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Identification of Cation Reaction and Separation of Group I Cations

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Abstract
Qualitative analysis is an analytical method used to detect the presence of a chemical element in a substance whose composition is unknown. Cations are ions with a positive charge. Qualitative analysis is one of the most effective ways to study chemistry and the elements and their ions in solution. Qualitative analysis can be done in two ways, namely the dry reaction and the wet reaction. The dry method is usually used for solids, while the wet method is used for liquids (solutions) which mostly use water as a solvent. The dry way only provides the necessary information and that information is short term. Meanwhile, the wet method can be used for macro, semi-micro and micro analysis so that there are many advantages, for example the reaction occurs quickly and is easy to work on. Changes that occur in the wet method are the occurrence of precipitate, discoloration of the solution, and the emergence of gas. In the qualitative analysis method we use several reagents including group reagents and specific reagents, these two reagents are carried out to determine the type of anion or cation in a solution. The class reagents used for the most common classification of cations are hydrochloric acid, hydrogen sulfide, ammonium sulfide, and ammonium carbonate. This classification is based on whether a cation reacts with these reagents by forming a precipitate or not. The group I cations form insoluble chlorides, but lead chloride is sparingly soluble in water, and therefore lead never precipitates completely when dilute hydrochloric acid is added to a sample of the remaining lead ions it precipitates quantitatively with H2S in a mutual acidic solution. As well as group II cations, nitrates from group I cations are very soluble among sulfates - sulfates, lead is practically insoluble, while silver sulfate falls more. Cation - Cation in group I consisting of Ag+, Hg+, and Pb2+.

INTRODUCTION

Analytical chemistry is a branch of chemistry that focuses on the analysis of samples/ samples of materials to determine the composition of their chemical structures and functions. Traditionally, chemical analysis (analytical chemistry) is divided into two types, namely quantitative analysis and qualitative analysis. Quantitative analysis aims to determine the amount of an element or compound in a sample. Qualitative analysis aims to determine the presence of an element or chemical compound, both organic and inorganic (Sahirman, 2013).

Qualitative analysis is an effective method that can be used to study the content of a solution. The qualitative analysis method uses group/selective reagents and specific reagents. The use of this reagent aims to determine the cations and anions contained in a solution (Patnaik, 2004).

Identification of anions and cations is carried out by adding certain reagents to the liquid waste and then observing the occurrence of chemical reactions which are indicated by the formation of gas, precipitate or color change. The levels of CN-, and Cr6+ were determined

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using UV-vis spectrophotometry, while the levels of Pb2+, total Cr, Cu2+, Fe2+, and Zn2+ were determined by AAS (Atomic absorption spectrophotometry) (Marwati et al., 2004).

Quantitative analysis is concerned with identifying chemical substances, recognizing what compound elements are in a sample. Generally chemistry is faced with qualitative analysis, a number of elements are separated and identified by precipitation with hydrogen sulfide. Qualitative analysis is concerned with determining how much of a certain substance is contained in a sample. The specified substance is expressed as an analyte (Day and Underwood, 2002)

Cations in the group are precipitated as compounds, using a certain group of precipitating reagents. The resulting precipitate contains cations in a group. Separation of the precipitate from the solution is usually sufficient to do with the centrifugation technique followed by decantation (Chadijah, 2012).

Precipitating reagent when added to the solution produces decantation, namely:

1. Group I cations consist of three metal ions whose chloride salts are insoluble in acidic solutions. The reagent used to define this group is hydrochloric acid, so group I is sometimes called group hydrochloric acid, group chloride, and group silver.
2. Group II cations. Group II sulfide cations are precipitates resulting from the addition of hydrogen sulfide in dilute acid conditions to the sample solution. Group II is often also called hydrogen sulfide acid or group III copper.
3. Group III cations. the ions of group III are all precipitated by hydrogen sulfide in ammonia-ammonium chloride buffer. This group is a basic hydrogen sulfide group or an iron aluminum group.
4. Group IV cations. Calcium and barium are in a group so they have similar chemical properties, and are difficult to separate from each other. Because, it only consists of two cations and has similar properties, because for this group discussed together.
5. Group V cations have a very high degree of solubility, so they are sometimes referred to as soluble groups. (Syamsidar, 2013)

Qualitatively separating metal ions must follow a typical procedure. The substance to be studied must be prepared or converted into a solution. For solids we must choose a suitable solvent. Ions in the cation group are deposited one by one to separate the solution by filtering or rotating it with a centrifuge. The precipitate is washed to free it from the main solution or filtrate and any metal to be separated (Cokrosarjiwanto, 2012).

