

EXPERIMENT TITLE :				
Preparation of Bakelite or Phenol Formaldehyde resins				
EXPERIMENT NO. :9 MIT(T)/BSH/Engg. Chemistry Lab/ Engg. Chemistry /Manual No				
Class: F.Y. BTech.		DEPARTMENT: Basic Sciences & Humanity		
LABORATORY : Engg. Chemistry		Location:-	PART:	PAGE:

Aim:- Preparation of phenol formaldehyde resins (Bakelite).

Apparatus:- Beakers, Glass rod, funnel, filter paper, etc.

Chemicals:- Glacial Acetic Acid, 40% Formaldehyde solution, phenol, conc. HCl, etc.

Theory:-

1. Phenol formaldehyde i.e. Bakelite is the example of thermosetting polymers.
2. Thermosetting resins are those which set upon heating and cannot be reformed when once they are set.
3. Thermosetting resins have three- dimensional network structure and have very high molecular weights.
4. These resins have predominant covalent cross-links between the long chain molecules which are responsible for the three-dimensional network structure.
5. Phenol formaldehyde resins are the most important and extensively used synthetic plastics.
6. These polymers are obtained by condensation of phenols with aldehydes.
7. So, in general, “Those resins which are formed by condensation are called as thermosetting polymers”.
8. In those resins, one of the monomer is always a phenol molecule.
9. The phenol formaldehyde reaction is catalyzed by alkalis and acids
10. The nature of the product obtained depends upon mainly:
 - a. Nature of the catalyst used
 - b. The proportion of the reactants i.e. molar ratio of the reactants.
11. The formation of phenol formaldehyde resin comprises of following steps:
 - a. Methylation
 - b. Novolac formation
 - c. Resole formation
 - d. Resite formation

Properties:-

1. Bakelite is hard, Strong and rigid polymer
2. They have outstanding heat resistance, dimensional stability and good dielectric properties
3. They have excellent adhesive properties and loading strength.
4. It is resistant to the action of atmosphere and mainly chemicals.
5. It cannot be remolded.

Applications:-

1. It is used for making electrical insulating parts i.e. switches, plugs, switchboards, handles of electrical instruments.
2. They are used in automotive, radio and TV parts due to their good dielectric properties.
3. They are used for impregnating paper, wood and other filters, for producing decorative laminates, wall coverings and industrial laminates for electric parts including printed circuits.
4. They are used for producing brake linings, steering wheels, sand paper, bottle caps, etc.
5. Phenolic resins are widely used in varnishes, electrical insulations and protective coatings.
6. It is used in manufacture of ion exchange resins in water softening.

Procedure:-

1. Place 5 ml of glacial acetic acid and 2.5 ml of 40% formaldehyde solution.
2. Add 2gm of phenol to it
3. Wrap the cloth loosely round the beaker. Add a few ml of conc. HCl into the mixture carefully and heat it slightly.
4. A large mass of plastic, pink in colour is formed.
5. The residue is washed with water and is filtered
6. The product is drained and yield is calculated.

Precaution:- The reaction is sometimes vigorous and it is better to be a few feet away from the beaker while adding the HCL until the reaction is completed.

1. Methylation: in presence of acid or alkali, ortho and para monomethylols are formed.
2. Novolac formation: The (I) isomer or o-hydroxy methylol when react with phenol molecule forming a linear polymer called "Novolac" Depending the phenol foemaldehyde(P/F) ratio, different types of resins are obtained i.e. if P/F ratio is greater than 1, then methylol (o-hydroxy methylol) condense with phenol to form a linear polymer with little methylol groups and the product is called as 'Novolac'.
3. Resole formation: "IN presence of alkaline catalysts with P/F ratio less than 1, the methylol phenols condense to form linear structure called resoless".
4. Resite formation: On further heating, resole is transformed into a three dimensional polymer called 'Resite', due to the presence of active groups and mobile hydrogens. Resite is an infusible and insoluble material. If molar ration is more, then cross linked polymer is obtained called "Bakelite".

