Chemical Heat Packs

Many types of sports-related pain come from strained muscles. Heat application eases pain by dilating the blood vessels surrounding the painful area. Increased blood flow provides additional oxygen and nutrients to help heal the damaged muscle tissue. In this activity, you'll measure the amount of heat produced from a commercial reusable heat pack.

Stuff You'll Use:

▸reusable heat pack ▸480-mL (16-ounce) or larger Styrofoam® cup ▸thermometer ▸graduated cylinder ▸water

What to Do:

1. Create a calorimeter setup to determine the temperature change (ΔT) and the amount of heat produced by the heat pack: Place the heat pack in the large Styrofoam cup. Measure and record the volume of room-temperature water needed to totally cover the heat pack. Record the temperature of the water.
2. Remove the heat pack from the cup, activate it, and submerge it in the water. Record the temperature every few minutes until it stops rising.
3. Calculate the ΔT using the starting and ending temperatures. Calculate the heat released (q) in the crystallization process using the equation below where m is the mass of the water used and C_P is the specific heat (for water, C_P is 4.18 J/g•K).

$$q = m \times \Delta T \times C_P$$

4. *How much heat will be needed to reactivate the heat pack?*

How It Works:

The heat pack contains a supersaturated solution of the salt sodium acetate in water. A supersaturated solution is one in which there is more solute (sodium acetate) dissolved in the solvent (water) than would normally be possible at a given temperature. This is accomplished by heating the solution to a higher temperature and allowing it to slowly cool.

A supersaturated solution is inherently unstable but remains as a solution until something initiates crystallization. In the heat pack, the flexing of the metal disk creates a shock wave that is sufficient to initiate crystallization. Once this occurs, the supersaturated solution immediately crystallizes to form the more stable solid. Heat is given off as the solution crystallizes.

More Fun?

Learn more about the topics addressed in this activity. Terrific Science Press (www.terrificscience.org/sciencestore) offers the following book that includes activities involving the chemistry of heat, phase changes, and heating solutions:

▸▸ *Teaching Chemistry with TOYS*

Want to buy a heat pack? Visit the Terrific Science Toys, Etc. Store at www.terrificscience.org/sciencestore.

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