Cations are positively charged ions for the purpose of systematic qualitative analysis. Cations are classifies into five groups based on their properties. The group reagent used for the classification of the most common cations in hydrolic acid, hydrogen sulfide, ammonium sulfide, and ammonium carbonate. This classification to form a precipitate or not. Cations and Anions are ions that have a positive and negative charge. Systematic qualitative analysis the cations are classified into five groups based on the properties of the cations are clssiefied to some reagent. By using the so called group reagencies systematically, we can determined the presence or obsence of cation groups, and can also separate the groups for furthere examinations. (Chang 2005)

MATERIALS AND METHODS

Material

Cation Identification Reaction

0,4 M Ammonium oxalate, 1M Ammonium sulfat, 1M acetic acid, Acetic uranyl zinc, 4M NH4OH, 1M Na2HPO4, C28N19N5Na2O6S4, 4M NaOH, Na3[CO (NO2)6], Pa HCL, 6M HCL, 6M HNO3, 6M H2SO4, HCL dilute, 4M HNO3, 1M KI, 1M K2CrO4, 1M (NH4)2CO9, 0,1M K4Fe (CN), NH4CNS, KCNS, HgCL2,AgNO3.

Separation Of Group I Cations

Pa HCl, 6M HCl, 2M HCl, 1M K_2CrO_4, 2M NH_4OH, 2M H_2SO_4, 2M HNO_3, 1M KI

Methods

a. Cation Identification Reaction

1. Identification for sodium (Na^+), potassium (K^+) and magnesium ions (Mg^{2+}).
   Into the sample solution, add 1 drop of 0.4 M ammonium oxalate solution and 1 drop of 1 M ammonium sulfate solution, shake. Na^+: take 2 drops of solution a) add 1 M acetic acid solution untilacid reaction. Add 5 drops of zinc uranill acetate solution, shake. Observethe precipitate that forms and see the crystals form under a microscope.Sodium forms diamond crystals.Mg^{2+}: take 10 drops of solution a) basify with 4 M NH_4OH, add 2drops of 1 M Na_2HPO_4 solution, shake. Observe the precipitate that forms.Magnesium: white precipitateThe precipitate was dissolved in a mixture of 2 drops of 1 M oxalic acid and 3 dropswater, shake until dissolved. Add 1 drop of yellow titan ($C_{28}H_{19}N_5Na_2O_6S_4$) and excess $NaOH/NH_4OH$ 4 M. Observe the precipitate that occurs.K^+: sample solution plus 5 drops of 4 M acetic acid, then heat.After it cools down, add 2 drops of $Na_3[Co(NO_2)_6]$ solution, shake. Observeprecipitate that occurred. Potassium: yellow precipitate. Crystal: envelope-shaped. Flame test, Dip the Ni-chrome wire into concentrated HCl, burn it on oxidizing flame until no flame color appears.Take the solid or ionic solution to be analyzed withNi-chrome wire, burn in an oxidizing flame. Observe colorflame that happened.
2. Identification of the hydronium ion (H_3O^+)
   Into a test tube containing 2 ml of 6 M HCl or 6 M HNO_3 or 6 M H_2SO_4, add Zn metal. Observe the changes that occur. Into a test tube containing an acid solution as in experiment 1), Dip into it blue litmus paper and red litmus paper. Observechanges that occur.
3. Identification of the ion NH_4^+
   Into a test tube, add a solution containing NH_4^+ ions. Add into it a 4 M NaOH solution, place the wet red litmus paper at the mouth of the test tube. Heat the test tube and observe the change in color of the litmus solution. Into the test tube, add the substance containing NH_4^+ ions. Add a few drops of Nessler's reagent and observe the change occur.
4. Identification of silver ions (Ag^+), lead (Pb^{2+}), mercury (Hg_2^{2+})
   Prepare 3 test tubes:Tube 1 is filled with silver ions, tube 2 is filled with lead ions and tube 3 is filled with mercury or mercury ions Into each tube add dilute HCl, observe the changes that occur.Each tube is heated and observe the color change that occurs.Add to it excess 4 M NH_4OH solution; observe changesoccurring color. Add 4 M HNO_3 and observe the changes that occur. Prepare 3 test tubes; in each tube filled with a solution as in experiment a). Into each tube add 1 M KI solution, observe what happens.Add more KI excess, observe the changes that occur.Prepare 3 test tubes, into each tube filled with a solution as shown experiment a. Into each tube add 1 M K_2CrO_4 solution; observechanges that occur. Provide 3 test tubes, into each tube filled with a solution as inexperiment a. Add into each tube of 4 M NaOH solution; observechanges that occur.
5. Identification of barium (Ba^{2+}), calcium (Ca^{2+}) and strontium ions (Sr^{2+})
   Ten drops of sample solution plus 1 drop of 6 M HCl, shake until dissolved. Basify the solution with 4 M NH_4OH, add 2 drops of 1 M $(NH_4)_2CO_3$. Observe the changes that occur. Heat in a water bath, let it mixuntil cold. Observe the changes that occur. Add 2 drops of 4 M acetic acid and 4 drops of 4M ammonium acetate solution,Shake it and observe the changes that occur. Add 1 drop of K_2CrO_4 1 solutionM, shake. Observe the changes that occur.If a yellow precipitate forms, add 4 drops of 6 M

