CHEMISTRY INVESTIGATORY PROJECT

"To analyze and compare cations present in everyday items made from alloys."

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 analyze and compare cations present in everyday items made from alloys” is an authentic record of my own experimentation carried out under the guidance of Mr. Harish Rautela, PGT - Chemistry, Birla Vidya Niketan, New Delhi

INDEX

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 analyze and compare cations present in everyday items made from alloys"**

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 analyze and compare cations present in everyday items made from alloys.

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

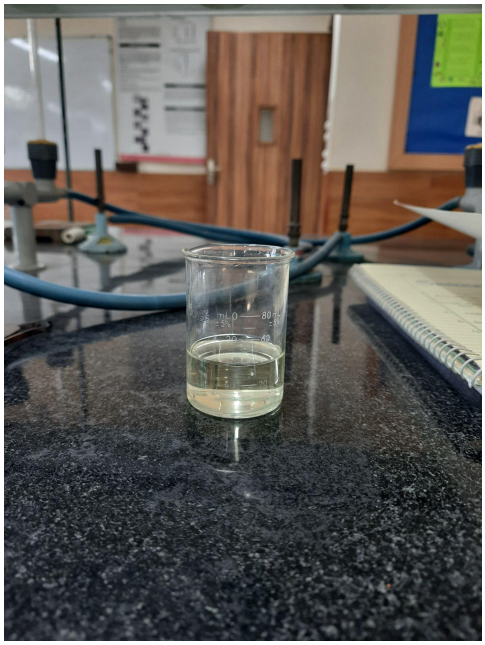
PREPARATION OF AQUA REGIA

Procedure:

Take 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 we take the 30ml conc. HCl in a beaker and slowly add 10mL conc. HNO_3 drop by drop. Then allow the solution to react for a few minutes until it reaches a faint yellow color.

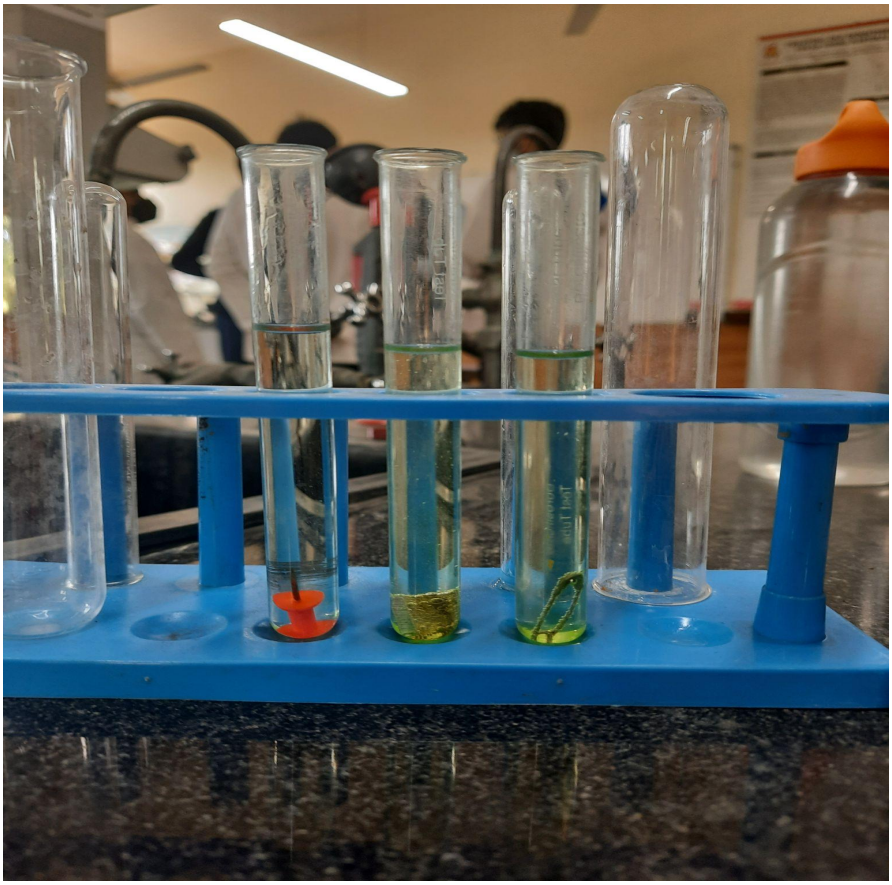
Precautions:

- Always wear protective gear such as gloves, glasses and lab coat while performing this experiment.
- This is a highly exothermic reaction and should be performed under supervision.
- Always make sure to add conc. HNO_3 drop by drop to the conc. HCl and never the other way around.



