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# Photostabilization of Poly (Vinyl Chloride) by Some Schiff Base Derivedfrom 2-amino pyridine

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## Abstract

In this paper, Schiff bases (1-6) were prepared and synthesized by condensing aromatic aldehydes (benzaldehyde, salicylaldehyde,$\rho$-methoxylbenzaldehyde, $\rho$-hydroxybenzaldehyde, furfural and isatin) with 2-amino pyridine. Spectrophotometric (FTIR) and (UV.VIS) and elemental analysis (CHN) techniques have been employed for the characterization of the additives. All the additives were used as photostabilizer for poly (vinylchloride). The rate of photodegradation and photostabilization of PVC films (40µm) were monitored with irradiation time by measuring the carbonyl (Ico) and polyene (Ipo) indices values (the concentration of additives kept constant at 0.3% wt/wt). The light of wave length 313nm is used for irradiation of polymer films at temperature around 40°C.

The effect of additives concentration range from (0.1-0.5) wt% on the rate of photodegradation and photostabilization was also monitored for PVC films. The rates increase when additives concentration is increased. The effect of film thickness is also studied and results show that increasing film thickness will decrease the rate of photo degradation in the following sequence:

[2] > [5] > [4] > [6] > [3] > [1]> PVC

According to the experimental results several mechanisms were suggested depending on the structure of the additive.

Keywords: 2-amino pyridine , Poly vinyl chloride (PVC), Photostabilization, Schiff Base.

## Introduction

Thermoplastic form poly(vinyl chloride) (PVC) have a considerable commercial importance in industry and in everyday life. They are successfully replacing some natural raw materials due to their particular properties which offer a combination of easy modification in thermoplastic processing, rigidity, compatibility with a large number of other products, resistance to corrosion and low cost technology [1].

Plastics are very susceptible towards solar ultraviolet radiation, so when it is exposed to long term outdoor environment it wouldundergo more or less rapid degradation resulting in discoloration, embitterment, cracking of surface, stiffing and ultimately lose or decrease in their useful mechanical engineering properties [2]. The extent of outdoor service life of synthetic polymer (plastics) or naturally occurring polymers are limited by their structures., The type and amount of additives and the magnitude of UVB 313[UVB is made up of wavelength from approximately [280-320nm] rays absorbed, while temperature and humidity may further reduce service life [3]. Plastics can be protected against thermal and photodegradation by using efficient stabilizers designed to prohibit or slow down the degradation process in order to prolong the use life of the plastic [4-9].

2-Aminopyridine compounds are well known class of compoundes fora long time, and still are interestingly considerable due to their application in various fields.

The primary use of 2-aminopyridine is an intermediate in the manufacture of pharmaceuticals:anti-histaminesandpiroxican. Lornoxican and Tenoxican are considered as new non–steroidal, ant-inflammatory drugs of oxicam class inhibiting cyclooxgenase the key enzyme of prostaglandin biosynthesis at site of inflammation [10-13]. The photostabilizing effect of mono Schiff base in films of PVC had been studied [14-16].To the best of our knowledge there is no previous attempt to in the literature investigate the photostabilization of PVC films by Schiff bases compounds containing pyridine and azomethine groups.

## Experimental

### Chemicals:

All chemicals used in this works were reagent grade (BDH/Aldrich) namely salicylaldehyde, benzaldehyde, $\rho$-methoxybenzaldehyde, $\rho$-hydroxybenzaldehyde, 2-furan carboxaldehyde and 2-amino pyridine which used without further purification.

### I) Synthesis of Schiff Bases (1-6) :

General procedures for the synthesis of Schiff bases of amino pyridines had been reported earlier [17-19]. The Schiff bases were prepared by adding 30ml aromatic aldehyde ethanolic solution 0.01mole, to ethanolic solution 30% of aromatic amine(0.01mole).The mixture was stirred for ~6hrs.at 100°C. The resulted solution was evaporated under vacuum to remove the solvent. The product then collected by filtration, washed several times with methanol and recrystalized from DMF and then dried under vacuum. The physical properties of Schiff bases (1-6) are listed in Table (1).

### Experimental Techniques :

### 1. Films Preparation :

A poly (vinyl chloride) solution (5gm/ 100ml) in tetrahydrofuran (THF) was used to prepare different thickness of polymer films (measured by digital micrometer type 2610A Germeny) with (0.1-0.5)wt/wt% of the prepared compounds. The films were prepared by evaporation technique at room temperature for 24hrs to remove the possible residual (THF) solvent. Film samples were further dried at room temperature for 3hrs under reduced pressure. The films were fixed on stand specially used for irradiation which is aluminum plate (0.6mm) in thickness supplied (Q-panel) company.

### 2.Irradiation Technique :

Accelerated weather meter Q.U.V. tester (Philips Germany), was used for irradiation of polymers films. The accelerated weathering tester contains stainless steel plate which has two holes in the front side and another one behind each side contains lamps type (Fluorescent Ultraviolet Lights) 40 watt each, the lamps are of the type (UV-B313) giving spectrum range between (290-360nm) and the maximum wavelength is (313 nm). The polymer film samples vertically fixed and parallel to the lamps assure the vertical incidence of UV radition on the samples. The places of the irradiated samples are changed places from time to time to be sure that intensity of light incident on all sample is equal.

