

Title: Zinc volcano

Work instructions

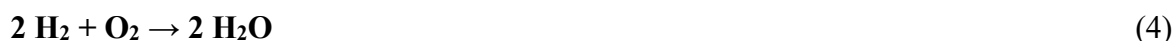
Task: Water-induced redox reactions of a mixture of zinc and ammonium salts achieve exothermic explosive-pyrophoric effects.

Theory

Ammonium salts decompose violently into gaseous products in the presence of zinc metal and water, causing an explosive-pyrophoric decomposition process with the development of heat and light effects



If ammonium chloride is also present, the explosion is amplified as explosive products are formed:



Equipment: porcelain bowl, large iron bowl with sand, glass rod, spoon for chemicals, plastic syringe, fume hood

Chemicals: ammonium nitrate, ammonium chloride, zinc

Procedures:

1. Separately weigh 4 g of NH_4NO_3 , 1 g of NH_4Cl and 4 g of Zn.
2. Grind the individual components of the mixture separately.
3. Then add them carefully to one porcelain dish and mix gently. When mixing the mixture, do not lean over it in case spontaneous ignition occurs. Spontaneous ignition may be caused by moisture in a component or utensil.
4. Place the bowl with the mixture in a large iron bowl with sand in the fume hood.
5. Finally, add a few drops of water onto the mixture with a syringe and observe the rapid ignition of the prepared mixture.

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



Management of chemical substances

Chemicals	Form	H-statements	P-statements
NH_4NO_3	Solid	H272, H315, H319, H335	P220, P261, P305 + P351 + P338
NH_4Cl	Solid	H302, H319	P305 + P351 + P338
Zn	Solid, powdered	---	---

Sources of risk and assessment of risk severity

Possibility of skin burns and eye damage.

Waste management method

Certified chemical waste disposal company.

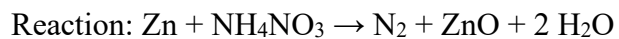
Risk reduction measures

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

Worksheet

Calculations

1. In a reaction with ammonium nitrate, 4 g of zinc reacted. Calculate:
 - a. the amount of zinc oxide formed
 - b. the volume of nitrogen formed at 20°C and pressure 101,3 kPa.



$M(\text{Zn}) = \dots\dots\dots \text{g}\cdot\text{mol}^{-1}$, $M(\text{ZnO}) = \dots\dots\dots \text{g}\cdot\text{mol}^{-1}$

Amount of zinc oxide

Nitrogen volume

Observation

1. Describe the course of the zinc volcano experiment.

Questions

1. Write the state reaction of zinc with ammonium nitrate.
2. Write the oxidation and reduction half-reactions in the reaction of zinc with ammonium nitrate.
Oxidation:
Reduction:
3. Decide whether zinc is an oxidizing or reducing agent in the reaction with ammonium nitrate.
4. Write the reactions in the presence of ammonium chloride.
Reaction No. 1:
Reaction No. 2:
Reaction No. 3:
5. Explain why it is necessary:
 - a. to spread out the individual components of the mixture separately
 - b. place the bowl with the mixture in the iron bowl with the sand
 - c. carry out the experiment in the fume hood
 - d. keep the mixing aids dry
6. Explain what pyrophoric substance means.

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



Conclusion

Instructions to elaborate conclusions:

1. Briefly summarise the aim of the demonstration experiment. What was the experiment trying to find out or prove??
2. Describe what you observed during the experiment. What were the most important results and what connections did you notice?
3. Explain the results using theory. How do the results confirm or refute the assumed principles?
4. Think about the practical meaning. How can the findings from the experiment be used in real life or in further study?

Disclaimer

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or Slovak Academic Association for International Cooperation, National Agency for the Erasmus+ Programme for Education and Training Sectors. Neither the European Union nor the granting authority can be held responsible for them.