



# Preparation And Characterization Of Polyacrylic Acid

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## ABSTRACT

Polyacrylic acid is an acrylic polymer. It is a synthetic polymer with a high molecular weight. Polyacrylic acid is synthesized using Free radical polymerization, using hydrogen peroxide as initiator as well as an oxidizing agent and ascorbic acid as reducing agent and with the monomer acrylic acid to give polyacrylic acid. It's like a free radical redox reaction.

The characterization of Polyacrylic acid can be done through spectroscopic studies like Fourier Transform Infrared Spectroscopy ( FTIR) and UV spectroscopy. FTIR determines the functional group of polyacrylic acid and the UV analysis determines the metal present in the polymer. PAA can be used as thickening agents in pharmaceuticals and cosmetics, paint additives, adhesives and sealant chemicals etc. PAA is a superabsorbent, non-toxic, non-irritating and biodegradable synthetic polymer.

**Keywords:** Polymer, Molecular Weight, FTIR, Uv-Visible

## INTRODUCTION

Polymers are amorphous solid consisting of very large molecules known as macromolecules, containing many repeating subunits. The word polymer arise from Greek words called 'Poly' as "many" and 'mer' means "unit". Polymer molecules are very large and has a high molecular weight. Polymers are classified as natural, bio, and synthetic Polymers. Polymers has no specific length and they don't form crystalline structure. Polymers have unique properties depending on the type of molecules being bonded and how they are bonded ie, some Polymers have properties like bending and stretching eg, rubber and polystyrene, but others are hard and brittle and tough eg, epoxies and glass (1).

Polymers has wide variety of applications in our modern and developing world, such as Polymers are used for making plastics many household things also. Polymers are used in industries in pharmaceuticals and in many other fields (2-4).

Polymerization is a method where the synthetic Polymers are produced by combining smaller molecules that is monomers into a chain which is held together by the means of covalent bond.

Now in this modern world Polymers are used on every single area ie,for example grocery bags, soda and water bottles, textiles, paints, food packaging, pharmaceuticals and cosmetics etc (5).

## Polyacrylic Acid

Polyacrylic acid is an amorphous synthetic polymer with a high molecular weight. PAA is a non-toxic, non-irritating, biocompatible and 26% biodegradable polymer, has many variety of applications in many fields which have been found in recent years. It is hygroscopic when absorbs water and brittle under normal condition

Polyacrylic acid has the ability to absorb and hold water molecules even if it expands to many times from their original volume. This behavior of polyacrylic acid makes a base for varieties of applications. Its approximate molecular weight is 450,000 and it cannot be dissolved in its monomer but is soluble in water, dioxane, ethanol, methanol and it's viscosity is 700cp. PAA is water sensitive polymer to serve as plastics.

### MATERIALS:

Acrylic acid as monomer, hydrogen peroxide, ascorbic acid, and sodiumhydroxide and chromiumoxide.

### METHOD:

Into an 200 ml clean and dry beaker 10ml of acrylic acid is taken and about 2.5g of ascorbic acid is weighed and transferred in an another clean dry 100ml beaker and is dissolved in 10ml of distilled water. This 10ml ascorbic acid is then combined with the 10ml of acrylic acid taken in the 200ml beaker and this mixture is kept on a magnetic stirrer. 2ml of hydrogen peroxide was added drop by drop while stirring.



Figure 1. Polyacrylic Acid

From the prepared polymer the metal addition is done. The metal addition is done in two ways, direct method and indirect. For direct method, a small amount of polymer about 6g is weighed and about 5ml of 1M chromiumoxide is added and a polymer metal complex is obtained. In indirect metal addition, about 3g of polyacrylic acid is weighed and dissolved in 200ml water taken in a 250ml beaker and kept in a magnetic stirrer. After dissolving completely 25ml of chromiumoxide is added and continued stirring for 30 minutes after that polymer metal complex is formed.