### 3- Photo Degradation Measurements :

The photodegradation of polymer film samples were followed using Shimadzu spectrophotomet model 84005. The absorption spectra of the film samples were recorded in the range of (4000-400) $cm^{-1}$. The carbonyl and polyene groups absorbtion are allocated at 1720 and $1633cm^{-1}$ respectively [20]. The photodegradation during different irradiation times were followed by through the variation in carbonyl and polyene absorption band. Then carbonyl (Ico) and polyene (Ipo) indices were subsequently calculated by comparison of the FTIR absorption peaks at $1720cm^{-1}$ and $1633cm^{-1}$ with reference peak at $1428cm^{-1}$, respectively. This method is called band index method [21], which includes:

$$Is_{C=O\,,C=C} = A_S/A_r \text{..........................................(1)}$$

As : Absorbance of peak under study.
Ar : Absorbance of reference peak.
Is $_{C=O\,,C=C}$: lndex of the group under study.

The absorbance (A) at the specified wave number for carbonyl and polyene for PVC were calculated using the following relation shown in equation (2).

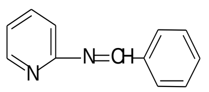
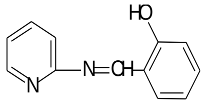
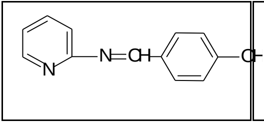
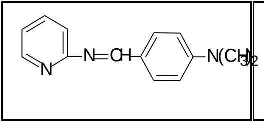
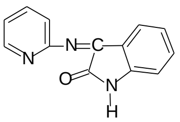
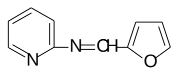
$$A = 2 - \log\ T\,\% \text{............................................(2)}$$

Actual absorbance, the difference between the absorbance base line and top of the absorption peak is calculated using the base line method [22].

## Results and Discussion

The characterization of Schiff bases additives was confirmed on the basis of their chemical structure using FTIR, UV-Visible and (CHN) analysis. The code name, chemical structure are reported in Table (1).The spectra show an absorption band at (1620-1650)$cm^{-1}$, which were assigned to (C=N) stretching of the Schiff base additive formed as well, the other informative bands are listed in Table (2).

***Table (1)***
***Physical Properties of Schiff Bases Additives.***

| Comp. No. | Structure | Names | M. Formula M.Wt | yield % | m.p. °C | Color | Recrystallization Solvent | C.H.N | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | C% | H% | N% |
| | | | | | | | | *Cal (Fou) | *Cal (Fou) | *Cal (Fou) |
| 1. |  | N-benzylidin-2-amine | $C_{12}H_{10}N_2$<br>182 | 68 | 110-112 | Yellow | DMF | 79.1<br>(78.9) | 5.49<br>(5.01) | 15.38<br>(15.12) |
| 2. |  | 2-[(pyridine-2-ylimino)methyl) phenol | $C_{12}H_{10}N_2O$<br>198 | 60 | 162-163 | Pale yellow | DMF | 72.72<br>(71.51) | 5.05<br>(4.99) | 14.14<br>(13.73) |
| 3. |  | 4-[pyridine-2-ylimino)methyl]phenol | $C_{12}H_{10}N_2O$<br>198 | 50 | 120-122 | Brown | DMF | - | - | - |
| 4. |  | N-[4-dimethyl amino)benzylidene pyridine-2-amine | $C_{14}H_{15}N_3$<br>225 | 55 | 189-190 | Yellow | DMF | 74.66<br>(73.85) | 6.66<br>(6.38) | 18.66<br>(18.03) |
| 5. |  | 3-(pyridine-2-ylimino)-1,3-dihydro-2H-indol-2-one | $C_{13}H_9N_3O$<br>223.23 | 50 | 220-222 | Brown | DMF | 69.95<br>(68.89) | 4.03<br>(3.96) | 18.83<br>(17.69) |
| 6. |  | N-Furan-2-ylmethylLidene) pyridine-2-amine | $C_{10}H_9N_2O$<br>172 | 50 | 190-192 | Yellow | DMF | 69.77<br>(68.02) | 4.65<br>(4.53) | 16.28<br>(15.63) |

***Cal = Calculated value**
***Fou =Found value element analysis (C. H. N.)***

***Table (2)***
***Characterization of FT-IR and UV Absorption bands of Schiff Bases Additives.***

| Comp. No. | $\upsilon_{C=N}$ | $\upsilon_{C-H}$ar. | $\upsilon$ Others | $\lambda_{max}$ (nm) |
|---|---|---|---|---|
| 1. | 1618 | 3132 | Out of plane $\upsilon_{(=C-H)}$ 750,720 | 227,285 |
| 2. | 1622 | 3120 | Out of plane $\upsilon_{(=C-H)}$ 750 | 245,293,310 |
| 3. | 1630 | 3050 | Out of plane $\upsilon_{(=C-H)}$ 820 | 236,275, 327 |
| 4. | 1593 | 3080 | $\upsilon_{(C-H)}$ al.2887-2992<br>Out of plane $\upsilon_{(C-H)}$ 815 | 210,245,337,427 |
| 5. | 1640 | 3070 | $\upsilon_{NH}$ 3291<br>$\upsilon_{C=O}$ 1695 | 256,387,399,416 |
| 6. | 1635 | 3150 | $\upsilon_{C-O}$ 1150 | 255,285,352 |

In order to study the photo chemical activity of these additives for the photostabilization of PVC films, the carbonyl and polyene indices were monitored with irradiation time using FT-IR spectrophotometry. The irradiation of PVC films using light of wave length λ=313nm led to new changes in their FTIR spectrum. Appearance of bands at 1770cm$^{-1}$ and 1720cm$^{-1}$, respectively is attributed to the formation of carbonyl groups. The first is related to chloro keton while the second one is assigned to aliphatic ketone, together with formation of a band at 1633cm$^{-1}$ related to polyene group[23].

