The Collapsing Can

We are so accustomed to the pressure of the air around us that we don't even notice it. However, the air pressure is large enough to crush a soda can. You can see the air crush a can in this experiment.

For this experiment you will need:

- an empty aluminum soft-drink can
- a 2- or 3-liter (2- or 3-quart) saucepan
- a pair of kitchen tongs

Fill the saucepan with cold water. Put 15 milliliters (1 tablespoon) of water into the empty soft-drink can. Heat the can on the kitchen stove to boil the water. When the water boils, a cloud of condensed vapor will escape from the opening in the can. Allow the water to boil for about 30 seconds. Using the tongs, grasp the can and quickly invert it and dip it into the water in the pan. The can will collapse almost instantaneously.

What caused the can to collapse? When you heated the can you caused the water in it to boil. The vapor from the boiling water pushed air out of the can. When the can was filled with water vapor, you cooled it suddenly by inverting it in water. Cooling the can caused the water vapor in the can to condense, creating a partial vacuum. The extremely low pressure of the partial vacuum inside the can made it possible for the pressure of the air outside the can to crush it.

A can is crushed when the pressure outside is greater than the pressure inside, and the pressure difference is greater than the can is able to withstand. You can crush an open aluminum can with your hand. When you squeeze on the can, the pressure outside becomes greater than the pressure inside. If you squeeze hard enough the can collapses. Usually, the air pressure inside an open can is the same as the pressure outside. However, in this experiment, the air was driven out of the can and replaced by water vapor. When the water vapor condensed, the pressure inside the can became much less than the air pressure outside. Then the air outside crushed the can.

When the water vapor inside the can condensed, the can was empty. You may have expected the water in the pan to fill the can through the hole in the can. Some water from the pan may do this. However, the water cannot flow into the can fast enough to fill the can before the air outside crushes it.

CAUTION: Do not heat the can over high heat or heat the can when it is empty. This may cause the ink on the can to burn or the aluminum to melt.

For additional information, see *CHEMICAL DEMONSTRATIONS: A Handbook for Teachers of Chemistry*, Volume 2, by Bassam Z. Shakhashiri, The University of Wisconsin Press, 2537 Daniels Street, Madison, Wisconsin 53704.

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