

Title: Bengal flames

Work instructions

Task: Use concentrated sulfuric acid to induce a strongly exothermic disproportionation of potassium chlorate, which ignites the sucrose. Colour the oxidation flame of sucrose with the appropriate nitrate of the *s* or *p* element.

Theory

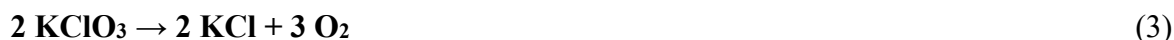
Potassium chlorate is decomposed by concentrated acid in a highly exothermic manner according to the Eq



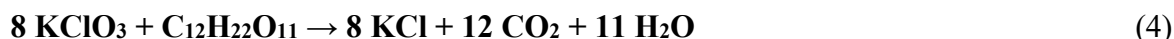
produces chlorine dioxide, a highly reactive oxidising agent, which decomposes into oxygen and chlorine



The high temperature of reaction (1) also causes the thermal decomposition of potassium chlorate



Until sufficient oxygen is formed, potassium chlorate forms an explosive mixture with sucrose, which explodes at high temperature or pressure even in the absence of oxygen according to the Eq



When the entire amount of potassium chlorate has reacted, sucrose is oxidized by the oxygen produced by the preceding reactions, or from the air while burning with a flame in which the nitrate is also vaporized, and the corresponding nitrate cation stains the flame.



The colouring of the flame by the cations present can be determined from the following table

Cation	Flame color
K^+	pink-purple
Sr^{2+}	crimson-red
Cu^{2+}	blue

Cation	Flame color
Na ⁺	yellow

Equipment: mortar and pestle, spoon, beaker, pipette, protective shield, fume hood

Chemicals: potassium chlorate, sucrose, concentrated sulfuric acid, potassium nitrate, sodium nitrate, strontium nitrate, copper nitrate

Procedures:

- Put 2 spoons of KClO₃, 2 spoons of sugar, 1 spoon of the corresponding nitrate into a mortar.
- Mix the mixture well. Wear gloves and a shield during this operation, as the mixture may spontaneously ignite with pressure.
- Using a pipette, add a few drops of concentrated sulfuric acid.
- The mixture will ignite, a small explosion will occur, and then the mixture will begin to burn with a colored flame depending on the cation of the nitrate used.

Management of chemical substances

Chemicals	Form	H-statements	P-statements
KClO ₃	Solid	H271, H302 + H332, H411	P210, P220, P261, P273, P280
H ₂ SO ₄	Liquid, 96%	H290, H315, H319	P260, P280, P302 + P352, P305 + P351 + P338, P337, P313
Sucrose, commercial	Solid	---	---
KNO ₃	Solid	H272	P220
NaNO ₃	Solid	H272, H319	P220, P280, P305 + P351 + P338, P337 + P313
Sr(NO ₃) ₂	Solid	H271, H318	P210, P280, P305 + P351 + P338, P310
Cu(NO ₃) ₂ ·3H ₂ O	Solid	H272, H302, H315, H318, H400	P220, P273, P290, P305 + P351 + P338

Name of the project: Digitization of chemistry experiments to improve the quality and support chemistry teaching in secondary schools
Acronym: ChemIQSoc
Project number: 2021-1-SK01-KA220-VET-000027995



Sources of risk and assessment of risk severity

Possibility of burns and eye damage.

Waste management method

Certified chemical waste disposal company.

Risk reduction measures

Lab coat, gloves, shield, keeping a safe distance.