The absorption of the carbonyl and polyene group are used to follow the extend of polymer degradation during irradiation, this absorption was calculated as carbonyl index (Ico) and Polyene index (Ipo). Accordingly, one could expect that the growth of carbonyl index is a measure for the extent of degradation. As seen from Figs. (1 and 2).the presence of compounds (1-6) show lower growth rate for carbonyl and polyene indices with irradiation time with for PVC film without additives (control).

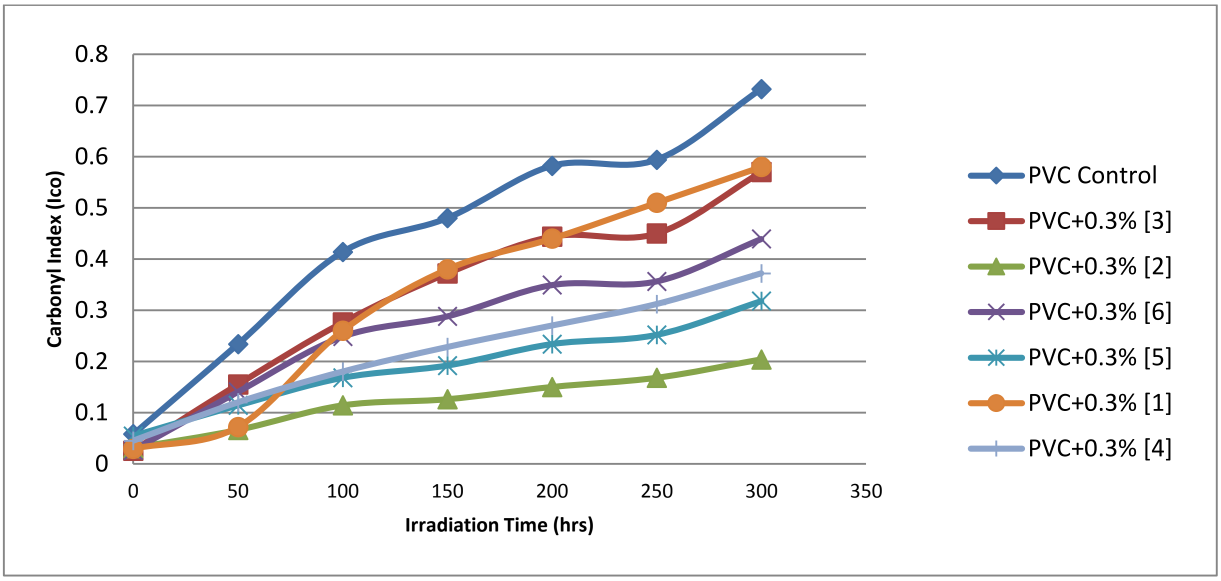


*Fig.(1) The variation in the carbonyl index (Ico) with irradiation time for PVC film (40µm) in thickness containing (0.3%wt) of additives (1-6).*

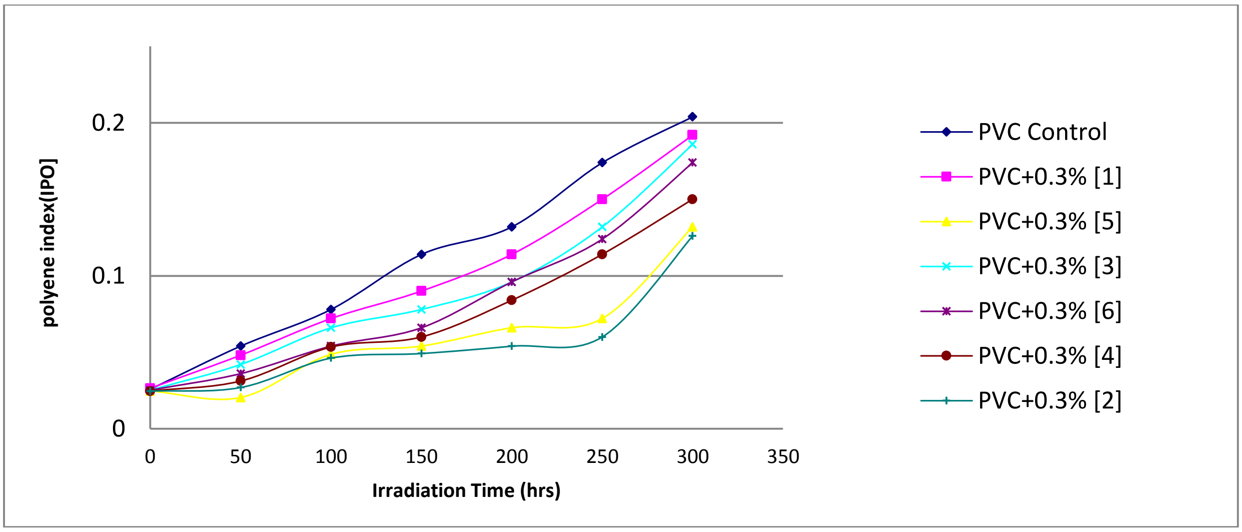


*Fig.(2) The variation in the Polyene index (Ipo) with irradiation time for PVC film (40µm) in thickness containing (0.3%wt) of additives (1-6).*

