Baked ice cream – impossible?

Questions should be of general interest and be about temperature measurement techniques and/or heat transfer.

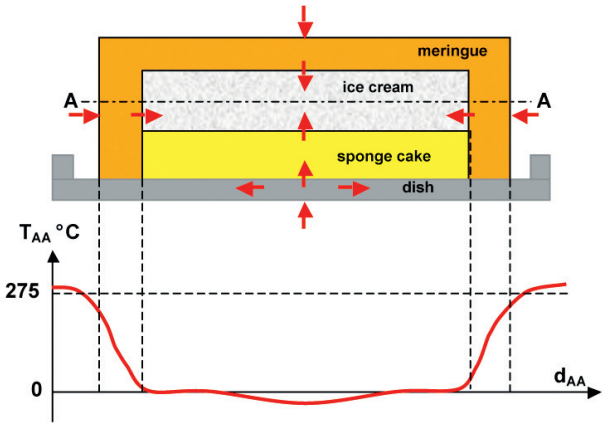
QUESTIONS ANSWERS

QUESTION: During winter time we often have baked Alaska. The ice cream is still cold on the inside, despite this dessert having been baked in a very hot oven. How does that happen?

Lars A

Baked Alaska (baked ice cream)

Frozen ice cream is put on a bed of sponge cake which is placed in an oven-proof dish. Both the ice cream and the sponge cake are covered with meringue. A jam can be added on top of or underneath the ice cream. The dessert is baked in a hot oven (275 °C) until the meringue mixture has set and slightly changed colour, which usually takes a few minutes to happen. Serve immediately and enjoy the contrast between a hot outer shell and cold interior.



ANSWER: The meringue mix is porous and contains a lot of air, which is incorporated into the mixture when the sugar and egg white are beaten until stiff peaks form. The mixture provides insulation and reduces the heat flow from the oven to the ice cream. When the meringue mix sets, heat is required for the phase change, and the heat flow to the ice cream is reduced further. The sponge cake base is also porous and contains a lot of air, so that the sponge cake is a good insulator, which reduces the heat flow from the oven to the ice cream. The dessert has been placed on a dish and the dish has to be heated, which initially reduces the heat flow to the ice cream through the sponge cake. Using a high oven temperature causes rapid setting, which reduces the time the dish has to stay in the oven.

The jam has virtually no positive thermal effect, if anything the opposite. If the jam is placed directly on the sponge cake, the sponge becomes wet and its insulation capacity is adversely affected. If the jam is placed on top of the ice cream there is less of a negative effect. Whether or not to add the jam is primarily a matter of taste.

The heat that reaches the ice cream causes it to start to melt. This melting represents a phase change, and this process requires a great deal of heat. Melting therefore proceeds relatively slowly. Baked Alaska is based on the following thermal principles:

- The heat flow is limited by insulating the ice cream with the meringue mix and sponge cake
- The heating process is delayed by the phase change in the meringue mix and ice cream
- High oven temperature causes the meringue mix to set quickly

FOOD TECHNOLOGY AND MEASURING TECHNIQUES

The principle of reducing heat flow and delaying heating with a phase change material can be used, for instance, to design a heat barrier for a thermometer that travels with materials that need to be heat treated in an oven (a 'travelling thermometer'). The phase change material in this case may be water or a salt with a suitable melting point.

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