Determination of Chlorine and Iodine in Water

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Chemistry 131

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Introduction:

The objectives of this lab were to standardize the sodium thiosulfate, because of microorganisms eating it the concentration changes over time and needs to be standardized each day it is used. The moles of KIO_3 were found and from this moles and molarity of thiosulfate were calculated, the molarity was used for the rest of equations to measure chlorine in bathroom tap water and to measure iodine in water by finding the average molarity of iodine in the iodine treated water and the molarity of chlorine in the bathroom tap water. This could have important applications because too much chlorine in water can give it a bad taste so water purification plants must know how much chlorine is in the water after purification so be sure the right amount has been used.

Procedure:

The buret was filled with sodium thiosulfate, using a funnel to pour the solution. Underneath the buret 25mL of KIO was placed into a 250 mL beaker the exact volume was obtained by using a volumetric pipette then 50 mL of deionized water and .5 grams of KI were added and mixed together. 2 mL of glacial acetic was added and the solution turned yellow and was then titrated until the color was almost gone. 1 mL of starch was then added, this turned the solution blue to further reveal the un-reacted iodine and it was titrated until the blue disappeared and all the iodine reacted. The initial volume of the sodium thiosulfate was measured from the buret and then the final volume was taken after the sodium thiosulfate was added to the KIO_3 solution. These were subtracted from one another to get the volume of the amount released into the KIO_3 solution. This was repeated two additional times. This number was then multiplied by the concentration of the solution of KIO_3 solution to get the amount of moles and then calculated with the correct ration. Since 2 moles of sodium thiosulfate are needed for each mole of I_2 and 3 moles of I_2 are formed for each mole of IO_3^- there will be 6 moles of sodium thiosulfate for each mole of IO_3^- used. This calculation was used for each standardization and the average molarity was found.

To determine the amount of chlorine in tap water the buret was again filled with sodium thiosulfate and the initial volume was recorded. The beaker was filled with a 100 mL of bathroom water and .5 grams of KI and 2 mL of acetic acid was added and stirred until it dissolved. The solution was titrated and starch was again added once it lost its yellowish color, this turned the solution blue and the titration continued until it was clear. The final volume was recorded and volume used was found. The moles of thiosulfate was calculated by multiplying the molarity of thiosulfate by liters of thiosulfate, then to get moles of chlorine, moles of thiosulfate was divided by two because two moles of thiosulfate are required for each mole of chlorine, this was used to obtain the molarity of chlorine for bathroom water. This experiment was repeated an additional two times. The

experiment was repeated with 4 iodine purification tablets dissolved in 2 liters of deionized water. The iodine water replaced the bathroom water in the last experiment, this was done three times.

Data:

Standardization of sodium thiosulfate solution

	First standardization	*Second standardization*	*third standardization*
Initial Volume	0mL	3mL	4mL
final Volume	23.5mL	26mL	25mL
Volume used	23.5mL	23mL	21mL
Concentration of sodium thiosulfate	.001	.001	.001

First standardization = .000170 M x .0235 =3.995 10^{-6} mol KIO_3

399.5 10^{-6} mol KIO_3 x 6 = 2.397 10^{-5} mol/.0235L=.001mol/liter thiosulfate

Second standardization = .000170 M x .023 =3.91 10^{-6} mol KIO_3

$399.5\ 10^{-6}$ mol KIO_3 x 6 = $2.346\ 10^{-5}$ mol/.023L=.001mol/liter thiosulfate

Third standardization = .000170 M x .021 = $3.57\ 10^{-6}$ mol KIO_3

$3.57\ 10^{-6}$ mol KIO_3 x 6 = $2.142\ 10^{-5}$ mol/.021L=.001mol/liter thiosulfate

Concentration of iodine

#1 .001/.011=.091mol thiosulfate

.091mol/2=.045mol iodine

.045mol/.100=.455 molarity of iodine

#2 .001/.0115=.087mol thiosulfate

.087mol/2=.043mol iodine

.043mol/.100=.435 molarity of iodine

#3 .001/.0105=.095mol thiosulfate

.095mol/2=.047mol Iodine

.047mol/.100=.476 molarity of Iodine

Concentration chlorine

#1 .001/.002=.5mol thiosulfate

.5mol/2=.25mol chlorine

.25mol/.100=2.5 molarity of chlorine

#2 .001/.0035=.289mol thiosulfate

.289mol/2=.143mol chlorine

.143mol/.100=1.43 molarity of chlorine

#3 .001/.0035=.289mol thiosulfate

.289mol/2=.143mol chlorine

.143mol/.100=1.43 molarity of chlorine

Titration of tap water and Iodine solution

	1st titration		*2nd titration*		*3rd titration*	
	Tap water	*Iodine*	*Tap water*	*Iodine*	*Tap water*	*Iodine*
Initial Volume	14.5mL	4mL	18.5mL	16mL	22mL	4mL
final Volume	16.5mL	15mL	18.5mL	16mL	22mL	4mL
Volume used	2mL	11mL	3.5mL	11.5mL	3.5mL	10.5mL
Concentration of Chlorine and iodine	2.50M	.455	1.43M	.435	1.43M	.476
Average value Molarity	1.786M	.455M				

Conclusion:

The objectives of this lab were to standardize the sodium thiosulfate, because of microorganisms eating it the concentration changes over time and needs to be standardized each day it is used. The moles of KIO_3 were found and from this moles and molarity of thiosulfate were calculated, the molarity was used for the rest of equations to measure chlorine in bathroom tap water and to measure iodine in water. The chlorine was reacted with KIO to form I_2 which was titrated with the standardized sodium thiosulfate solution, the iodine turned the solution yellow which disappeared once all the iodine had reacted, and starch was added to give a blue color to see more clearly if all the iodine had reacted. The volume of sodium thiosulfate used in the titration was used to find the average molarity of iodine in the iodine treated water and the molarity of chlorine in the bathroom tap water. The molarity of the chlorine in the bathroom water was much higher than in the iodine water this may have been caused from titrating to much of the sodium thiosulfate because once we added the starch it did not turn blue this must have meant that all the iodine was already reacted because too much was added. When doing the standardizations they all had the exact same concentration so those were most likely right and with the iodine everything seemed to go correctly and the averages were similar but with the chlorine experiment each titration was over the correct amount of sodium thiosulfate which most likely caused this large error.