HClsolution.shake until dissolved. Add 1 drop of 4 M H2SO4, observe the changeoccur. If a white precipitate forms, perform a flame test.

6. Identification of copper (Cu2+) and cadmium (Cd2+) ions
   Ten drops of the sample were acidified with 4 M acetic acid, then added K4Fe (CN)6 0.1 M solution. Observe the precipitate that occurs. Pink precipitateindicates the presence of copper ions. A white precipitate indicates the presence of ionscadmium.Identification for copper ions. Into 4 test tubes containing copper ion solution: Tube 1, add NaOH solution, observe, then heat, observechanges that occurTube 2, add excess ammonia, observeTube 3, added potassium ferrocyanide solution, observeTube 4, inserted an iron nail (which is not rusty). Observe the color of the nails.
7. Identification for cobalt ion (Co2+)
   Acidify the sample solution with 1 M HCl. Add a few grains of NH4CNS, shake. Add acetone in the same volume, shake. Blueindicates the presence of cobalt ionsProvide 3 test tubes each filled with Co2+ solution,Tube 1, add 1 M NaOH, observe the changes that occur. Shut up After a while, observe the changes that occur. Tube 2, add 1 ml of amylalcohol and NH4CNS solution. Observe the changes that occur. tube 3, add ammonia. Observe the changes that occur.
8. Identification of nickel ion (Ni2+)
   Into a test tube containing nickel solution, add 4 M NH4OH solution to alkaline. Add a few drops of dimethylglyoxime (DMG) solution.A red precipitate indicates the presence of nickel ions.
9. Identification for aluminum (Al 3+) and zinc (Zn2+) ions
   Prepare 2 test tubes. Tube 1 is filled with aluminum solution and tube 2 is filled zinc solution. Into each tube added 4 M NaOH solution,observe the changes that occur. Add more 4 M NaOH solution untilover, observe the changes that occur. Then add Alizarin S solution, observe the changes that occur. Acidify with acetic acid, observe changesthat happened. Into each tube add K4Fe (CN)6 solution, observechanges that occur.
10. Specific reaction for ferric ions
   Into a test tube containing Fe3+ solution, add NH4CNS solution orKCNS, observe the changes that occur. Add 1-2 ml of ether or amyl solutionalcohol.