DISSOLVING ALLOYS IN AQUA REGIA

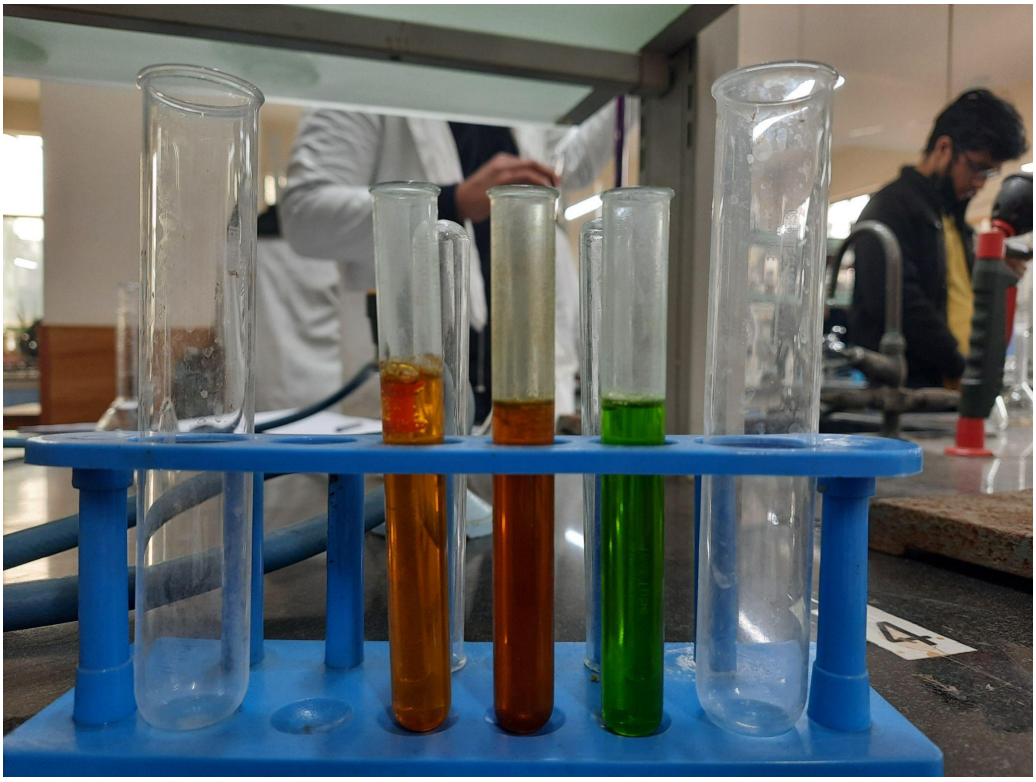
Take three everyday items made of alloys, ie, a thumb pin, staple pins and a safety pin and put them in their test tubes namely A, B and C respectively. Then add equal amounts of aqua regia in all three test tubes making sure that all three articles placed in the test tubes have been fully submerged in aqua regia. Then let these test tubes sit 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)

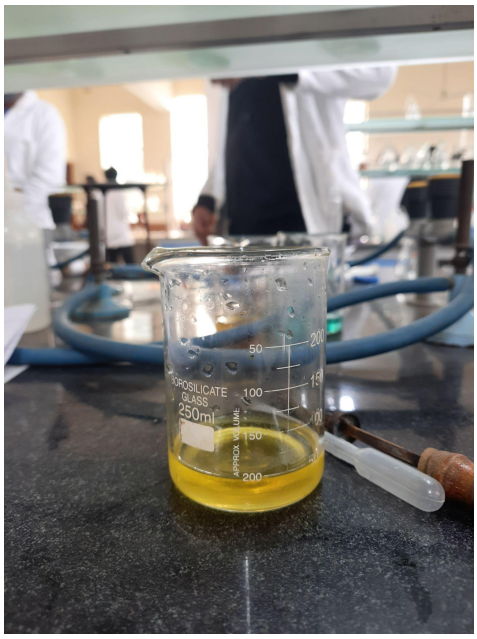
PREPARATION OF ORIGINAL SOLUTION

After a day it is observed that most of, if not all of the article has been dissolved by the aqua regia. Take the test tubes of each article and take out any remaining debri left. Take the remaining aqua regia with the ions of the alloys dissolved in it and make an OS with it. To make an OS first take 50mL of water in a beaker and slowly add the aqua regia with dissolved ions into it with the help of a dropper. Stir this solution and let it mix evenly, now use this OS to do 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+}

