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The latent heat released when water condenses is an important driver of weather phenomena. And as a simple experiment shows, it also makes it tough to enjoy a frosty one in the summertime.

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Results

The experimental procedure was repeated for a wide range of temperature and humidity. The following plot shows data from nine experiments, all taken at 25 °C and together covering a range of relative humidity. (The data shown are reproduced in the print Quick Study, along with those for the experiment run at 35 °C.) The filled-circle data points indicate the actual temperature change \( (\delta T) \) measured after five minutes. The open circles are an estimate of the temperature change from latent-heat release, calculated from the mass of condensate collected in the can and saucer. The condensate mass is multiplied by the latent heat of vaporization and divided by the heat capacity of the can to convert into a temperature change.
SINGULARITIES

An experiment uses cold beverages to demonstrate the warming power of latent heat

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Can condensation really heat your beer? If you’ve read our Quick Study, "Condensation, atmospheric motion, and cold beer" in the April 2013 issue of Physics Today, you know the answer is "yes." Cold drink cans warm up significantly faster in hot, humid locations than in hot, dry locations—by approximately a factor of two in typical summertime weather conditions.

To reproduce the results of the experiments described in our Quick Study, or to see the effect of condensation on drink cans in your location, follow the experimental procedures described below.

But first, you might enjoy watching this video, which shows a slightly less scientific demonstration of how condensation can also help melt frozen drinks. It was produced in collaboration with the University of Washington department of atmospheric sciences outreach group.

The experimental procedure

We placed bottle tops, plastic snap-on tops that allow resealing of canned drinks, onto 12-oz aluminum cans filled with water. We then replaced the twist-off cap for the bottle top with a single-hole rubber stopper. As shown in the first photograph below, a digital thermometer was inserted through the hole in the stopper and an enlarged opening in the top of the can, so that the thermometer sensor penetrated well into the can's interior.

The cans sat in an ice–water bath until they cooled to about 1°C. After selecting a can for an individual trial, we removed it from the bath, dried it off, shook it to mix its contents, and recorded its temperature. We then placed the can on a saucer capable of catching condensate that might subsequently run off the can's sides and weighed the can and saucer together using a precision scale.
An experiment uses cold beverages to demonstrate the warming power of latent heat. After each experiment, we put the can-saucer unit inside an enclosed, temperature-controlled chamber for five minutes. After that time, we removed and reweighed the unit; the following photo shows the operation being carried out by undergraduate research assistant Stella Choi. The difference from the original measurement was due to the mass of condensate on the can and in the saucer. Finally, the temperature of the can was measured after its contents were shaken up.

Results

The experimental procedure was repeated for a wide range of temperature and humidity. The following plot shows data from nine experiments, all taken at 25 °C and together covering a range of relative humidity. (The data shown are reproduced in the print Quick Study, along with those for the experiment run at 35 °C.) The filled-circle data points indicate the actual temperature change (\(\delta T\)) measured after five minutes. The open circles are an estimate of the temperature change from latent-heat release, calculated from the mass of condensate collected in the can and saucer. The condensate mass is multiplied by the latent heat of vaporization and divided by the heat capacity of the can to convert into a temperature change.

Data from 18 experiments at 30 °C and varying relative humidity are plotted below.