

# PEO: PVP: NaClO<sub>2</sub> based polymer electrolyte prepared by solution cast technique and study its characterization

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## Abstract

The polymer electrolyte PEO: PVP: NaClO<sub>2</sub> was prepared by solution cast technique. Polymers PEO, PVP, NaClO<sub>2</sub> were taken separately at three different ratio with as (40:50:10), (30:50:20), (20:50:30). These electrolyte were characterized by XRD and FTIR technique.

**Keywords:** Polymer electrolyte, PEO, PVP, NaClO<sub>2</sub>.

## 1. Introduction

The polymer electrolyte (Solutions) serve as electronic insulators between the anode and cathode but it must be a good ionic conductor. Polyethylene oxide (PEO) is used as the polymer matrix because it is chemically inert, able to dissolve in number of inorganic salts and it provides moderate ionic conductivity. Polymers are macromolecules having high molecular weights and composed of smaller repeating units called monomers. The term polymer is derived from Greek roots 'poly' means 'many' and 'meres' means 'part'. Monomers are small and simple molecules and have a capacity of forming two chemical bonds with two other monomers. DNA in human body, proteins, nerve fibres, muscles, nails, hairs, etc. are all polymers.[1]

Polymer electrolytes based on PEO-PVP complexed with Na<sup>+</sup> ion, Mg(NO<sub>3</sub>)<sub>2</sub> salt, NaCl salt, NaPF<sub>6</sub>, NaIO<sub>4</sub> salt have been reported [2]-[6]. The polymer electrolyte based on PEO, PVP complexed with NaClO<sub>2</sub>, NaCl were also prepared [7]-[9]. Keeping this view in mind, authors prepared polymer electrolyte based on PEO, PVP complexed with NaClO<sub>2</sub> and study their XRD and FTIR analysis.

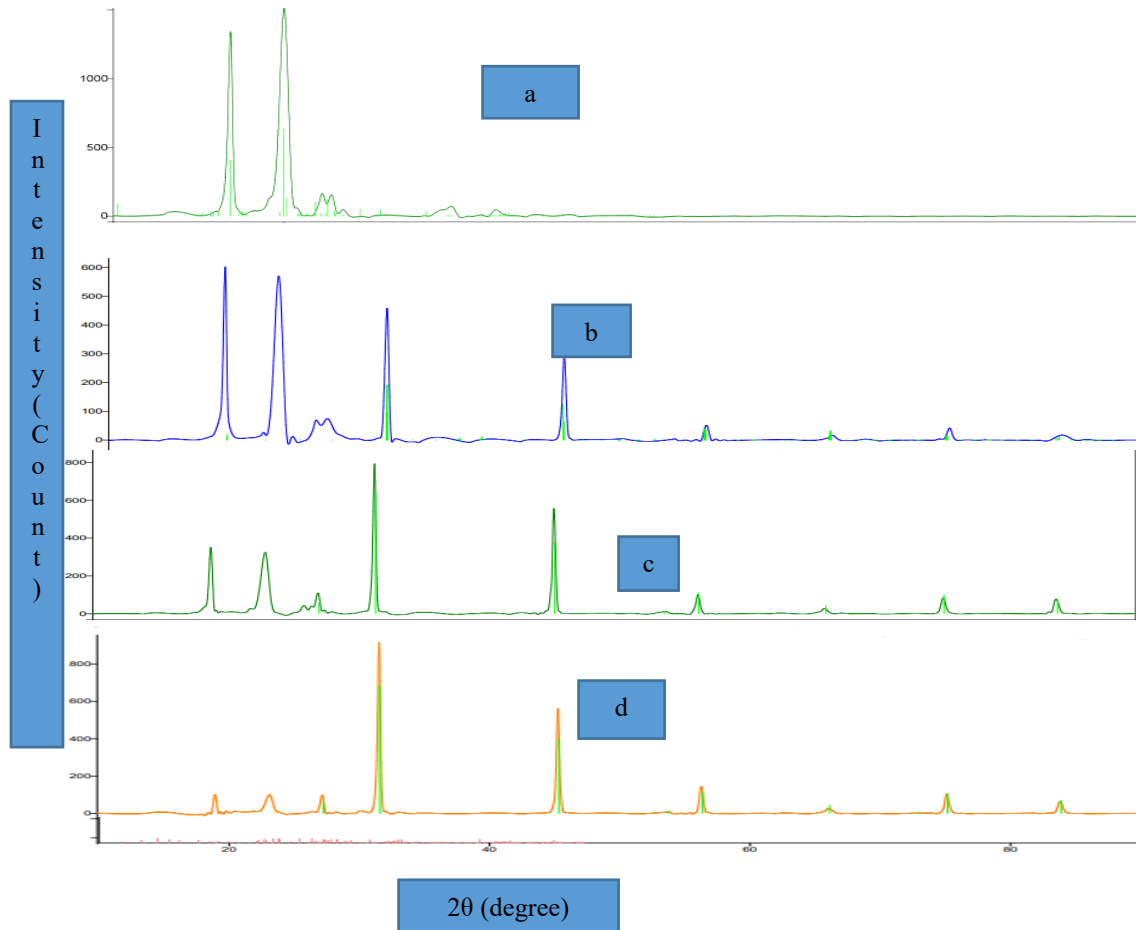
## 2. Preparation of polymer electrolyte

