

# [Quantitative analysis of soda ash essay sample](https://assignbuster.com/quantitative-analysis-of-soda-ash-essay-sample/)

Titration is a method of chemical analysis that can be used to determine the amount of analyte present in the solution through the determination of the endpoint of the reaction (Dartmouth College, 2000). In the experiment, the percent composition of soda ash was determined. Soda ash could be composed of NaOH, Na2CO3, NaHCO3, or a mixture of NaOH and Na2CO3, and NaHCO3 and Na2CO3. A mixture of NaOH and NaHCO3 is impossible because OH- and HCO3- will react to form CO3- and H2O. This reaction could cause errors in the analysis because it could change the concentration of the HCl standard. To be able to determine the composition, acid-base titration, which uses the concept of a neutralization reaction, was used. Also, double-indicator titration was used since soda ash could contain two bases. This means that there could be two endpoints in the titration process. Phenolphthalein and methyl orange indicators were used. Bromocresol green indicator could also be used in place of methyl orange indicator as it is also an acid-range indicator and actually encompasses a better and more suitable pH range for the experiment. The primary standard that was used to standardize HCl (titrant) was Na2CO3 which has 99% purity. CO32- + H3O- HCO3- + H2O [1]

HCO3- + H3O+ H2CO3 + H2O CO2 + 2H2O [2]   
According to the University of Adelaide, primary standards must be extremely pure, stable, has no waters of hydration, and has a high molecular weight. These characteristics qualify Na2CO3 to be a valid primary standard for HCl. However, NaOH cannot be used as a primary standard for HCl. Obviously, NaOH has a relatively low molecular weight. Moreover, it easily absorbs water from the air, and it cannot be weighed and diluted so getting its exact concentration would be not so accurate (Spurlock, 2012). Soda ash was weighed and diluted with boiled water. Boiled water removes CO2 in the solution which could form H2CO3 when dissolved in water. H2CO3 could react with the base components of soda ash which could change the soda ash’s composition concentration. Since the phenolphthalein indicator has a higher pH range (8. 30-10. 00) it was used first until the solution becomes clear. For the methyl orange indicator, the solution was heated when the color started changing. This is to remove the CO2 that forms when HCO3- was being neutralized. Formation of CO2 contributes to the change in color.

The volumes of HCl used at the phenolphthalein were 4. 10 ± 0. 05 mL and 4. 30 ± 0. 05 mL. The volumes of HCl used at the methyl orange endpoint were 8. 20 ± 0. 05 mL and 11. 8 ± 0. 05 mL. The second volume is higher than the first volume. This means that more acid was used to neutralize HCO3- than CO32-. If only CO3- is present, both volumes must be equal theoretically because there is supposedly the same amount of moles being titrated. This means that there is more HCO3- than CO32- so it can be concluded that HCO3- present. From these volumes and the concluded components on the soda ash, the percent composition was calculated. For the molarity of HCl, the equation

It was multiplied by two since the ratio of the H+ and CO32- is two. The average of the computed molarity was then used to calculate for the percent composition.

For Na2CO3,   
For NaHCO3   
Table 1. Percent Composition of Soda Ash Components % Composition   
Trial 1 Trial 2 Average   
Na2CO3 13. 0 ± 10. 6 13. 5 ± 11. 1 13. 3 ± 15. 3   
NaHCO3 10. 3 ± 8. 5 18. 7 ± 15. 3 14. 5 ± 17. 5