CHEMISTRY INVESTIGATORY PROJECT

"To investigate everyday items made of alloys for the presence of Iron, Aluminium, Copper and Zinc cations."

Submitted by: Aditya Sharma

Roll no: 5

Class: 12-C

Session: 2021-22

UNDER THE GUIDANCE OF

Mr. Harish Rautela

(PGT, Chemistry)

BIRLA VIDYA NIKETAN

DECLARATION

I hereby declare that the work being presented in the project report entitled “To investigate everyday items made of alloys for the presence of Iron, Aluminium, Copper and Zinc cations.” is an authentic record of my own experimentation carried out under the guidance of Mr. Harish Rautela, PGT - Chemistry, Birla Vidya Niketan, New Delhi

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CERTIFICATE

This is to certify that the experimentation has been done to investigate about the subject matter, and the related data collection and investigation has been completed sincerely by **Aditya Sharma** of **XII-C** of **Birla Vidya Niketan, Pushp Vihar, New Delhi** regarding his project titled **"To investigate everyday items made of alloys for the presence of Iron, Aluminium, Copper and Zinc cations."**

ACKNOWLEDGEMENT

It would be my utmost pleasure to express my sincere thanks to **Mr. Harish Rautela** (PGT, Chemistry) and **Mr. Ankit** (Lab Assistant) in providing a helping hand in this project. Their valuable guidance, support and supervision have made this project possible.

AIM

To investigate everyday items made of alloys for the presence of Iron, Aluminium, Copper and Zinc cations.

THEORY

An alloy is a mixture of two or more compounds of which at least one is a metal. Alloys retain all the properties of the metals in them like ductility, malleability, conductivity etc. They can be of use because sometimes they reduce the overall cost of the material but retain the desired qualities of the parent metals.

Alloys are made by combining a metal with one or more elements. The most common way of doing this is by melting the metal and then dissolving the solutes into the molten metal. By adding another element to a metal, differences in size of the atoms of the elements creates internal stress in the lattice of the crystal, these can enhance its properties. For example, when carbon is added to iron it creates steel, which is stronger than iron. Engineering properties such as tensile strength, ductility and shear strength may be sustainably different from those of parent materials. This is sometimes due to the sizes of the atoms in the alloy, because larger atoms exert a compressive force on neighboring atoms and smaller atoms exert a tensile force on their neighbors helping in resisting deformation.

Alloys also don't have a fixed single melting point but instead have a melting range during which the material is a mixture of solid and liquid phases. For many alloys there is a particular alloy proportion called a eutectic proportion, which gives the alloy a unique and low melting point and no transition.

APPARATUS

- Beakers
- Test tubes
- Test tube holder
- Dropper

CHEMICALS REQUIRED

- Concentrated HNO_3
- Concentrated and dilute HCl
- Blue Litmus
- Potassium Ferrocyanide
- NH_4OH Solution

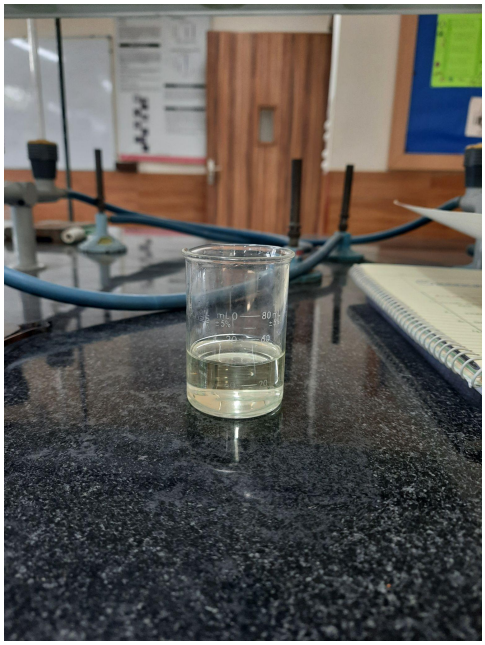
PREPARATION OF AQUA REGIA

Procedure:

Took conc. HCl and conc. HNO_3 in the ratio 3:1, for the purpose of this experiment the amount taken was 30mL conc. HCl and 10mL conc. HNO_3. Firstly took the 30ml conc. HCl in a beaker and slowly added 10mL conc. HNO_3 drop by drop. Then allowed the solution to react for a few minutes until it reached a faint yellow color.