The polymers PEO and PVP were taken separately at different ratio with NaClO<sub>2</sub> wt% as (40:50:10), (30:50:20) and (20:50:30). Each mixture dissolved in methanol for making polymer-salt mixture into solution. To obtain the perfect solution of this mixture, the solution was stirred well for 24 hours and poured into a polypropylene dishes. The solution was slowly evaporated at room temperature. Thus, thin film of polymer electrolyte was prepared by solution cast technique. Further these films were crushed into powder form. This powder was used for XRD and FTIR analysis.

### 3.Result and Discussion:

#### 3.1X- ray diffraction (XRD) analyse:

Fig. 1 shows the XRD patterns of  $\text{NaClO}_2$  complexed with PEO and PVP.



**Fig.1 XRD patterns of  $\text{NaClO}_2$  complexed PEO, PVP a) pure PVP+PEO b) PEO+ PVP+  $\text{NaClO}_2$  (10%) c) PEO+ PVP+  $\text{NaClO}_2$  (20%) d) PEO+PVP+ $\text{NaClO}_2$  (30%)**

The Complexation of PEO and PVP with salt  $\text{NaClO}_2$  has been studied using X- ray diffraction. A comparison of the diffraction spectra of complexation of  $\text{NaClO}_2$  with polymer PEO and PVP.

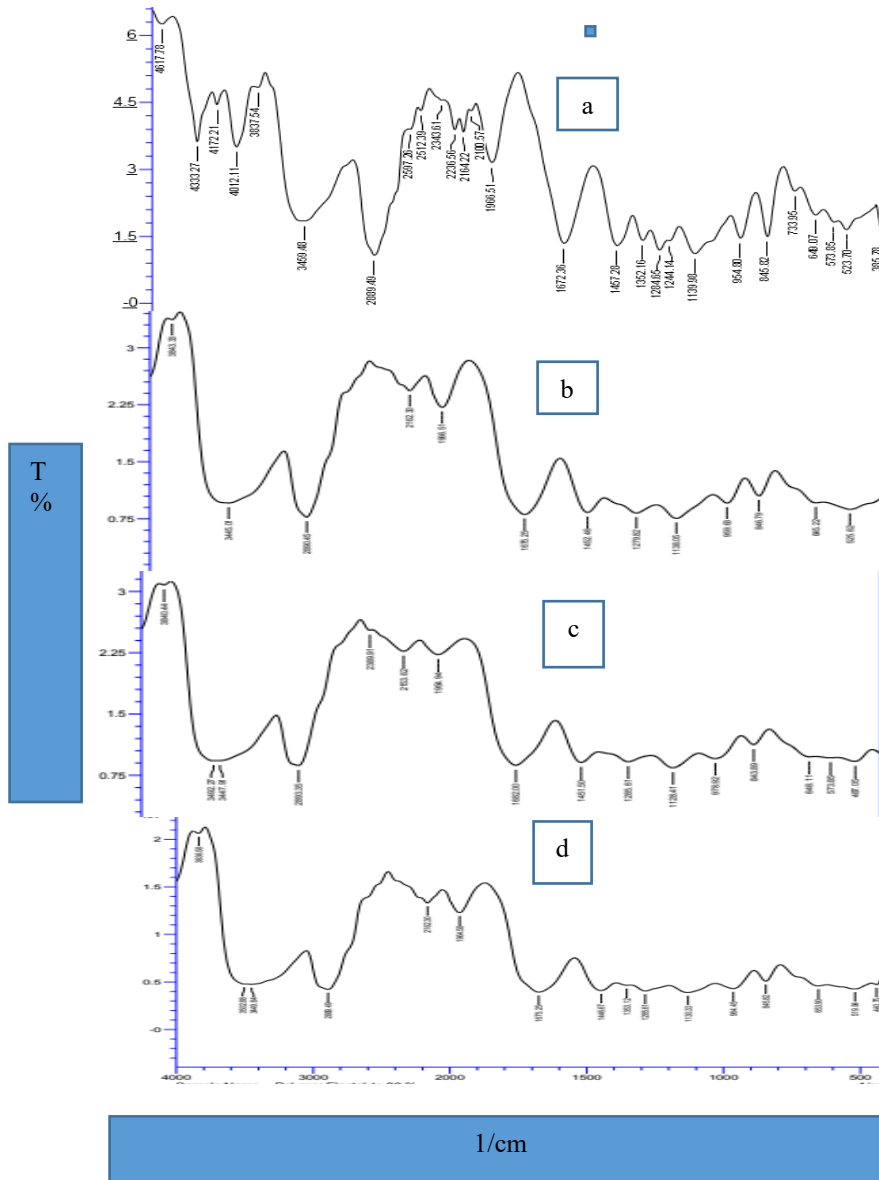
- The diffraction peaks observed for  $2\theta$  values at  $19.05^\circ$  to  $28.05^\circ$  were found to be less intense in complexed PEO, PVP films compared to the pure PEO, PVP film. This indicates that the addition of  $\text{NaClO}_2$  salt increases with decreasing the intensity. [11]
- The X-ray diffraction pattern sharp peak around  $32.05^\circ$  to  $45^\circ$ , indicating its crystalline nature. [12]
- No sharp peaks were observed in the higher concentrations of  $\text{NaClO}_2$  salt in the polymer. No peaks corresponding to  $\text{NaClO}_2$  salt is observed in the higher compositions of the complex PEO and PVP, which indicates the absence of excess salt in the material.[11]

