THE ROYAL SOCIETY OF CHEMISTRY

32. A hot dinner from a can

Time

1–2 h.

Curriculum links

Simple thermochemistry and enthalpy calculations.

Group size

2– 4.

Materials and equipment

Materials per group

- fresh calcium oxide (approximately 50–100 g per group). The calcium oxide must not be slaked and fresh commercial CaO is recommended; alternatively CaO can be obtained by roasting $CaCO_3$ in a kiln (some institutions may have a Muffle furnace). The temperature required is over 1000°C so a Bunsen burner is not hot enough. The CaO should be tested before the session to avoid disappointment.

Equipment per group

Items from the junk list (pXX), including types of insulation

- glass stirring rods
- glass beakers
- boiling tubes
- test-tubes
- thermometers
- safety glasses.

Safety

Eye protection must be worn.

The reaction can be unpredictable (probably because $Ca(OH)_2$ forms on the surface of the CaO). In one case a student added 5 cm^3 of water to about 50 g of CaO all at once and the evolution of heat was very rapid – cracking the pyrex beaker quite violently. Care should be taken in disposing of unreacted CaO as a delayed exothermic reaction could occur in the waste pipe if it is accidentally washed down the sink!

Risk assessment

A risk assessment must be carried out for this activity.

Commentary

It is suggested that the students use the exothermic reaction between calcium oxide and water to produce a steady supply of heat.

$CaO(s) + H_2O(l) \longrightarrow Ca(OH)_2(s)$

The students will need to calculate the quantities of heat involved before designing the system. The enthalpy change for the reaction above is approximately –65 kJ mol^{-1}. This information may be provided or they may calculate it by using standard molar enthalpy changes obtained from a data book. They should then find the heat transferred when 1 g of calcium oxide reacts with water. During trials the students were encouraged to do small-scale trial runs and this worked particularly well. The specific heat capacity of the food may be approximated to that of water for the purposes of this activity.

An important criterion in assessing the final design is that the system should be as compact and light as possible. 'Hotcans' that work on this principle can be bought in camping shops and the best student designs could be compared with the commercial product.

Extension

The students could be asked to consider how the proposed device would perform under adverse weather conditions – *ie* would it work below freezing point?

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▼ Produce a design for a self-heating can. The aim is to heat the food contained in a standard size tin to 65°C and to maintain it at this temperature for up to 60 minutes.

The can is intended for use on a camping expedition. It should be convenient to carry and easy to use; and the food will be eaten straight out of the can.

▼ Make a prototype for demonstration at the end of the session.