Separation Of Group I Cations

As much as ½ part of the original solution was added 1 drop of 6 M HCl until no more precipitate formed. Furthermore, the separation of the precipitate from the solution is carried out by centrifugation. If a white precipitate appears, then it probably contains $PbCl_2$, Hg_2Cl_2 and AgCl. Furthermore, the precipitate was washed twice with water containing 2 M HCl and heated and then immediately stirred. Wash the precipitate with hot water until the washing water gives no precipitate when tested with 1 M K_2CrO_4 where the sign of Pb^{2+} has disappeared. Then separate the precipitate and solution. The solution may contain $PbCl_2$, divide the solution into 2, in tube 1 add 1 drop of 1 M K_2CrO_4 a yellow precipitate will form and in tube 2 add 1 drop of 2 M H2SO4 a white precipitate will form. The tube that has a white precipitate may contain AgCl and/or Hg_2Cl_2. Then add a few drops of 2 M NH4OH, centrifuge and separate the precipitate and solution. The black precipitate formed consists of $HgNH_2Cl$ + Hg indicating the presence of Hg^{2+}.

RESULTS AND DISCUSSION
Results
Identification of cations

Table 1. Identification of cations

No	Method	Bagian	Result	Reaction
1	Identification reaction Cation	Identification sodium, potassium, calcium, barium, lead with Flame test	Sodium : golden yellow Potassium : pink to purple Calcium : brick red Barium : light green Lead : pale blue	
		Identifications for the hydronium ion (H3O)+	HCl + Zn metal ; white blubbling Litmus res $\rightarrow$ red Litmus blue $\rightarrow$ red	2HCl(aq) + Zn(s) $\rightarrow$ ZnCl2 (aq) + H2 (g)
		Identifications for the NH4 ions	NH4OH : colorless NaOH : colorlesss NH4OH + NaOH : colorless Litmus red $\rightarrow$ blue	NH4OH (aq) + 2NaOH (aq) $\rightarrow$ NH4+(aq) + 2NaOH (aq) NH4+(aq) + OH- (aq)$\rightarrow$ NH3 (g) + 6H2O(l)
		Identifications for silver (Ag+), lead (Pb2+), mercury (Hg22+) ions	Ag+ + HCl : white precipitate Pb2+ + HCl : clouds Ag+ + KI : white precepitate Ag+ + K2CrO4 : yellow precipitate Ag+ + NaOH : brown precipitate	Ag+ (aq) + HCL (aq) $\rightarrow$ AgCl (s) + H+ (g) Pb2+ (aq) + 2Cl (aq) $\rightarrow$ PbCl2 (s) Ag+ (aq) + KI (aq) $\rightarrow$ AgI (s) + K+ (aq) Ag+ (aq) + K2CrO4 (aq) $\rightarrow$ AgCrO4 (s) Ag+ (aq) + NaOH (aq) $\rightarrow$ AgOH (s)
		Identifications for Barium, Calcium, ions	Barium + ammonium carbonat : after heating have precipitate Barium + acetic acid : have gaseous Calcium + ammonium carbonate : cloudy after heating have precipitate Calcium + acetic acid : the precipitate dissolve	Ba2+ (aq) + (NH4)2CO3 (aq) $\rightarrow$ BaCO3 (s) + 2NH4 Ba2+ (aq) + CH3COOH (aq) $\rightarrow$ CH3COOBa + (aq) + H+ (g) Ca2+ (aq) + (NH4)2CO3 (aq) $\rightarrow$ CaCO3 (s) + 2NH4 Ca2+ (aq) + CH3COOH (aq) $\rightarrow$ CH3COOCa + (l)
		Identifications for copper and cadmium ions	Coppper + K3Fe(CN)6 : have precipitate brown red and green solution Cadmium + K3Fe(CN)6 : have precipitate of white and solution is yellow and colorless	CuCl2 (aq) + K3Fe(CN)6 $\rightarrow$ Cu3(Fe(CN)6)2 (s) + KCl (aq) CdCl3 (aq) + K3Fe(CN)6 $\rightarrow$ Cd3(Fe(CN)6)2 (s) + KCl (aq)
		Identifications for cobalt ions	Cobalt + HCl : acidic Litmus blue $\rightarrow$ red Cobalt + NH4CNS : pink Cobalt + NaOH : blue Cobalt + NH3 : bllue	CoCl2 (aq) + NaOH (aq) $\rightarrow$ Co2+ (aq) + 2NaCl (aq) + OH- CoCl2 (aq) + 2NH3 (aq) $\rightarrow$ Co2+ (aq) + 2NH4Cl (aq) Co2+ (aq) + 4CNS- (aq) $\rightarrow$ [Co(CNS)4]2- (aq)
		Identifications for nickel ions	Nickel + NH4OH : colorless Nickel + DMG : red precipitate	NiCL2 (aq) + NH4OH (aq) $\rightarrow$ Ni(DMG)2 (s) + NH4Cl (aq) + H2O2 (aq)