- In summary, these observations confirm the complexation of the NaClO<sub>2</sub> salt PEO and PVP. [13]

The average crystallite size of synthesized polycrystalline sample (PEO: PVP: NaClO<sub>2</sub>) of 10% solution is 289.14 Å, (PEO: PVP: NaClO<sub>2</sub>) of 20% is 393.09 Å and (PEO: PVP: NaClO<sub>2</sub>) of 30% is 351.63 Å. The X – ray diffraction can be used to determine the crystallite size by using Scherer’s equation.

### 3.2 FTIR analysis

Fig.2 shows the FTIR patterns of NaClO<sub>2</sub> complexed with PEO and PVP .



**Fig2: FTIR patterns of NaClO<sub>2</sub> complexed PEO, PVP a) Pure PEO+ PVP b) PEO+ PVP+ NaClO<sub>2</sub> (10%) c) PEO+ PVP+ NaClO<sub>2</sub> (20%) d) PEO+PVP+NaClO<sub>2</sub> (30%).**

The following observation in the FTIR spectra confirm the PEO and PVP contents complexation in the present electrolyte system.

- The strong broad absorption band appearing at  $2890\text{ cm}^{-1}$  in pure PEO corresponds to symmetric and asymmetric C-H stretching modes of  $\text{CH}_2$  group. The width of this band in PEO was found to decrease with increase of dopant concentration. [11]
- The intensity of the aliphatic C-H stretching vibrational band observed  $2890\text{ cm}^{-1}$  in PEO and PVP decreases with increasing concentration of  $\text{NaClO}_2$  salt in the polymer. [11]
- The width of C-O Stretching band observed around  $1139\text{ cm}^{-1}$  in PEO also showed a decrease with an increasing concentration of  $\text{NaClO}_2$  salt in the polymer. [10]
- In the FTIR spectra, the presence of all allowed vibrational modes of carbonyl group (C=O) of PVP are in congruent with previous reports.
- The width of carbonyl group (C=O) stretching band observed around  $1675\text{ cm}^{-1}$  in PVP also showed a decrease with increasing concentration of the  $\text{NaClO}_2$  salt in the polymer. [5]
- The vibrational modes present at around  $846\text{ cm}^{-1}$  and  $954\text{ cm}^{-1}$  are accountable for  $\text{CH}_2$  rocking motion with little C-O stretching motion and C-O stretching motion with same concentration from  $\text{CH}_2$  rocking motion respectively. [6]
- If the actions of  $\text{NaClO}_2$  get coordinated with etherical oxygen of PEO the spectral changes are expected to be in C-O-C stretching and deformation ranges. [11]

The width of NH stretching band observed around  $3459\text{ cm}^{-1}$  increases with increasing the concentration of  $\text{NaClO}_2$  salt in polymer.

#### 4. Conclusions

(PEO+PVP+ $\text{NaClO}_2$ ) based polymer electrolyte have been prepared by using solution cast technique with the weight percent ratio. The complexation of polyethylene oxide, polyvinyl-pyrrolidone and  $\text{NaClO}_2$  salt have been confirmed by using X-ray diffraction and FTIR.

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