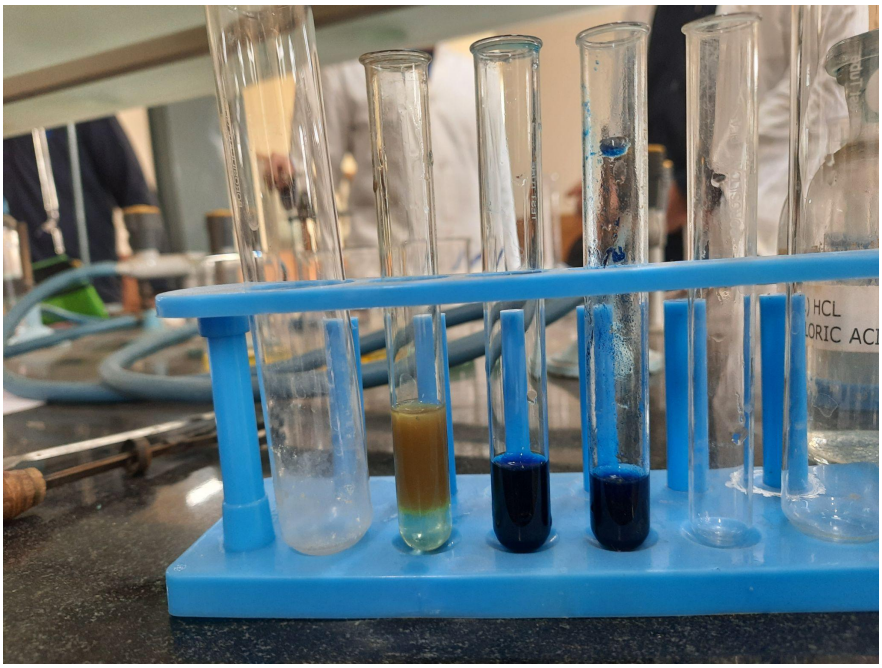
Take a small amount of the OS in a test tube and add dil. HCl to it. To this we add a pinch or Potassium Ferrocyanide $\{K_4[Fe(CN)_6].3H_2O\}$. This results in the appearance of Prussian blue coloration for solutions containing Fe^{3+}.

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 we see that tes 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+}

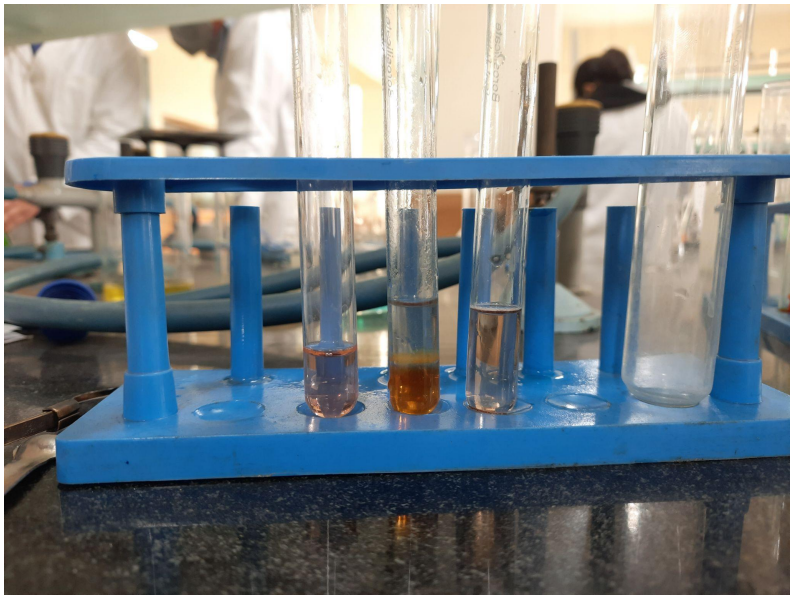
Take a small amount of the OS into a test tube and add 2-3 drops of blue litmus solution. To this add NH_4OH solution dropwise, heat it for a few seconds and then let it rest. This results in the appearance of a ppt. floating in a clear solution. The color of the ppt. can depend on the amount of blue litmus added.

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 we see that test tubes C and A, containing safety pin and thumb pin dont show any gelatinous ppt, but test tube A, containing staple pins shows the presence of ppt.



