

**CLEAPSS SCHOOL SCIENCE SERVICE**

**Risk Assessment (to meet the COSHH and/or Management Regulations)**

<b>Applicant:</b>	Education manager (schools and colleges)
<b>School/LEA:</b>	Royal Society of Chemistry
<b>Operation:</b>	Reacting a "jelly baby" with molten potassium chlorate

**Details of operation:**

15 g of reagent grade potassium chlorate(V) is weighed into a Pyrex boiling tube. The tube is clamped at a slight angle to the vertical. The apparatus is surrounded by safety screens and the potassium chlorate(V) is heated until it melts. The demonstrator, wearing a full face shield and heat resistant gloves, uses tongs to drop a jelly baby into the melt.

**It is the responsibility of the applicant to inform the CLEAPSS School Science Service if these details of the operation are substantially inaccurate.**

<b>Substance(s) possibly hazardous to health, etc:</b>	(a) Potassium chlorate(V) (b) Jelly babies are a form of confectionery, with stated contents sugar, glucose syrup, water, gelatine, citric acid, flavourings, colours.
<b>Classification under CHIP Regulations 2002</b>	(a) oxidising: explosive when mixed with combustible material harmful: harmful by inhalation and if swallowed (b) -
<b>Particular risks/precautions:</b>	See CLEAPSS <i>Hazcard 77, Potassium chlorate.</i>  Bretherick's <i>Handbook of Reactive Chemical Hazards</i> (6 <sup>th</sup> edition, 1999, Butterworth) states:  "Potassium chlorate: Although most explosive incidents have involved mixtures of the chlorate with combustible materials, the exothermic decomposition of the chlorate to chloride and oxygen can accelerate to explosion if a sufficient quantity and powerful enough heating are involved.....  Potassium chlorate with Sugars: A stoichiometric mixture with sucrose ignites at 159°C and has been evaluated as a rocket propellant. Dry powdered mixture with glucose containing above 50% chlorate explode under a hammer blow. Pyrotechnic mixtures with lactose begin to react exothermically at about 200°C, when the lactose melts and carbon is formed ..."
<b>Maximum exposure limits:</b>	-
<b>Occupational exposure standards:</b>	-

## Risk assessment

Potassium chlorate(V) is notoriously unstable. The thermal decomposition of potassium chlorate(V) has been a common activity in school science in the past. Catalysed by manganese dioxide it demonstrates catalysis in a clear and striking manner, although problems have arisen when the manganese dioxide has been impure, or charcoal (very similar in appearance) has been used in its place. Nevertheless, the use of potassium chlorate(V) in schools is well established and guidance on safe use in some contexts is given on the relevant CLEAPSS *Hazard*.

The proposed activity involves the use of a jelly baby which is not covered by the *Hazard* or similar safety texts. Most of the texts used by education employers as model risk assessments warn of the risk of dangerous or unstable mixtures with sugars and recommend that such mixtures should not be made. A jelly baby contains sugars, but it is a single lump rather than crystals or powder, thus the surface area exposed (and hence the rate of reaction) is less. In addition, the sugars will be diluted by the water present, again reducing the rate of reaction, and making an explosion much less likely.

The conclusion is that notwithstanding the general advice that chlorate/sugar mixtures should not be made in schools, jelly babies present a safe, but spectacular demonstration of the power of potassium chlorate as an oxidising agent, and of the energy stored in foodstuffs **provided that certain safety precautions are adhered to.**

**1 The activity must be carried out only by teachers who should practice it in advance. They should NOT be tempted to increase the scale of the operation.**

**2 Teachers must take steps to prevent theft of the chemicals, in case pupils are tempted to repeat the activity outside school.**

**3 In case of explosion, the apparatus should be surrounded by safety screens (or in part by a wall). A closed/sealed apparatus must NOT be used.**

**4 The reaction is very vigorous and molten potassium chlorate(V) and decomposition products are likely to shoot out of the boiling tube. The safety screens should be arranged to prevent the ejected particles from scattering around the room and especially landing on combustible objects. There should be heat resistant mats to protect the bench.**

**5 Bench mats and safety screens may be spattered with potassium chlorate(V). After the reaction, this should be carefully washed away with plenty of water, to prevent the possibility of inadvertent combustion.**

**6 Spectators must be several metres away from the demonstration, and should wear eye protection.**

**7 The demonstrator will, inevitably, be closer to the demonstration than the spectators and should make use of the additional protection provided by a full face shield.**

**8 The demonstrator's hand is at some risk during a few seconds whilst the jelly baby is being dropped in to the melt, even if tongs are used. Heat resistant gloves should be worn.**

**9 As impurities can cause an explosion, care should be taken to ensure that the potassium chlorate is pure (use reagent grade) and that the boiling tube is clean (and free, for example, from traces of carbon).**

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If further clarification is required, members can contact:

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