It can be observed, from the results obtained in Figs. (1 and 2) that the growth rate of carbonyl and polyene indices with irradiation time is lower in the presence of additives (1-6) with respect to the poly (vinyl chloride) without additives (control). So these additives in their FTIR spectral behavior might all be considered as photostabilizers. Also,

Fig.(1 and 2) shows that the relative photostability of additives incorporated with PVC is increased in the order :
[2] > [5] > [4] > [6] > [3] > [1]> PVC.

The calculated values of carbonyl and polyene indices for different concentration (0.1-0.5)%wt/wt for different concentration 0f additive (5) are shown at Figs.(3, 4).

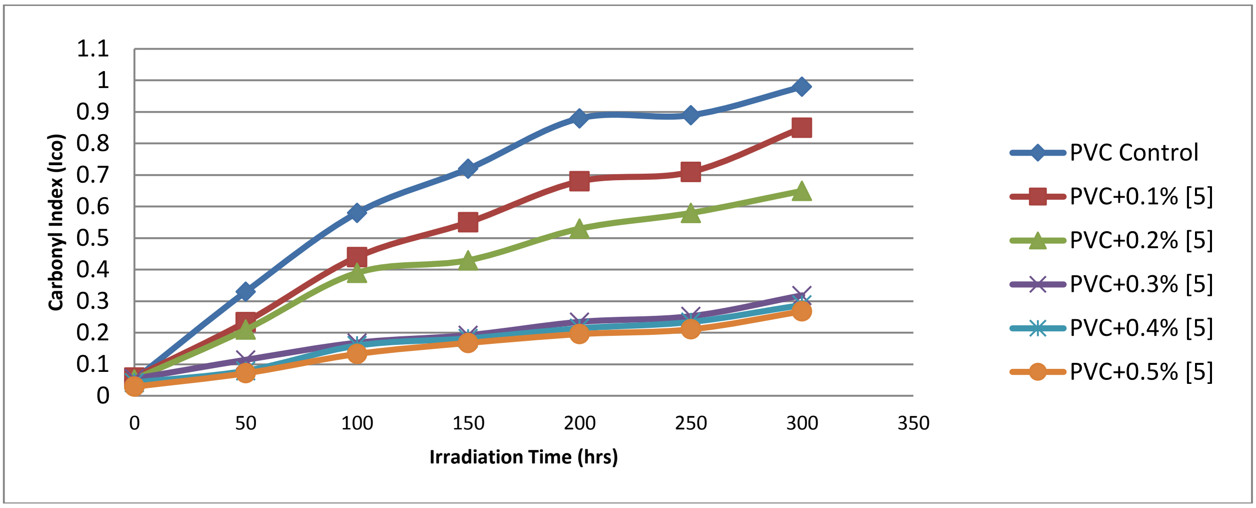


*Fig.(3) Change in Carbonyl index with irradiation time for PVC film (40μm in thickness containing different concentrations of compound (5).*

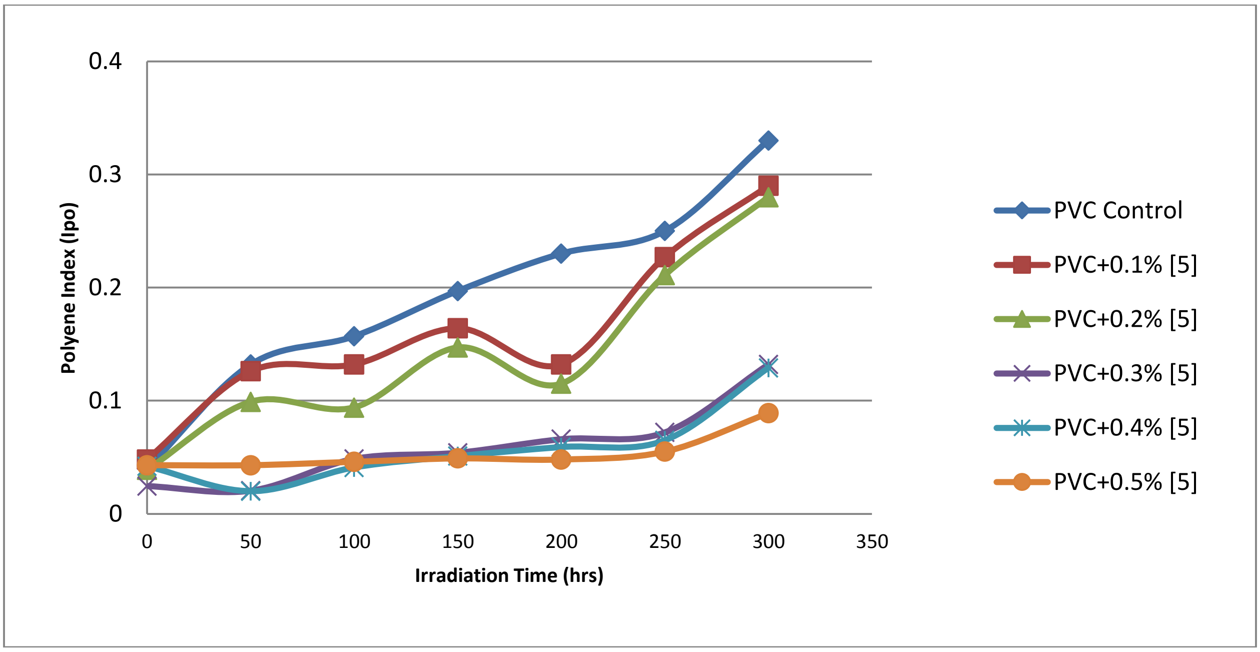


*Fig.(4) Change in Polyene index with irradiation time for PVC film (40μm) in thickness containing different concentrations of compound (5).*

