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Drying of anhydrous sodium carbonate

Posted by Anonymous on Thu, 2016-06-09 13:44

Drying of anhydrous sodium carbonate: I am about to standardise a sodium hydroxide solution, but I have been wondering about the recommended temperature and time for drying anhydrous sodium carbonate as the first step in the process.

I have always done it for many hours at a high temperature, but recently I've been told on good authority that it just needs to be at 60 degrees C for an hour and that the higher temperature would cause decomposition.

Some sources say 270 degrees for 30 minutes and others have recommended 100 degrees C.

Would you please advise me of the temperature and time?, with some definitive references?

Voting:



No votes yet

Year Level:

Senior Secondary

Laboratory Technicians:

Laboratory Technicians

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Drying of anhydrous sodium carbonate

Submitted by sat on 24 June 2016

Answer Reviewed 19 February 2023

Anhydrous sodium carbonate is a common primary standard used in senior high school chemistry. This substance can absorb moisture whilst in storage after opening the original sealed container. Therefore. It is

a standard recommended practice to dry the chemical to eliminate this moisture before using as a primary standard in titrations.

After reviewing several references, we recommend heating sodium carbonate in an oven in the range of 250-300°C, with 270°C as an optimum temperature for at least 30 minutes. This is best done spread evenly in a shallow dish, such as a watchglass or an evaporating dish. Cooling the heat dried sample and storing it until it is required in a desiccator is important to eliminate re-absorption of moisture. Note that after placing the heated salt in the desiccator, venting of the desiccator may be required to release the pressure of heated air. Further assurance of elimination of all the moisture can be achieved by repeating the heating /cooling and weighing to a constant mass.

Alternative methods

If there is no access to an oven at 270°C, heat in an oven at 110°C for at least an hour. As the monohydrate is reported to lose water at 100°C⁶ and as water boils at 100 °C, heating at 60°C for an hour may not effectively remove absorbed water. Another alternative is to heat over a Bunsen burner for 30 minutes.

Decomposition of sodium carbonate

Reputable sources suggest that decomposition of sodium carbonate begins at 400°C and occurs at its melting point of 851°C. References suggest that decomposition of sodium carbonate is unlikely to occur when heated over a Bunsen burner.

Additional information

The following information was sourced:

Heating sodium carbonate

- From Armarego and Chai (2009): analytical grade sodium carbonate should be heated at 260-270°C for 30 minutes and then allowed to cool in a desiccator.¹
- The Joint FAO/WHO Expert committee on Food additives describes the preparations of Test Solutions for volumetric analyses. For preparation of sodium carbonate it specifies drying at 270°C for 1 hour. (p244, 288)²
- The Food and Agriculture Organisation of the United Nations produced a monograph of sodium carbonate recommended to heat to 70°C first and then to raise to 250-300°C.³
- Asakai, T. Ogura, T. Murayama, M and Tanaka, T. (2008) concluded that the optimum drying conditions are at 300°C for 2 hours.⁴
- Newkirk, A.E. and Aliferis (1958) noted the recommended drying temperature of sodium carbonate is in the range 250°C to 300°C, whilst also stating that it is thermally stable close to its melting point of 851°C. ⁵
- From The Merck Index (2013): sodium carbonate monohydrate will become anhydrous when heated at 100°C. ⁶
- The Creative-chemistry website suggests heating over a Bunsen burner for 30 minutes or in an oven at 110°C for an hour. ⁷

Decomposition of sodium carbonate

- Newkirk and Aliferis point out that, for drying sodium carbonate, the upper temperature limit of 300°C is the same as the temperature at which sodium carbonate begins to react with silica. They suggest that reports of sodium carbonate having decomposed below 800°C, might in fact be cases where it has reacted with the container in which it was heated. ⁵

- The NCBI states that sodium carbonate begins to decompose at 400°C and forms carbon dioxide and toxic Na₂O. 8
- Clarke states that apart from Lithium, the rest of the Group 1 carbonates do not decompose at laboratory temperatures. 9
- The Chemguide website states that apart from Lithium, the rest of the group 1 carbonates don't decompose at Bunsen burner temperatures. 10
- The Royal Society of Chemistry and the Nuffield Foundation developed a class activity to investigate the decomposition of carbonates, which confirms the relative difficulty of decomposing sodium or potassium carbonate. 11

References

- 1 Armarego, W.L.F., Chai, C.L.L. (2009). *Purification of Laboratory Chemicals*, 6th Edition, Butterworth-Heinemann.
- 2 Joint FAO/WHO Expert Committee on Food Additives. (2006). *Combined compendium of food additive specifications. Volume 4 Analytical methods, test procedures and laboratory solutions used by and referenced in the food additive specifications*, FAO JECFA Monographs 1. FAO: Rome. Retrieved from FAO website: <https://openknowledge.fao.org>
- 3 Food and Agriculture Organization. (2006). *Sodium Carbonate*. Retrieved from FAO website: <https://www.fao.org/food/food-safety-quality/scientific-advice/jecfa/jecfa-additives/detail/en/c/197/>
- 4 Asakai, T., Ogura, T., Murayama, M., and Tanaka, T. (2008). *Investigation of Drying Conditions for High-Purity Sodium Carbonate. Bunseki Kagaku* (57) 49-53. Retrieved from J-STAGE website: https://www.jstage.jst.go.jp/article/bunsekikagaku/57/1/57_1_49/_article
- 5 Newkirk, A.E., and Aliferis, I. (1958). *Drying and decomposition of sodium carbonate*. *Analytical Chemistry*, 30, 982-984 DOI: 10.1021/ac60137a031. Retrieved from ACS Publications website: <https://pubs.acs.org/doi/abs/10.1021/ac60137a031>
- 6 O'Neil, Maryadele J. (2013). *The Merck Index: An Encyclopedia of Chemicals, Drugs, and Biologicals: Edition 15*, RSC Publishing, p 1537.
- 7 Saunders, N. (2003). *Volumetric Analysis 1. To make a standard solution of sodium carbonate*. Retrieved from Creative Chemistry website: <https://www.creative-chemistry.org.uk/documents/N-ch1-35.pdf>
- 8 *Sodium carbonate*. Retrieved from National Center for Biotechnology Information (NCBI) website: <https://pubchem.ncbi.nlm.nih.gov/compound/10340#section=Information-Sources>
- 9 Clarke, J. (2020). *Group 1 Compounds*. Retrieved from Chemistry Libre text library website: [https://chem.libretexts.org/Bookshelves/Inorganic_Chemistry/Supplemental...\(Inorganic_Chemistry\)/Descriptive_Chemistry/Elements_Organized_by_Block/1_s-Block_Elements/Group__1%3A_The_Alkali_Metals/2Reactions_of_the_Group_1_Elements/Group_1_Compounds](https://chem.libretexts.org/Bookshelves/Inorganic_Chemistry/Supplemental...(Inorganic_Chemistry)/Descriptive_Chemistry/Elements_Organized_by_Block/1_s-Block_Elements/Group__1%3A_The_Alkali_Metals/2Reactions_of_the_Group_1_Elements/Group_1_Compounds)
- 10 *Some compounds of the group 1 elements*. Retrieved from Chemguide website <https://www.chemguide.co.uk/inorganic/group1/compounds.html>
- 11 Royal Society of Chemistry. (2016). *Thermal decomposition of metal carbonates*. LearnChemistry. Retrieved from Royal Society of Chemistry website: <https://edu.rsc.org/lcredir/learn-chemistry/resource/res00000450/thermal-decomposition-of-metal-carbonates?cmpid=CMP00005971>