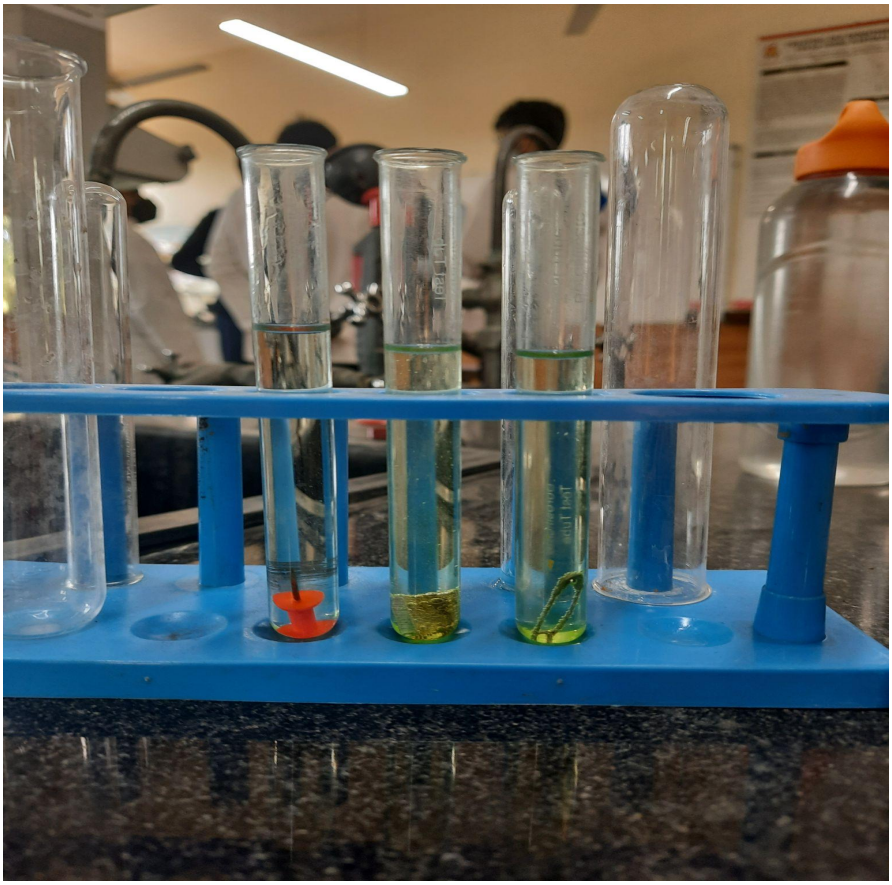
Precautions taken:

- Protective gear such as gloves, glasses and lab coat was used while performing this experiment.
- This is a highly exothermic reaction and was performed under supervision.
- It was made sure that conc. HNO_3 was added drop by drop to the conc. HCl and not the other way around.



DISSOLVING ALLOYS IN AQUA REGIA

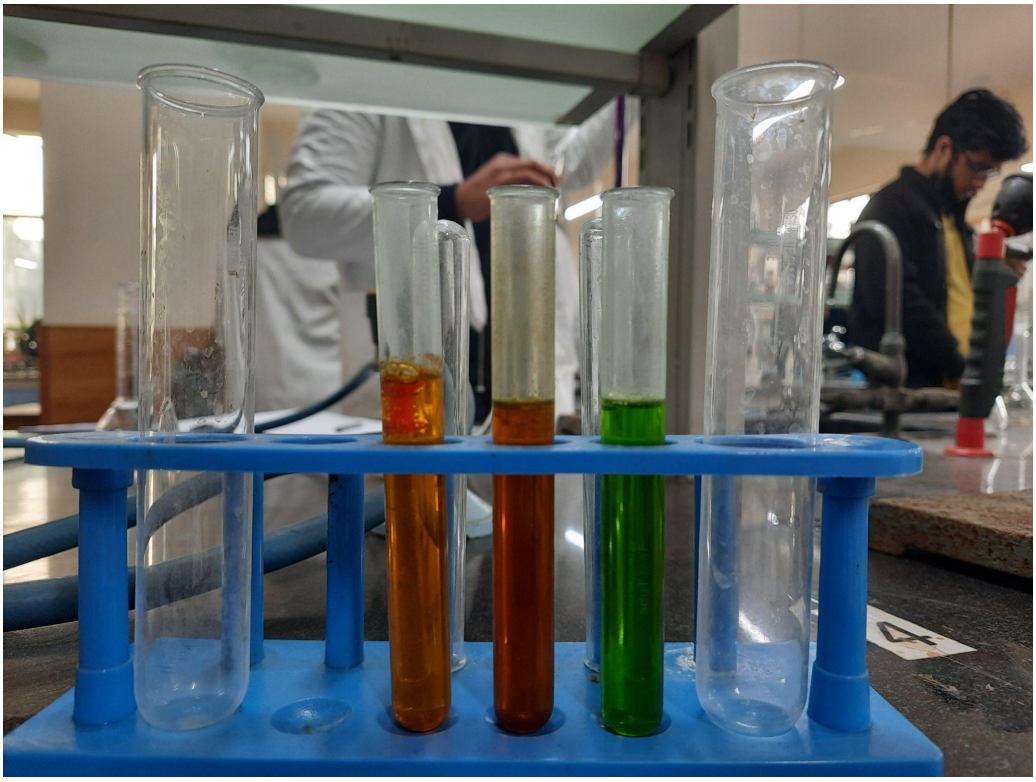
Took three everyday items made of alloys, ie, a thumb pin, staple pins and a safety pin and put them in their test tubes namely A, B and C respectively. Then added equal amounts of aqua regia (10mL) in all three test tubes making sure that all three articles placed in the test tubes were fully submerged in aqua regia. Then these test tubes were left undisturbed for a day, to give enough time for the articles to completely dissolve in the aqua regia.