Figs. (5 and 6) show the relationship between the additives concentration and carbonyl (Ico) or polyene (Ipo) indices for PVC film at fixed irradiation time (150 hrs) and fixed thickness (50 μm).

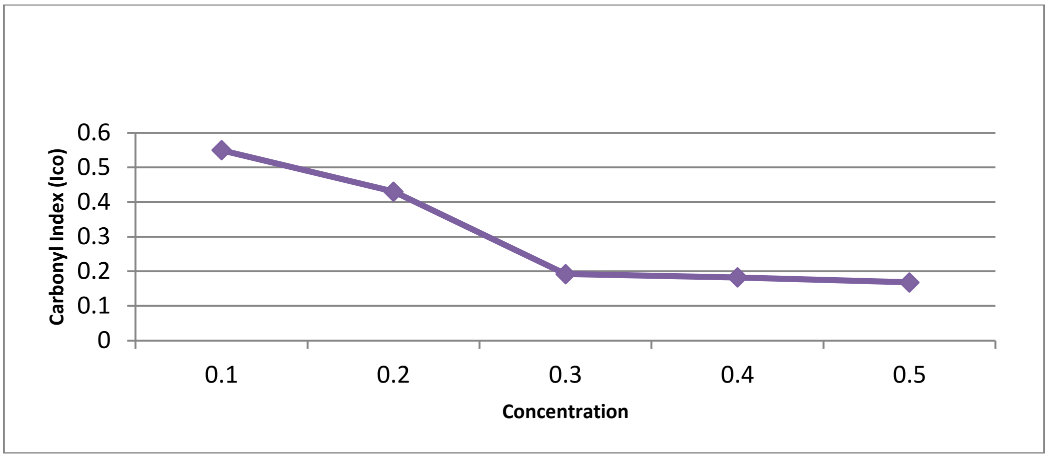


***Fig.(5) Changes in carbonyl index (Ico) with irradiation time (150hrs) for PVC films (40µm) thickness containing different concentrations of additive (5).***

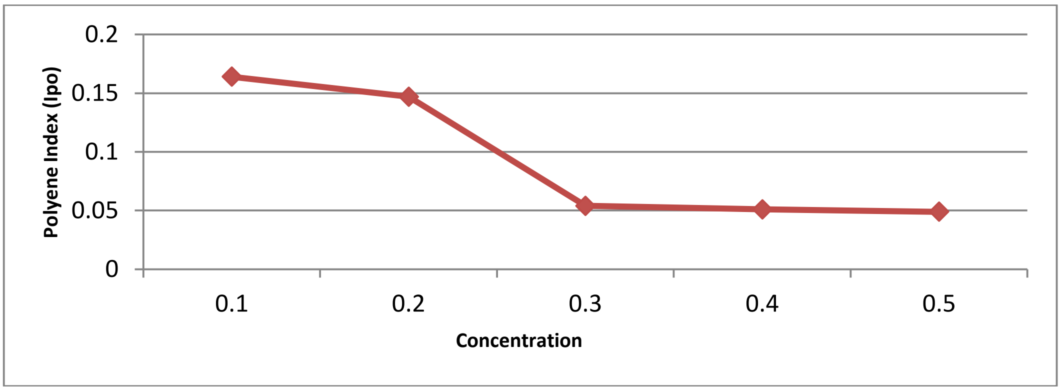


***Fig.(6) Changes in polyene index (Ipo) with irradiation time (150hrs) for PVC films (40µm thickness containing different concentrations of additive (5).***

Results of Figs. (3-6) show that the carbonyl and polyene indices decrease with increasing concentration of additives in films. The photooxidation of (1000µm) and (~80µm) thicknses of has already been reported by Anton et al [24] together with other studies [15,25] for the influence of films thickness in the presence of additives.

In order to investigate the effect of the films thickness on the PVC films with and without additives, FTIR spectroscopy was used to verify the occurrence of surface oxidation of different thicknesses using (30, 40 and 50 µm) of PVC film stabilized with additives as their profile of carbonyl and polyene concentration as displayed in Figs. (7 and 8).