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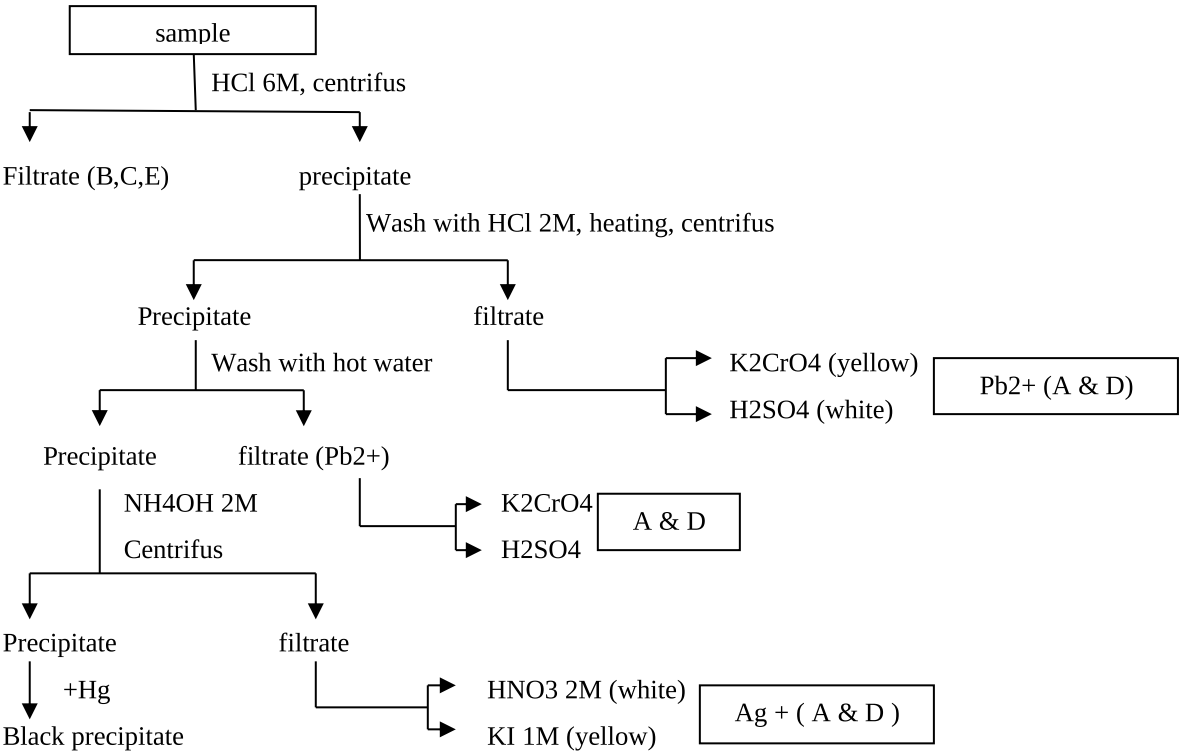
	Identifications for aluminium and zinc	Aluminium + NH4OH : white Aluminium + alzarins : purple Aluminium + K4Fe(CN)6 : yellow Zinc + NaOH : white Zinc + alizarins : purple Zinc + K4Fe(CN)6 : orange	AlCl3 (aq) + NH4OH (aq) → Al(OH)3 (aq) + NH4CL (aq) AlCl3 (aq) + NaOH (aq) → Al(OH)3 (aq) + 3NaCl (s) AlCl3 (aq) + K4Fe(CN)6 (aq) → Al(CN)6 (aq) + K4FeCl3 (aq) Zn2+ (aq) + 4OH- (Aq) → [Zn(OH)4]2+ (aq) Zn2+ (aq) + K4Fe(CN)6 (aq) → 2Zn(CN)3 (aq)
	Spesific reaction for ferri ions	Fe3+ : yellow Fe3+ + NH4CNS : red dark Fe3+ + alcohol : dissolved	Fe3+ (aq) + 9NH4SCN (l) → 2Fe(CNS)3 (aq) + 9NH4 (l) Fe3+ (aq) + CNS- (aq) → [Fe(CNS)]2+