A (Thumb pin), B (Staple pins), C (Safety pin)

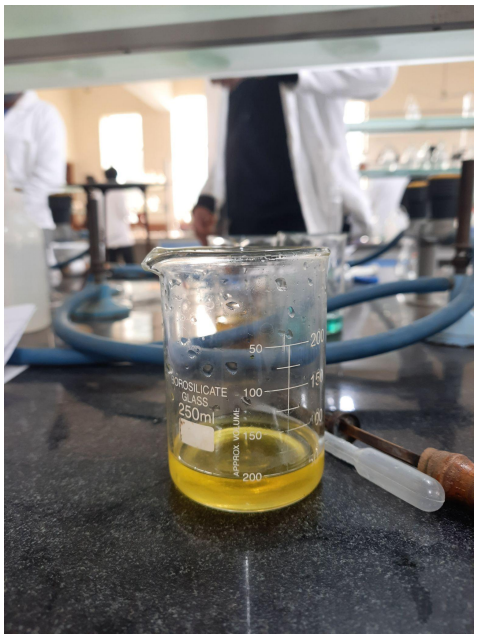
PREPARATION OF ORIGINAL SOLUTION

After a day it was observed that most of, if not all of the article was dissolved by the aqua regia. Took the test tubes of each article and any remaining debris was removed with the help of a pair of wooden tongs. Took the remaining aqua regia with the ions of the alloys dissolved in it and made an OSout of it. To make an OS first 50mL of water was taken in a beaker and slowly the aqua regia with dissolved ions was slowly added into it with the help of a dropper. This OS was used for the confirmatory cation tests.



A-Orange (Thumb pin), B-Dark orange (staple pins), C-Green (safety pin)


C-Blue (Safety pin), B-Dark Yellow (Staple pins)



A-Yellow (Thumb pin)

TESTING FOR Fe^{3+}

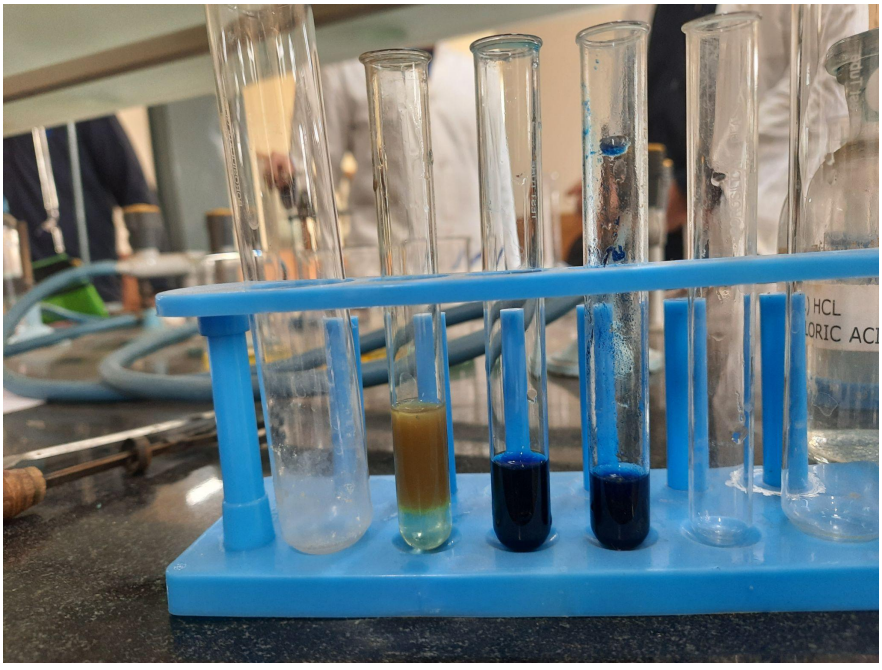
Took a small amount of the OS in a test tube and added dil. HCl to it. A pinch or Potassium Ferrocyanide $\{K_4[Fe(CN)_6].3H_2O\}$ was added to this. This results in the appearance of Prussian blue coloration for solutions containing Fe^{3+}.

