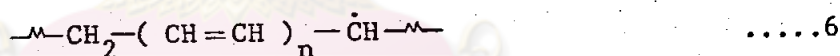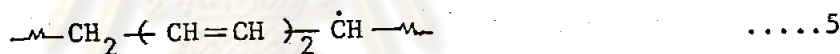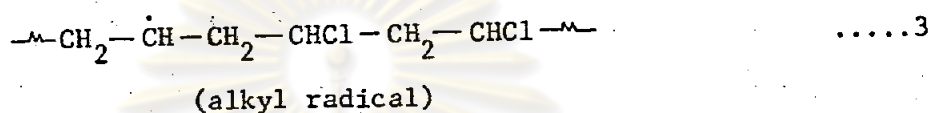# CHAPTER 4

CONCLUSION

The investigation of photodegradation of PVC in this research work was followed by measuring the hydrogen chloride evolved. Thus apparatus has been designed such that the hydrogen chloride can be conductometrically detected during the irradiation.

The concentration of hydrogen chloride produced depends upon the number of polymer chains and the presence of added additives(plasticizer, stabilizer and pigments).It is found that the amounts of hydrogen chloride produced increase with increasing number of polymer chain and decrease with increasing the concentration of added additives. With 25, 50 phr TINUVIN P and 50 phr DOP, no hydrogen chloride was observed. This suggests that 25, 50 phr of TINUVIN P and 50 phr DOP are sufficient to protect degradation of PVC. Furthermore, the result is shown that carbon black offered more protection than titanium dioxide.
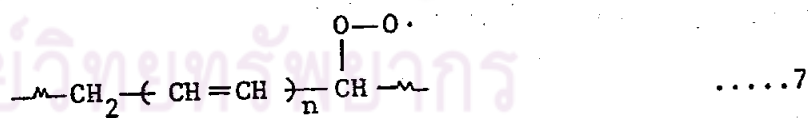
It is quite clear that discolouration during the photodegradation of PVC in nitrogen is associated with the formation of conjugated double bonds within the polymer chains. The absorption spectrum of irradiated PVC consists of several sharp absorption bands corresponding to polyene of $n \geqslant 4$. With increasing irradiation time higher absorbances were obtained. This can be explained that more polyene of the same type were formed.

The infrared spectrum of photodegraded PVC in oxygen shows the absorption bands near 1,700 cm.$^{-1}$. This means that the oxidation product containing C=O is produced. Comparison of the results from this study with other works reveals that the trend of photodegradation of PVC both in solid form and in solution are similar. Consequently, the

mechanism for the photodegradation of PVC in solution presumably the same as the photodegradation of PVC film or rigid PVC. The following reaction mechanism can be proposed:

$$PVC\ (I) \longrightarrow PVC\ (I)^* ; \qquad I = Impurity \qquad \dots\dots 1$$

$$PVC\ (I)^* \longrightarrow -CH_2-\overset{\cdot}{CH}-CH_2- \ +\ Cl^{\cdot} \qquad \dots\dots 2$$

$$-CH_2-\overset{\cdot}{CH}-CH_2-CHCl-CH_2-CHCl- \qquad \dots\dots 3$$

(alkyl radical)

$$\downarrow\ -HCl$$

$$-CH_2-CH=CH-\overset{\cdot}{CH}-CH_2-CHCl- \qquad \dots\dots 4$$

$$\downarrow\ -HCl$$

$$-CH_2-(CH=CH)_{2}-\overset{\cdot}{CH}- \qquad \dots\dots 5$$

$$\downarrow\ -HCl$$

$$-CH_2-(CH=CH)_{n}-\overset{\cdot}{CH}- \qquad \dots\dots 6$$

In the presence of air:

$$\overset{\displaystyle O-O^{\cdot}}{\overset{|}{-CH_2-(CH=CH)_{n}-CH-}} \qquad \dots\dots 7$$

$$\downarrow$$

$$-CH_2-(CH=CH)_{n}-\underset{\displaystyle O}{\overset{\displaystyle \|}{C}}- \qquad \dots\dots 8$$

The reaction occurs via the initiator step in which the impurities in the PVC is the initiator. Finally the PVC will be degraded to polyene. In the presence of air, carbonyl compound will be generated.