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U. Bhatnagar[a]; G. C. Saxena[a]
[a] Department of Chemistry, RBS College, Agra, India

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# SYNTHESIS AND BIOLOGICAL SCREENING OF CHROMIUM CONTAINING POLYMER ALLOYS

U. Bhatnagar and G.C. Saxena *
Departmentof Chemistry,
R.B.S. College, Agra (India)



A B S T R A C T

Chromium containing polymer alloys have been prepared by using different concentration of poly (chromium acrylate) in the presence of methylmethacrylate and styrene. The samples have been polymerized in different test tubes initiated by $\alpha$-$\alpha'$ azobisisobutyronitrile and finally the metal containing polymer alloys were recovered by shattering the glass tubes. Polymer alloy has been characterized by infrared spectoscopy. The sharp band of C=O group down around 1700 $cm^{-1}$ for the highest chromium content other properties such as chemical resistance antimic robial activity, adsorbity, softening range and

* Author to whom all correspondence should be addressed.

permeability have been studied in the form of film of the same composition.

## INTRODUCTION

Polymer alloys have found extensive applications (1-5) in recent years such as in the field of engineering and automobiles. Physical and Chemical properties of the polymers are usually modified by means of the preparation of polymer alloys. Engineering properties such as heat resistance, solvent resistance and high molecular weight of polymers can be greatly improved by the formation of polymer alloys.



Because of their industrial significance, the synthesis of polymer films has revolutionized research in the field of polymer Chemistry during the past decades. The literature includes very few reports on the synthesis and characterization of copolymer films (6).

The application of metal containing polymers in the field of metal containing polymer alloys have not yet been fully investigated (7). Therefore, we decided to undertake a systematic study of metal containing polymer alloys The present communication reports the synthesis and properties of polymer alloy in the form of film.

## MATERIALS

Styrene (Sty) and methyl methacrylate (MMA) were distilled under reduced pressure and purified

according to the mehtod of Overberger (8). Solvents were purified by standard procedures (9). Chromium acrylate was prepared by the method reported in literature (10). $\alpha$-$\alpha'$ azobis isobutyronitrile (AIBN) was recrystallised by toluene. Polychromium acrylate has been prepared by using AIBN as an initiator at $85^0$C using dioxane as an inert solvent.

## METHODS

Samples were prepared by first weighing a given amount of low molecular weight polystyrene in different test tubes. To this was then added 'MMA(3.44 $moll^{-1}$) and sty(4.1 $moll^{-1}$) followed by $5.7x10^{-2}$ $moll^{-1}$ of AIBN to polymerize the samples for preparing metal containing polymer alloys. To the test tubes poly (Chromium acrylate) has also been added in different concentration. The polymerization was performed at $50^0$C for 3 days, followed by postcuring for about 20 hours at $80^0$C and 4 hours at $100^o$C, finally the polymer/polymer composite was recovered by shattering the glass tubes.

### Preparation of film solution:

Films were grown by dissolving copolymer of MMA and sty. in toluene using a fixed concentration of 15% by weight of the solute. The solution was continuously stirred for about 45 minutes using a magnetic stirrer to ensure homogenous mixing. Different concentrations (25, 50 and 100 mg) of poly (Chromium acrylate) was added in the 15% solution of copolymer for preparing different concentrations of poly (Chromium acrylate) doped films.

**Preparation of film:**

The glass plates used for casting were treated with a mixture of sulfuric acid ($H_2SO_4$) and potassium dichromate ($K_2Cr_2O_7$) and then washed and rinsed with distilled water and dried in the oven at 60°C for 1 h . The film was then cast by pouring the film solution onto the glass plate uniformly. The film was kept at room temperature.

**Permeation Experiment:**

In order to investigate the water permeability through the film, the end of a measuring cylinder, containing saturated sugar solution, was closed with the film. This cylinder was then placed in a beaker containing potassium permangnate solution and this system was left for 24 hours.

**Solubility and Chemical resistance:**

Film strips (about 25 mg in weight) were immersed in various organic and inorganic solvents for 7 days. The change in weight was noted.

**Adsorption Experiment:**

In order to study the phenomenon of adsorption, film strips (about 25 mg in weight) were immersed in various liquids (dimethyl sulfoxide, nitric acid and acetic acid) at 40°C. After a relatively short time, the incrase in weight due to adsorption was noted.

Table 1: Composition of Reactant used in the preparation of metal containing polymer alloys.

| Polymer alloys code | COMPONENT | | | |
|---|---|---|---|---|
| | (AIBN) $(mol\ l^{-1})$ $x10^{-2}$ | (MMA) $(mol\ l^{-1})$ | (STY) $(mol\ l^{-1})$ | Poly chromium acrylate (mg) |
| $PA_1$ | 5.7 | 3.44 | 5.6 | - |
| $PA_2$ | 5.7 | 5.16 | 2.3 | 50 |
| $PA_3$ | 5.7 | 3.44 | 4.6 | 50 |
| $PA_4$ | 5.7 | 1.72 | 6.9 | 50 |
| $PA_5$ | 5.7 | 3.44 | 4.6 | 100 |
| $PA_6$ | 5.7 | 3.44 | 4.6 | 25 |



## Biological Screeing:

The chromium containing polymer alloys were screened for their biocidal activity by adopting the agarplate technique (11) for fungicidal and agar diffusion technique for bactericidal activity. The screening was made at 250, 500 and 1000 ppm in acetone and number of replication in each case was three. Candida albucins and Bascillus subtillis were used as test organisms for fungicidal and bactericidal activity respectively. Sterile filter paper discs of 5 mm diameter were soaked in solution of different concentrations of test compounds and introduced on nutrient agar plates. The plates were incubated at

25+0.1°C for 48 hours and zones of inhibition based upon zone size around the disc was measured and data are presented in Table 3.