Reaction:

Fe^{3+} + $K_4[Fe(CN)_6]$ —> $Fe_4[Fe(CN)_6]_3$ (not balanced)

Here Fe4[Fe(CN)6]3 gives the Prussian blue coloration.

On doing this it was seen that test tubes A and B, containing thumb pin and staples pins, showed the coloration while test tube C, containing safety pin did not.



C (Brown), A (Blue), B(Blue)

TESTING FOR Al^{3+}

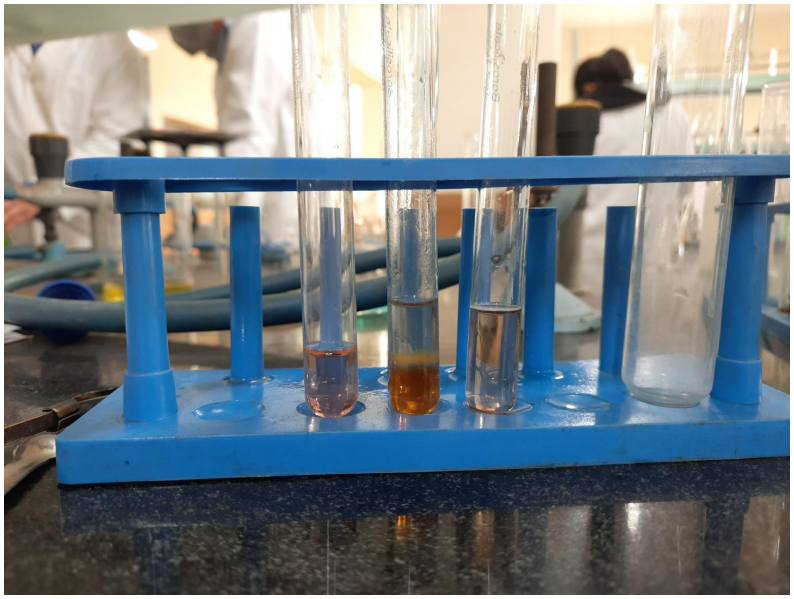
Took a small amount of the OS into a test tube and added 2-3 drops of blue litmus solution. To this NH_4OH solution was added dropwise. This results in the appearance of a ppt. floating in a clear solution whose color depends on the amt. of blue litmus added for solutions having Al^{3+}

Reaction:

Al^{3+} + $3OH^-$ —> $Al(OH)_3$ (gelatinous ppt)

$Al(OH)_3$ here absorbs the blue color of the blue litmus and gives blue ppt.

On doing this it was seen that test tubes C and A, containing safety pin and thumb pin did not show any gelatinous ppt, but test tube A, containing staple pins did.



A (no ppt), B (ppt), C (no ppt)