Separation of group 1 cation



Discussion

1. Identification of cations

The flame test is a test of groups five and four, and some ions, to prove that the ions are true, and the flame test is a test of the solution after separation with several reagents. A solution of the ions, when ixed with consentrated HCl and heated on a nickel/chrome wire in a flame. Causes the flame to change to the caracteristic color of an atom. Where sodium is bright yellow, potassium is pale purple, calcium is brick red, strontium is crimson, barium is light green, lead is pale blue and copper is green or blue.

HCl is useful for converting the analyzed substanves into its chloride salts so that is evaporates easily because the vapor from this substances will produce a color rather than a flame. In many burners, an oxidation flame is a flame that result from an excess or oxygen in a combustion reaction as the amount of oxygen increase, the flmae shortens, darkens in color, and products a hissing sound. A reduction flame is a flame with a low oxygen content. This flame has a yellowish color due to the presence of cation or oxygen landing hydrocarbons contained in the object being processed with the flame.

In third test, namely tessting for NH^{4+} ions, sampples that are not known to contain NH^{4+} ions are reacted with NaOH and then tested with red litmus, after reacting the litmus turn s blue. It is found that the NH^{4+} ions are positive in the sample, but why is the amount of NH^{4+} only slightly in NaOH solution because basically NH^{4+} is surrounded by more water ions than the NH^{4+} ions

NH^{4+} + NaOH → NH_3 + $6H_2O$ + Na^+

NH^{4+} + OH^- → NH_3 + $6H_2O$

The eight test is testing for Cobalt or Co^{2+} ions. The result did not match the literaure, which was pink, but when tested on other solvent, it was positive for cobalt. This is because in the sample solution, the solution has been contaminated with other solutions, so that the cobalt ion itself cannot trigger a reaction, and the desired result is obtained.

Co^{3+} + e^-→ Co^{2+}

$Co(OH)_3$ + e- → $Co(OH)_2$ + OH^-

Co^{2+} + HCl → $[CoCl_6]^{4-}$

$[CoCl_6]^{4-}$ + $6H_2O$ → $[Co(H_2O)_6]^{2+}$ + $6Cl^-$

4 $[Co(NH_3)_6]^{2+}$ + $2H_2O$ + O_2 → $4[Co(NH_3)_6]^{3+}$ + $4OH^-$

Co^{2+} + $4CNS^-$===$[Co(CNS)_4]^{2-}$ (on the amil alcohol)

Co^{2+} + $2NH_4OH$→ $Co(OH)_2$ + NH_4OH (more) → $[Co\ (NH_3)]^{3+}$

In the test, a complex compound reaction was obtained. A complex compound is a new compound formed from units that can stand alone, but form new bonds within the complex. In this case the complex formed contains two components each, but there is also something that occurs more than many components. In other words, a compound that is a realtionship between a central atom and its ligands, where the central atom and its ligand, where the ligands can donate a pair or more electrons to the central atom providing a ione pair of electrons

In the test, two zinck metals when reacted with HCl, experimenal an icrease in tempetemperature and had hot bubbles cased by the reaction with $H^{2+}$from HCl itself. Then when tested with blue litmus paper it turns red, this indicates that Zn metal has been acidified by HCl

In the fourth test these were some spesific results of $Ag^+$and Pb^{2+} which produced different precipitates and colour from different reagents. This is proven that when Ag reacts with Hcl it produces a white color while Pb^{2+} produces a coloudy solution

In the sixth test, Ba^{2+} can be seen y the formation of a precipitates by heating with $(NH_4)_2CO_3$. As soon as with Ca^{2+} is reacted with$(NH_4)_2CO_3$ it produces a precipitate which is carried out under heating

In the seventh test, spesific results were obtaine from Cd^{2+} and Cu^{2+} where there wwere brown and yellow deposits. By reacting with certain reactannts . in the ninth it was also like that, when reacted with certain reactans it could produce complex compounds and spesific colors.

