Potassium dichromate and sodium dichromate

Posted by Anonymous on Tue, 2014-10-14 17:33

Potassium dichromate and sodium dichromate:

We have combined four questions to be answered here

- **Determination of alcohol content in wine:** A prac for this has been suggested for our Year 12 chemistry students. The prac asks for 0.04 M K2Cr2O7. Is this solution okay for the students to use? I have viewed the SDS for potassium dichromate and am also wondering about the fertility and other health risks to the lab technician in preparation of these solutions.
- **Chemical cells:** When making a chemical cell (Year 9 Energy—Electricity) using a zinc electrode and a carbon electrode in acidified potassium dichromate, what molarity should the dichromate be and how much sulfuric acid (what molarity) do I add to it to acidify it?
- **Dichromic acid glass cleaner waste:** I use concentrated sulfuric acid and sodium dichromate in the glass cleaner I make. I reuse the cleaner until it is no longer active and changes pH. The residue from the glassware is diluted with water when being washed and put down the sink. Should I be using a different glass cleaner or procedure?

Chemical disposal (chromium): I have a small amount of potassium dichromate and potassium chromate for disposal. What is the best way to do this?

Voting:

No votes yet

Australian Curriculum:

Energy transfer through different mediums can be explained using wave and particle models

Year Level:

7
8
9
10
Senior Secondary

Laboratory Technicians:

Laboratory Technicians

Showing 1-2 of 2 Responses

Answer by labsupport on question Answer by labsupport on question Answer by delese on question Chemical Cell

Submitted by on 20 October 2014

Answer reviewed 27 February 2023

Hazardous properties of dichromate salts

Dichromate salts are toxic and corrosive irritants. They are carcinogenic to humans (classified as Group 1 carcinogens),[1,2] can affect the respiratory and gastrointestinal tract. They can affect the immune system, fertility or the unborn child. They have the ability to cause allergic reactions and are toxic for the environment.

It is important to consider the risks involved prior to purchasing and using chemicals.

Recommendations for the use of dichromate salts

It is recommended that stocks of chromium(VI) salts, namely sodium and potassium dichromate, be kept to a minimum and that only one bottle of either the sodium or potassium salt be stored at any one time.[3]

Minimise exposure to dichromate by using low concentrations of the reagent in micro quantities for only a short period of time.

In the school setting, dichromate salt solutions can be used to demonstrate Le Chatelier's Principle in aqueous solutions, and to differentiate between primary, secondary and tertiary alcohols.

Science ASSIST recommends potassium dichromate or sodium dichromate solution (? 0.1 M) should be **restricted to Year 12 students only**. Micro-chemistry should be used to ensure exposure chemical is kept to a minimum.

Preparation of dichromate salt solutions

To minimise exposure to teachers, students and laboratory technicians, we recommend purchasing commercially available (e.g., 0.1 M) potassium dichromate solution, rather than the solid chemical.

When using the pure chemical Science ASSIST recommends:

- Before using Chromium (VI) salts a site-specific risk assessment should be conducted. See the Science ASSIST Risk Assessment Template.[4]
- Suitable PPE such as protective clothing, nitrile gloves, closed-in shoes and safety glasses should be worn.
- Fume cupboards are used at all times.
- Always wash hands immediately after handling.
- Pregnant women should carefully consider the risks before proceeding.
- Stocks of sodium and potassium dichromate should be kept to a minimum. Only one bottle of either the sodium or potassium salt should be stored at any one time.

- Store the chemical in a cool, dry, well-ventilated area in suitable tightly closed containers protected from direct sunlight, moisture, heat and all sources of ignition.
- Keep the container away from incompatible chemicals (See SDS for details).
- Prepare 0.1 M solution of potassium/sodium dichromate in distilled water and keep in a properly labelled and tightly closed bottle. This solution can then be used to prepare solutions of lower concentrations.

Determination of alcohol content in wine

Science ASSIST advises against using potassium and sodium dichromate solutions for larger-scale, analytical activities. Risks associated with high degrees of exposure (large volume and time), logistics, cost of waste disposal and clean-up outweigh the educational benefits.

The drawbacks of using dichromate salt solutions for titrations are:

- the titration requires fairly large quantities of dichromate solution;
- Students and teachers need to be highly competent in titration techniques and laboratory clean-up to avoid exposure to any hazards;
- Large quantities of contaminated glassware would be generated. Hazardous chromium residues may pose a risk if not correctly decontaminated;
- Dichromate waste is not to be disposed of in the sink. The large volumes created by the activity would require a licensed chemical waste contractor to dispose of a large amount of waste generated.

Alternative activities

Determination of the alcohol content of wine

To avoid the use of potassium dichromate as an indicator for the alcohol content of wine, the following distillation process can be used.