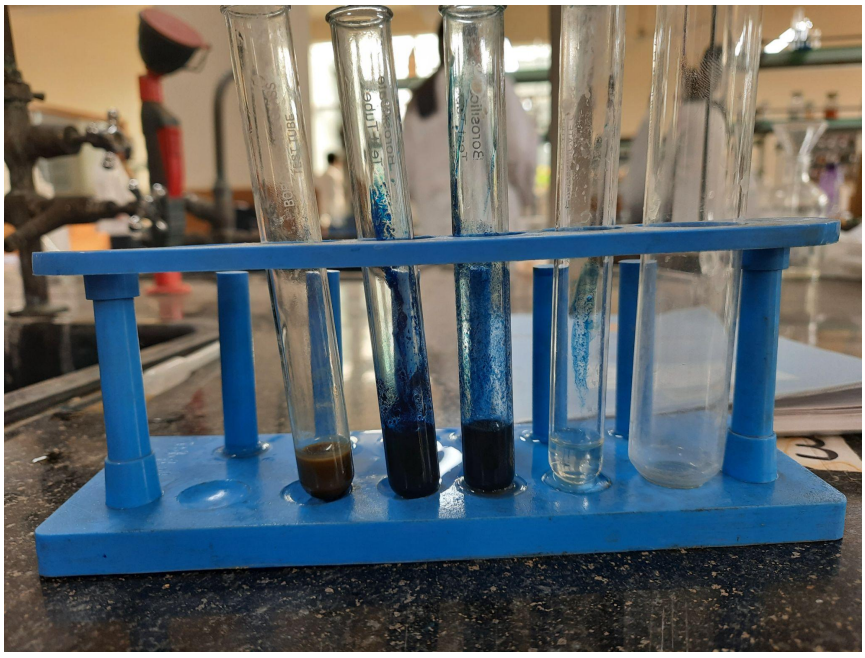
TESTING FOR Zn^{2+}

Took a small amount of OS in a test tube and added dil. HCl to it. A pinch of Potassium Ferrocyanide was added to this. This results in the appearance of bluish white ppt for solutions containing Zn^{2+}

Reaction:

$$3Zn^{2+} + 2K^{+} + 2[Fe(CN)_6]^{4-} \longrightarrow K_2Zn_3[Fe(CN)_6]_2 \text{ (coloration)}$$

On doing this it was seen that test tubes A and B, containing thumb pin and staple pins showed the right coloration but test tube C, containing safety pin did not.



C (Brown), A (bluish coloration), B (bluish coloration)

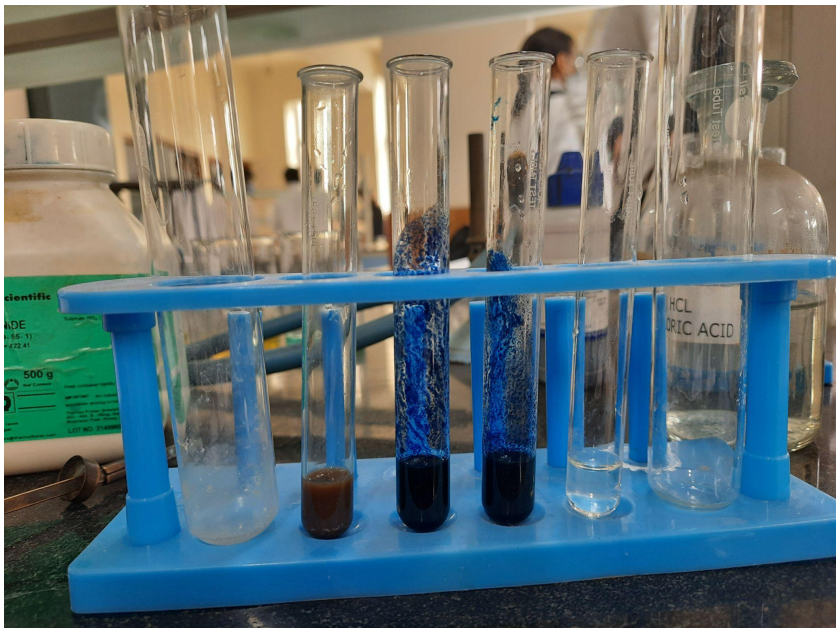
TESTING FOR Cu^{2+}

Took a small amount of OS into a test tube and added dil. HCl to it. A pinch of Potassium Ferrocyanide was added to this. This will result in the formation of chocolate brown color for solutions having Cu^{2+}.

Reaction:

$2Cu^{2+}$ + $[Fe(CN)6]^{4-}$ —> $Cu_2[Fe(CN)_6]$ (chocolate brown)

On doing this we observed that test tubes A and B, containing thumb pin and staple pins did not show the brown color but test tube C, containing safety pins did.



C (chocolate brown), A (not brown), B (not brown)

OBSERVATION TABLE

MATERIAL	Fe^{3+}	Al^{3+}	Zn^{2+}	Cu^{2+}
Thumb Pin	YES	NO	YES	NO
Staple Pin	YES	YES	YES	NO
Safety Pin	NO	NO	NO	YES

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