Heat Pad

P3-1015-03

INSTRUCTIONAL GUIDE

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Recommended for activities:

- Hot plate (PX-1043)
- Large pan for boiling water

Background

We know that it is necessary to add heat to liquefy a solid or vaporize a liquid. In the reverse process, heat is released when a gas condenses or a liquid freezes. Thermal energy that accompanies these changes of state is called latent heat of vaporization (going from gas to liquid or liquid to gas), and latent heat of fusion (going from liquid to solid or solid to liquid).Water, which normally freezes at 0°C (32°F), can be found under certain conditions in a liquid state as low as –40°C (–40°F) or more. This supercooled water (liquid water below 0°C) often exists as tiny cloud droplets, common in clouds where snow or ice particles form. Freezing in clouds depends on the presence of ice-forming nuclei, most of which are active in the –10°C to –20°C range. Ice-forming nuclei may be many different substances such as dust, bacteria, other ice particles, or silver iodide used to "seed" clouds during droughts. Silver iodide is active at temperatures as high as –4°C.

Cold clouds containing large amounts of supercooled water and relatively small amounts of ice particles can be dangerous to aircraft. The skin of the aircraft, well below freezing, provides an excellent surface on which supercooled water suddenly freezes. This is called aircraft icing, which can be quite severe under certain conditions.

Introduction

The heat pad provides a dramatic example of a supercooled liquid. What you observe in the heat pad is actually the release of the latent heat of crystallization, which is analogous to the release of latent heat of vaporization or the latent heat of fusion. The freezing temperature of the sodium acetate solution inside the heat pad is about 55°C (130°F), yet it exists at room temperature. The heat pad can be cooled down to as low as –10°C before it finally freezes.

It only takes a quick click to activate the heat pouch. You will notice that the internal trigger button has two distinct sides. If you use your thumb and forefinger and squeeze quickly, you will not need to worry about which side is up.

Instructions

The heat pad has been shipped in a solid condition. This is done to avoid damage. To return to a ready state, just follow the instructions printed on the pack.

When recycling the heat pad, you do not need to wrap it up in a towel if you use a double boiler or a pot with a strainer-type insert such as a pasta pot. The problem is that the heat pad is denser than water and sinks immediately to the bottom of the pan. The pan bottom will then be hot enough to melt the vinyl package. Any method to keep the heat pad off the bottom of the pan is acceptable.

Resources

Conceptual Physics Teacher Lab and Student Notes: https://www.arborsci.com/blogs/cool-labs/lab-23-5-heat-warming-by-freezing

Related Products

Experiencing Supercooled Crystallization (P3-1020) This fascinating hands-on experiment utilizes a heat pad to visually demonstrate crystallization and the subsequent release of latent heat. Contains twelve 3" x 3" pouches, one 7.5" x 7.5" pouch, 600g of sodium acetate, and the instruction manual.

Sodium Acetate Trihydrate 500 g (P3-1015-03) Experiment with creating your own heat pack. Sodium Acetate Trihydrate is the active ingredient commonly found in heating pads and hand warmers.

Drinking Bird (P3-5001) Known as the Drinking Bird, Drinking/Dunking Bird, Drinking Happy Bird or even a Dippy Bird. Whatever you call this loveable little drinking bird toy it is back and disguised as a great physics demonstration of heat and thermodynamics.