2. Separation of group 1 cations

In this practicum on the separation of group 1 cations, the aim is to separate group 1 cation consisting of Pb2+, Ag+ and Hg2+ with other group cation. The method used is to react the sample with a specific reagent for group 1, namely dilute HCl which will from a precipitate if it reacts with group 1 cation.

Group 1 cation can from a white precipitate when reacted. Based the theory (Harvey 2000) from a white precipitate from PbCl2, Hg2Cl2, and AgCl. If add hot water then the

PbCl2 precipitate will dissolve and this solution can be identified by the chromate ion which will from a yellow precipitate PbCrO4 and sulfate ion from a white precipitate of PbSO4. Where as AgCl can be separated from Hg2Cl2 by dissolving into NH4OH solution because AgCl dissolves to from Ag (NH3)2+ complex white Hg2Cl2 is insoluble. The presence of Ag+ ions in solution is recognized by adding Cl to from a yellow precipitate of Agl or by HNO3 which will from a white precipitate of AgCl.

In the experiment we did, the samples that produced the precipitate were samples A and D, then this sample will be separated. The solution to the sample will be added a few drops of HCl 6M and the result will from a white precipitate. The factor that cause the precipitate to mix beetwen these two solution is the type of reagent, namely HCl 6M which serves as a precipitation for group 1 cations. Another factor is the pH of a mixture. The separated precipitate all group 1 cations and can react in an acidic environment.

Then these 2 samples A & D are rinsed with a HCl 2M which is then heated and dicentrifugated which is able to form a filter and so dripped 1M K2CrO4 solution. When dripped K2CrO4 filtrate will produce a yellow precipitate. Why there's a yellow precipitate this happens because the filtrate and solution containing Pb2+ which react with K2CrO4 to make PbCrO4 in sample A in line with the reaction equation:

Pb2+ (aq) + K2Cr2O7 (aq) → PbCrO4 (s) + K+ (aq)

And when supplemented with H2SO4 filtrate will form a white deposit that forms PbSO4 in sample D. This is often also in accordance with the text book analytical chemistry book 1 by Ibnu M. sodiq. Et al who explained that when the filtrate is reacted with K2CrO4 and H2SO4 itt'll form yellow and white deposite.

Pb2+ + H2SO4 → PbSO4 + 2H+

The next step on practicum is heated in plight it aims to croos the ions of impurities whit in the sample. Then the precipitate added NH4OH will produce a filtrate which is then dripped HNO3 and so will form a white precipitate indicating the presence of Ag+ ions of sample A which is able to produce the equation reaction:

AgCl2 (s) + 2NH3 (aq) → Ag (NH3)2Cl (aq)

In sample D will form a yellow precipitate when KI is add, this can be thanks to the presence of the Hg2+ cation that press the yellow precipitate.

This is also in accor dance with the literature of analytical chemistry edt 2 by selamat, who stated that ib group 1 cation there'll be yellow and white deposit if unknow samples are reacted with HNO3 and KI.

CONCLUSIONS

Identification of Cations

Cation recognition reactions can be distinguished by the use of spesific solvents or reactions. Cations are ions that have a positive change and most are metal ions. By using ualitative analysis can determine the cations contained in the sample. Spesiffic reactions will form in each reacted substances, and some ions will also produce complex compounds. And by identifying the color and the resulting precipitate can know the type of cations.

Separation Of Group I Cations

Based on the practicum that has been carried out, namely the separation of group 1 cations in a sample, it is concluded that, samples A and D contain Pb^{2+}, Hg_2^{2+}, and Ag^+ ions which are known based on the separation of various reagents such as HCl and hot water separating Pb^{2+} and NH_4OH separating Hg_2^{2+} from Ag^+. Whereas in samples B, C, and E there were no group 1 cations in them.

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