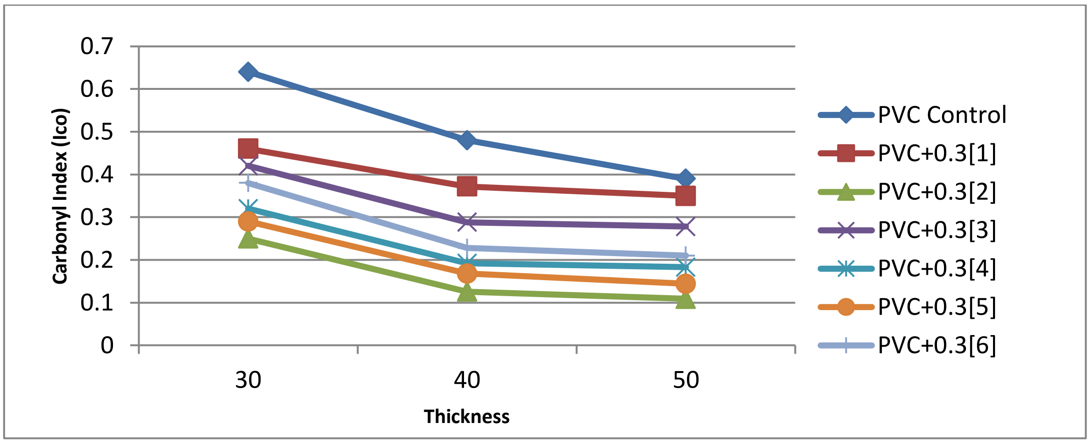


***Fig.(7) The relationship between the carbonyl indices with different thicknesses at (150hrs) irradiation time PVC films containing (0.3%) of additives.***

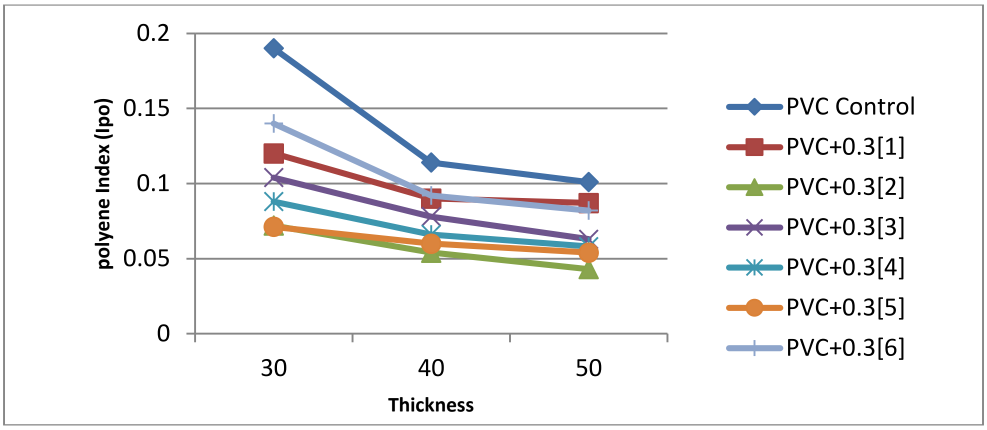


*Fig.(8) The relationship between the polyene indices with different thicknesses at (150hrs) irradiation time PVC films containing (0.3%) of additives.*

Figs. (7 and 8) show the relationship between the carbonyl index and polyene index with film thickness, which indicated the decrease of photodegradation with increasing of thickness of the film.

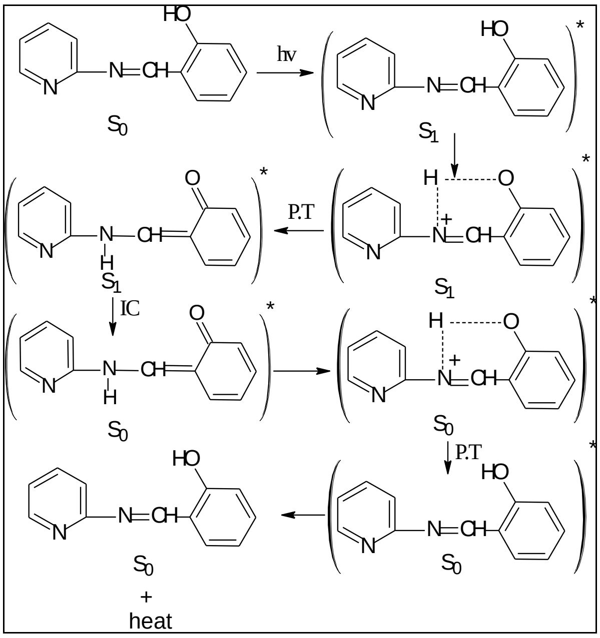
## Suggested mechanisms of photostabilization of PVC by additives:

Through the overall results abtained the efficiency of Schiff base additive as photostabilizers for PVC films can by arranged according to the change in the carbonyl and polyene concentration as a referene for the comparison as shown in Fig.(1-8).

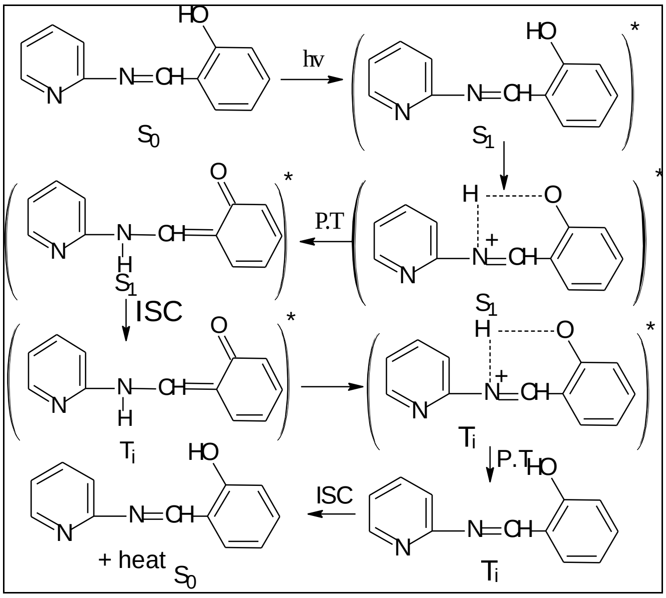
[2] > [5] > [4] > [6] > [3] > [1]> PVC

Schiff base stabilizes PVC via various mechanism a such as UV absorber, screener by radical scavenger.Therefor the action of Schiff bases as photostabilizer in PVC might be alttributed to Uv absorption of there additive and pissipate the Uv energy to harmless heat energy.