## RESULTS & DISCUSSIONS

The samples were very hard and translucant or opaque except copolymer sample in which only MMA and Sty were used (Table 1). The samples were completely soluble in benzene, toluene and tetrahydrofuran. The softening range of metal containing polymer alloys increases upto 240°C-250°C in comparison to copolymer samples (180°C-190°C) of the same composition.

The other properties of the alloys have been studied in the form of film of the same composition.

### Properties of metal containing polymer alloys copolymer films:-

The film was slight green in colour and opaque. Water permeability of the film was investigated at room temperature. The films prepared using different concentrations of poly (Chromium acrylate) ($PA_1$ to $PA_3$) were found to be impermeable in water (Table 1).

Various inorganic and organic solvents were used to check the solubility and chemical resistance of the film. The data showed that the film was insoluble in strong bases and distilled water but soluble in most of the organic solvents (Table 2).

Dimethyl sulfoxide, nitric acid, and acetic acid were used as test liquids. The adsorption of

Table 2: Solubility of metal containing copolymer film.

| Sl. No. | Solvents | POLYMER FILM $PA_1$ | $PA_2$ | $PA_3$ |
|---|---|---|---|---|
| 01. | Acetone | ++ | ++ | ++ |
| 02. | THF | ++ | ++ | ++ |
| 03. | Dichloromethane | ++ | ++ | ++ |
| 04. | $CH_3OH$ | -- | -- | -- |
| 05. | Diethylether | +- | +- | +-. |
| 06. | Benzene | ++ | ++ | ++ |
| 07. | Toluene | ++ | ++ | ++ |
| 08. | Carbon tetrachloride | ++ | ++ | ++ |
| 09. | DMF | +- | +- | +- |
| 10. | Dioxane | ++ | ++ | ++ |
| 11. | DMSO | -- | -- | -- |
| 12. | Water | -+ | -+ | -+ |
| 13. | $H_2So_4$ | ++ | ++ | ++ |
| 14. | HCL | -+ | -+ | -+ |
| 15. | $HNO_3$ | -+ | -+ | -+ |
| 16. | $CH_3COOH(25\%)$ | -- | -- | -- |
| 17. | NaoH (N/10) | -- | -- | -- |

++ = Soluble at room temperature;

+- = Sparingly soluble at room temperature;

-- = Insoluble;

-+ = Sparingly soluble on heating.

Table 3: Biological Screening of the Chromium containing polymer alloys.

| Compounds | ORGANISM | | | | | |
|---|---|---|---|---|---|---|
| | B Subtilis | | | Albucins candide | | |
| | Conc. in ppm. | | | Conc. in ppm | | |
| | 250 | 500 | 1000 | 250 | 500 | 1000 |
| 1 Blank | 1.5 | 3.0 | 5.0 | 0.5 | 1.0 | 1.5 |
| 2 50 mg | 4.0 | 6.0 | 10.0 | 2.5 | 3.0 | 4.0 |
| 3 100 mg | 5.0 | 8.5 | 13.0 | 3.0 | 4.0 | 6.0 |

Tame = 48 hours (for B. subtillis)

= 7 days (for Albucins candida)

Temperature = $28 \pm 1^{o}C$



nitric acid in film was highest (27.7%), while dimethyl sulfoxide also exhibited high adsorption (16.6%), but the absorption of acetic acid was relatively low (4.6%).

The results of fungicidal and bactericidal screening given in Table 3 show that compound are active against bascillus substillus. Antifungal activity of the compound is not good.

## Spectral Studies:

The bands at 2980 and 2940 $cm^{-1}$ are attributed to the fundamental vibrations of the ester methyl

group. The third band at 2930 $cm^{-1}$ is referred to the methyl group attached to the carbon atom. These bands appear also in case of bulk copolymer of MMA and styrene containing polychromium acrylate samples but with slight shifting at 3020 $cm^{-1}$, 2920 $cm^{-1}$ and 2840 $cm^{-1}$ respectively.

The sharp band at 1710 $cm^{-1}$ could be assigned to carbonyl group for the lowest chromium content and down around 1700 $cm^{-1}$ for the highest chromium content, band brodening increases with increasing polychromium content. The sharp band at 1600 $cm^{-1}$ is due to aromatic protons of C-H stretching. The C-H deformation bands show at 1510, 1480 and 1390 $cm^{-1}$ with slight shifting.

## CONCLUSION

The films were water impermeable and had higher adsorption property for nitric acid, adsorption was lowest in acetic acid. The film or films were active against bacteria 'bascillus subtillus'.



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