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

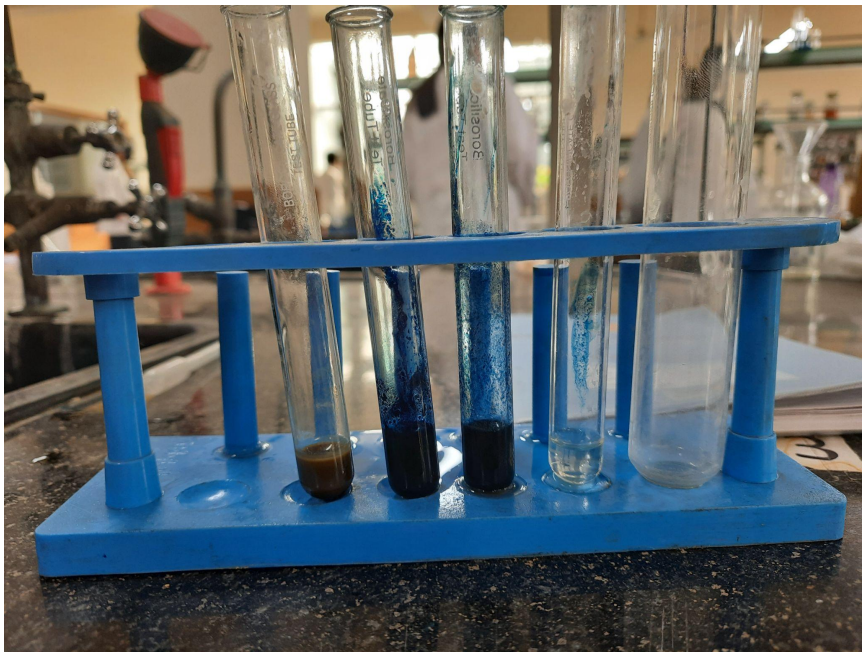
TESTING FOR Zn^{2+}

Take a small amount of OS in a test tube and add dil. HCl to it. To this add a pinch of Potassium Ferrocyanide. Results in the appearance of bluish white ppt confirming the presence of Al^{2+}.

Reaction:

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

On doing this we see that test tubes A and B, containing thumb pin and staple pins show coloration but test tube C, containing safety pin does not.



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

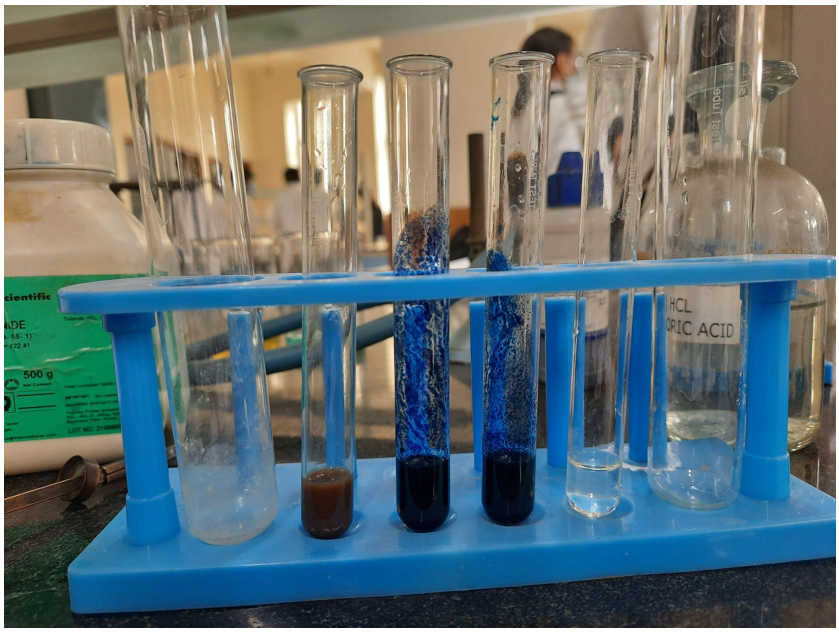
TESTING FOR Cu^{2+}

Take a small amount of OS into a test tube and add dil. HCl to it. To this add a pinch of Potassium Ferrocyanide. 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 observe that test tubes A and B, containing thumb pin and staple pins do not show the brown color but test tube C, containing safety pins does.



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

BIBLIOGRAPHY

1. School Practical File
2. Reactions (https://chem.libretexts.org/)
3. Wikipedia (https://www.wikipedia.org/)