This is also suggested for benzophenon [26- 27], benzotriazole [28-29] and aromatic Schiff base photostabilizer [15]. These stabilizerstability and a provide very good long time stability and are usually offered to these mechanism. The most probable mechanism involved in a photostabilization is the change energy of absorbed photon to the interamolecular proton transfer; this action may occur by two proposed cycles Scheme (1) and (2). The first passes by intersystem crossing (ISC) process to the triplet state, while the second is referred to internal conversion (IC) process to the ground state.

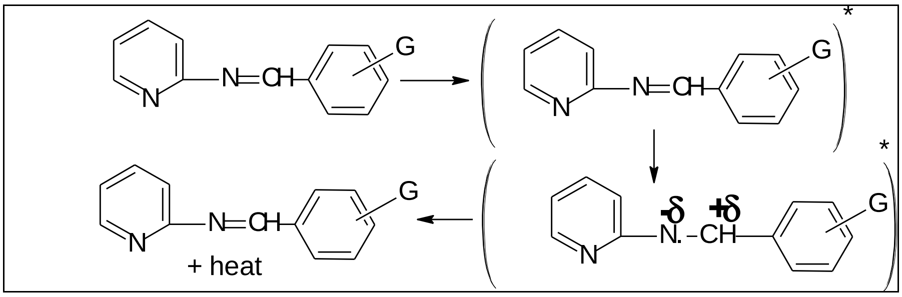


*Scheme (1) The suggested mechanism of photostabilization of PVC by 2-(2-pyriylimino methyl) phenol compound through absorption of Uv light and interamolecular proton transfer (internal conversion IC).*



***Scheme (2) The suggested mechanism of photostabilization of PVC by 2-(2-pyriylimino methyl) phenol compound through absorption of Uv light and interamolecular proton transfer (intersystem crossing ISC).***

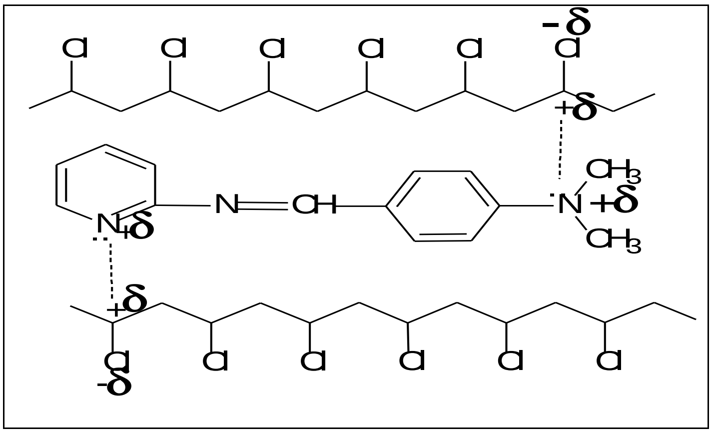
Another mechanism [30] explains the use of these compounds as photostabilizer is by change separated species, which could be inform the excited state such a structure would allow dissipation of energy through rotation on increased vibration about the control bond as shown in Scheme (3).



***Scheme (3) The suggested mechanism of photostabilization ofPVC by 2-(2-pyriylimino methyl) phenol compound as Uv absorber [30].***

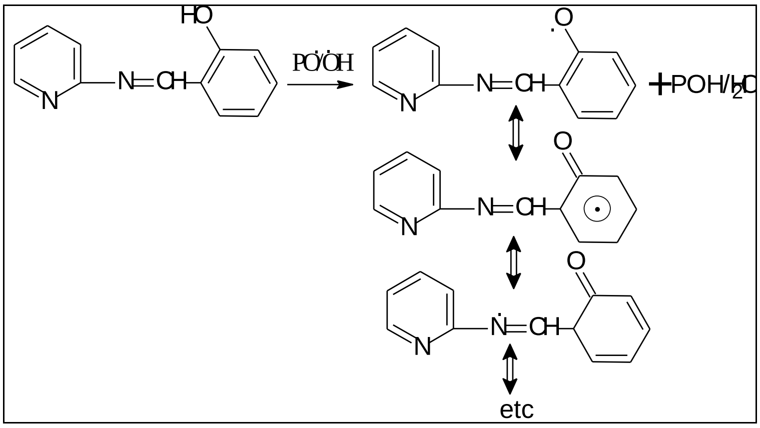
The compounds are selected with two different atoms of different electronagativity such as nitrogen and sulfur [30].

The polarity of the compound explains the attraction between the stabilizer and PVC (Scheme (4)).