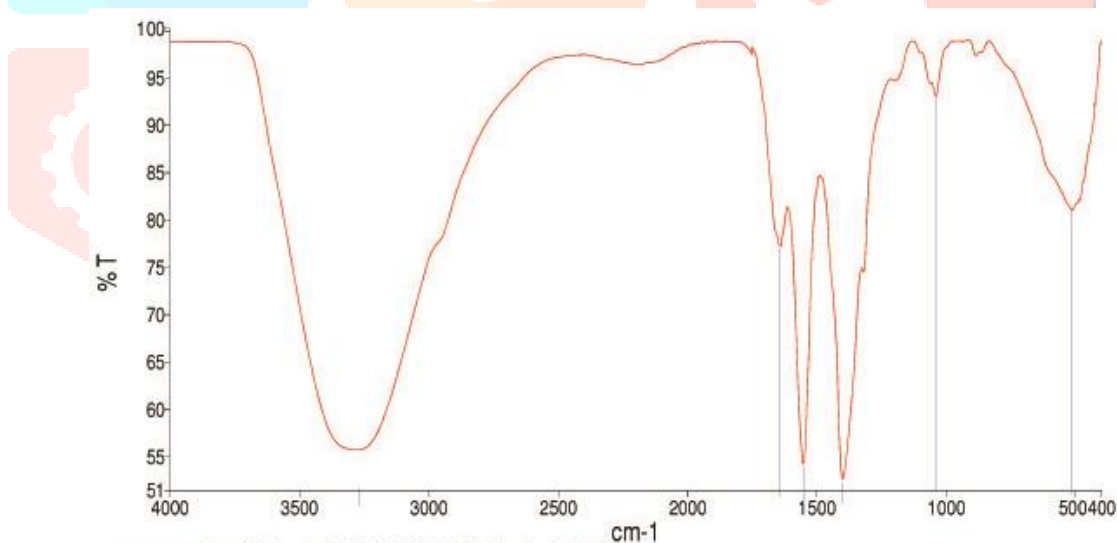
## RESULT AND DISCUSSION:

Polyacrylic acid was successfully synthesised via free radical redox polymerization. It also undergoes redox reaction as the hydrogen peroxide act as an oxidizing agent and the ascorbic acid act as reducing agent. It's an uncontrollable free radical Polymerization reaction.

Obtained product that is Poly acrylic acid is in solid form with a pale yellow transparent and on oxidation with atmospheric oxygen it becomes dark brown color. On adding water to the polymer it absorbs maximum water and swell. Due to this water absorbing property it can be used for many applications one of its applications is water treatment. And of capable of forming gels it is used for varieties of applications such as in pharmaceuticals, cosmetics, skin care products etc.

The molecular structure is determined using FTIR Spectroscopy (NIIST Trivandrum) and metal addition is analyzed by UV analysis taken from (NMCC College,Marthandam).

### Fourier Transform Infrared Spectroscopy:



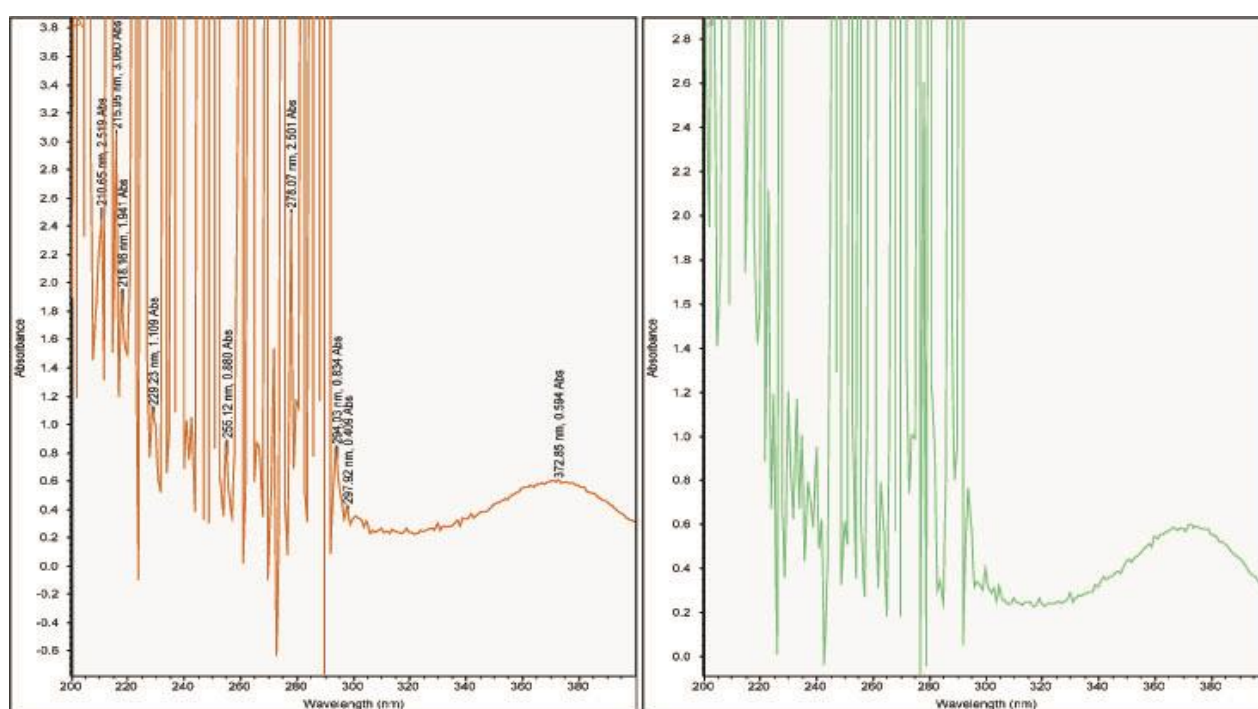
List of Peak Area/Height		
Peak Number	X (cm-1)	Y (%T)
1	3270.72	55.72
2	1640.04	77.26
3	1552.24	54.20
4	1399.26	52.63
5	1039.48	93.16
6	512.43	81.10