- Distill a sample of wine to give a distillate of ethanol and water, leaving behind sugar and other impurities. Add Water to make up the ethanol–water solution to the original volume.
- Use a hydrometer to determine the density of the ethanol–water mixture.
- Calculate the percentage of alcohol using reference tables of ethanol–water mixture densities and express as a percentage volume per volume. [5, 6]

Determination of the tannin content in wine

Tannins are the naturally occurring polyphenols found in fruit skins, seeds, leaves and plants which give wines their characteristics bitterness, dryness and astringency. Red wines contain more tannin than white wine, although white wines can gain tannin from being aged in wooden barrels. Tannins act as a natural antioxidant to protect the wine and that is why some wines age so well. The tannin content in red wine can be determined using potassium permanganate solution and an indigo carmine indicator.[7]

Making a chemical cell

Using potassium dichromate in a Year 9 activity is advised against. In the school science setting, potassium dichromate should be limited to senior chemistry practicals and be under strict supervision.

If the purpose of the activity is to demonstrate a chemical cell generating a small electric current, then we strongly recommend that another activity using safer chemicals be substituted. There are many possibilities here including:

- Al and Cu electrodes with salt water solution

- Cu and Zn electrodes with copper & zinc sulfate solution
- Fruit batteries using lemons, kiwi fruit

A web search on electrochemistry experiments will locate useful websites such as the one listed in the references below.[8, 9]

Dichromic acid glass cleaner waste

Science ASSIST strongly advises against the use of chromic acid solution to clean glassware.

Chromic acid is an environmental toxin and is considered to be a human carcinogen. Any chromium solutions should not be discharged to the environment but should be stored for collection via a licenced chemical waste contractor. For more information about cleaning glassware, see our previously answered Q&A Cleaning glassware

Waste Disposal

Chromium (VI) compounds, such as dichromate and chromate salts, are classified as Category 1 Carcinogens, are toxic to the environment and should be handled with care. Appropriate PPE—including chemical-resistant gloves (nitrile gloves) should be worn when handling these substances and an operating fume cupboard should be used where possible.

Whether you have these substances in solid form or in solution, we recommend that you store them in a suitable container for collection by a licensed waste disposal contractor.

The hazards posed by chromium (VI) can be lessened by treatment with a reducing agent to give a solution of chromium (III). This is also a suitable treatment for spills of chromium (VI) solutions. Our Chemical Management Handbook10 provides some brief instructions for carrying this out.

Water authorities in Australia accept low concentrations of small quantities of chromium salts in wastewater; the washing and rinsing water used in removing Cr residues on contaminated glassware would be unlikely to exceed these limits and should be acceptable to discharge to sink.

References

1 Chemsupply.com.au website (accessed October 2022), '*Safety data sheets – Potassium dichromate'* https://www.chemsupply.com.au/csascientific/safety-data-sheets/?keywords...

2 International Agency for Research on Cancer, Monograph, IARC (2018, July), *'Chromium (VI) Compounds* , *Volume 100C* https://monographs.iarc.who.int/wp-content/uploads/2018/06/mono100C-9.pdf

3 Science ASSIST. (2021). *List of recommended chemicals for science in Australian schools 2021*, Retrieved from the Science ASSIST website, https://assist.asta.edu.au/resource/4669/list-recommended-chemicals-scie...

4 Science ASSIST website (2014, July), Risk assessment template https://assist.asta.edu.au/resource/2298/risk-assessment-template?search...

[5]Bee and Thistle Winery website, M. MacInnis (2020, March 4), *'Alcohol by volume using distillation/hydrometry technique'*, https://beeandthistlewinery.wine/winemaker-weekly/2020/3/3/alcohol-by-vo...

6 Senior Chemistry, Deadly EEIs and student experiments, R. Walding (2022, August 11), Click wine and soft drink titrations to find *'1. Alcohol content by distillation'* https://seniorchem.com/index.html

7 Senior Chemistry, Deadly EEIs and student experiments, R. Walding (2022, August 11), Click wine and soft drink titrations to find *'11. Polyphenol index or permanganate index'* https://seniorchem.com/index.html

8 Senior Chemistry, Deadly EEIs and student experiments, R. Walding (2022, August 11), *'Electrochemistry experiments'* http://seniorchem.com/index.html#electrolysis

9 Royal Society of Chemistry website, (accessed October 2022) '*Electrochemical cells/practical videos/16-18 students'* https://edu.rsc.org/practical/electrochemical-cells-practical-videos-16-...

10 Science ASSIST, 2018, Chemical Management Handbook for Australian Schools – Edition 3, Science ASSIST website, https://assist.asta.edu.au/resource/4193/chemical-management-handbook-au...

Answer by Karin on question Chemical Cell

Submitted by on 17 October 2014

I have never heard of a prac that uses dichromate to make an electro-chemical cell. Dichromate is toxic and carcinogenic, I wouldn't use it for year 9s. A much safer way of making a cell would be to make the good old Daniell cell, this site has a good write up about it. http://www.nuffieldfoundation.org/sites/default/files/11_Cells_and_batte... You can substitute the copper and zinc sulfate with copper and zinc nitrate (all 1M solutions), the salt bridge should be made from potassium sulfate or nitrate to correspond with the anion used in the cell. If the only purpose of the prac is to show students that the cell produces a voltage, you can further increase the safety of the prac by reducing the concentrations of the copper and zinc to 0.1M.
