting or fusing point which falls within a wide range, the preferred materials will be those having a melting or fusing point within the range of 25° C. to 150° C. or 200° C.

The fusible sugars which may be employed in the practice of this invention include sugars and their derivatives such as sugar alcohols and sugar acids. Typical fusible monosaccharide sugars include glucose, fructose, arabinose, etc. Typical fusible disaccharide sugars include sucrose, lactose, maltose, fructosan, etc. Typical fusible polysaccharide sugars include gentiobiose, cellobiose, panose, malto-triose, malto-tetrose, etc. Typical sugar alcohols include sorbitol and mannitol. Typical sugar acids include gluconic acid and saccharic acid.

The fusible sugars useful in connection with this invention will preferably be in near-anhydrous state. Although, for example, anhydrous sucrose having a melting point of 186° C., may be employed, it is found that the desired results may be readily obtained if a small percentage of water be present. If 1% water be present, the apparent melting or fusing point will be about 127° C.; if 2% water be present, the apparent melting or fusing point will be about 118° C. Typically the quantity of water present may be about 1%–5% and fusible sugars containing these amounts of water may be said to be substantially anhydrous.

Although individual sugars such as sucrose may be used, it is a feature of this invention that combinations of sugars, e.g. sucrose and lactose give preferred products. A mixture of 30% lactose with 70% sucrose gives an excellent carbonated, hard product particularly characterized by its low hygroscopicity and reduced stickiness on standing. A mixture of sucrose with corn syrup (containing glucose, maltose, dextrin) is also satisfactory.

It is also a feature of this invention that more gas may be retained in the solid product when it comprises a fusible mixture of sugar together with (*a*) dextrin; or (*b*) starch; or (*c*) gelatin; or (*d*) a gum, typified by agar agar, carragheenin, alginates, and pectin. For example, sucrose and dextrin may be employed together. In all cases the desired mixture is fusible as heretofore defined.

When the product is prepared by pressurizing a fusible sugar, it possesses a bright transparent appearance; it has a gas content of e.g. carbon dioxide of 0.5 to 4.5–5.0 ml. per gram; it is fast dissolving in water; it is heavier than water; and the bubbles liberated therefrom are quite large in size.

When the product is prepared by pressurizing a fusible sugar in combination with the other materials heretofore noted, it possesses an opaque or translucent appearance; it has a gas content of e.g. carbon dioxide of 5–15 ml. per gram; it is slow dissolving in water; it is lighter than water; and the bubbles liberated therefrom are initially large but subsequently much smaller in size. This product appears to be one wherein the gas may be more tightly bound in molecular encapsulation.

Other materials which may be added to the fusible sugar particularly when the product is to be used for edible purposes include: edible acids, typically citric acid, tartaric acid, adipic acid, lactic acid, fumaric acid, etc. (in quantity sufficiently small to eliminate or minimize inversion); buffer salts, typically citrates, tartrates, etc.; flavors, typically cherry, lime, cola, root beer, etc.; or coloring, typically red, brown, yellow, etc.

In carrying out the process of this invention, the gas-containing product may be prepared either continuously