**Figure 2:** FTIR of Polyacrylic acid

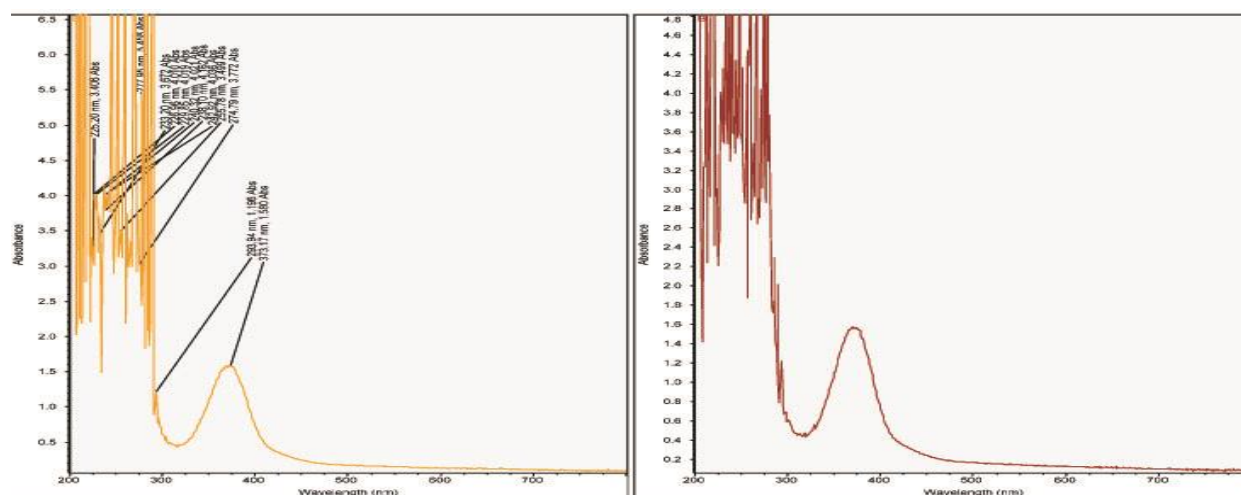
In FTIR analysis it shows the presence of six peaks which represents the functional group present. Here  $3270.72\text{cm}^{-1}$  indicates the presence of  $-\text{OH}$  group.  $1640.04\text{cm}^{-1}$  represents the presents of mono-substituted alkenes,  $1552.24\text{cm}^{-1}$  shows the presence of carboxylic acids group,  $1399.26\text{cm}^{-1}$  indicates the presence of  $-\text{CH}$  aliphatic bending group and  $1039.48\text{cm}^{-1}$  represent that it contains polysaccharide and also has a peak range at  $512.43\text{cm}^{-1}$  which indicates the presence of a specific chemical bond or functional group and contains a  $\text{C}=\text{O}$  bond stretching.

### UV analysis of Metal addition in Polyacrylic acid:

Chromium metal in Poly(acrylic) acid is determined by UV analysis. The UV analysis shows an peak at the range of  $372.16\text{nm}$ ,  $0.597\text{abs}$  for sample 'A' and it shows  $373.17\text{nm}$ ,  $1.580\text{abs}$  for sample 'B'. That is the sample may contain nano-particles and may have surface Plasmon resonance.



### Direct Metal Addition



### Indirect Metal Addition

Figure 3: Uv spectra of Polyacrylic acid after metal addition

## CONCLUSION

The preparation and characterization of polyacrylic acid is done successfully via series of experiments and analysis. It is synthesized via free radical redox polymerization and characterized using FTIR spectrum and UV spectrum. It acts as a good absorbing compound so called superabsorbant. It is 26% biodegradable and biocompatible synthetic polymer.

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