***Scheme (4) The suggested mechanism of photostabilisation of PVC by N-[4-dimethylamino] benzyliden-pyridine-2-amino) through the interaction between PVC and Schiff base [15].***

The hydroxyl group of the additive might acts as radical scavenger for photostabilization process, therefore, these Schiff bases besides acting as UV absorber they may also act as radical scavenger additives, Scheme (5).



***Scheme(5) The Suggested mechanism of photostabilization of PVC by 2-(pyridin-2-ylimino)methyl) phenol as radical scavenger.***

## References

[1] Robert, T. and Pierotti, J. "*Additives for Plastics*", Raymond B. S. academic Press, New York; Vol. 2; pp 103-112; 1978.

[2] Rocha, A. P.; Grandette, J. L. and Real, L. P., "*Artificial Accelerated Weathering of Poly (Vinyl Chloride) for Outdoor Applications*" Polym. Degrad. Stab.; Vol. 82; pp235-243; 2003.

[3] Andrady, A. L.; Hamid, S. H. and Torikai, A., "*Effects of Climate Change and UV-B on Materials*". J. Photo Chem. Photobiol. Sci, Vol. 2; pp 68-72; 2003.

[4] Cazako, E.; Vyatazal, Z.; Vymazalova, Z.; Skaiskytas, J. and Setpek, J.; "*Effect of the Stabilizer in the Thermal Treatment on PVC-V*", Eur. Polym. J.; Vol. 14; pp 1011-1013; 1978.

[5] Vymazal, Z.; Czako, E.; Vola, K.; Stepek, J.; Luas R.; Kolinsky, M. and Bouchal K.; "*Effect of Stabilizer in the Thermal Treatment of PVC-VIII*"; Eur. Polym. J.; Vol. 16; pp 151-157; 1980.

[6] Cooray B. B. and Scott G.; "*Effect of Thermal Processing onPVC-IX*"; Eur. Polym. J; Vol.17; pp 379-384; 1981.

[7] Volka, K.; Vymazal, Z.; Schmidt, P. and Vymazalova, Z.; "*Effect of Stabilizers in the Thermal Treatment of PVC-XIV*"; Eur. Polym. J.; Vol. 20; pp 219-220; 1984.

[8] Minsker, K. S.; Kolesov, V. S. and Zaikov, E. G.; "*Stabilization of Poly (Vinyl Chloride) by B. Dicarbonyl Compounds*"; Eur. Polymer J.; Vol. 25; pp 1245-1250; 1989.

[9] Bigger, S. W. and Detatycki, O.; "*The EffectHindered AmineLight Stabilizers on the Photooxidatives Stability of High-Density Poly Ethylene*"; J. Polym. Sci.; Vol. 27; pp 63-73; 1989.

[10] Baltork, M., M., Moghadam, S. Tangestaninejad V., Mirkhani, M., Zolfigol and S. Hojati. "*Silica Sulfuric A cid Catalyzed Synthesis of Benzoxazole, Benzimiddazole and Oxazole [4.5-b]pyridine Under Hetrogeneous and Solvent Free Condition*" J. Iran. Chem. Soc; Vol. 5; pp.565-570; 2008

[11] Jumat S., Nadia S., Hassan H., and Emad Y. "*Synthesisand CharacterizationofNew Heterocyclic Compounds Derived from 2-Aminopyridine";* EuropeanJournal of Scientific Research ; Vol31(2); pp 256-264; 2009.

[12] Itol, F., Y., Yoshioka, K., Yukishige , S. Yoshida ,K.,Otsu and H.,Akimoto. " *Non-glutamate TybePyrrolo [2,3-d]pyrimidine*

*Antifolate III .Synthesis and Biological Properties of NW- Masked Ornithine Analogs",* Chem. Pharm. Bull; Vol.48(9) ; pp. 1270-1280 ; 2000 .

[13] Sridhar, S., N., Pandeya, S., Bajpal and H., Manjula *"Synthesis and antibacterial and antiviral activities of isatin derivatives,.* Indian Drugs; Vol. 36; pp 412-414; 1999.

[14] Watoit N., A. 'Synthesis of New Polymers derived from poly (vinyl chloride) and study their photostability' M. Sc. Thesis, Al-Nahrain University, Baghdad-Iraq; 2009.

[15] Emad Y. *"Photostabilization of Poly Vinyl Chloride by 1, 3, 4-Thiadiazole and 1,3,4-OxadiazoleChelate Complexes and Some of Their Ligands*"; PhD. Thesis; Al-Nahrain University; 2004.

[16] Changtong, C, "Synthesis and Photochemistry of phenyl Substituted -1,2,4-Thiadiazole " Ph.D., thesis, the faculty of the Worcester Polytechnic Institute. 2001.

[17] ZGmerman and Z. Stefanac; "*Polyhedron*"; Vol.4; pp 1755-1760; 1985.

[18] Z. Gmerman; S. Milganic and N. Galic; "*Schiff Bases Derived from Amino Pyridines as Spectrofluorimetric Analytical Reagents*" Croatica Chemical Acta (CCACAA); Vol. 73(1); pp 81-95; 2000.

[19] L. Lovel L.; Colombia J. Popetties, A. Goakhman; "*Synthesis of Schiff Bases from Amino Pyridine in the Presence of Molecular Sieves*"; Chemistry of Heterocyclic Compotives; Vol. 65(1); pp 264-267; 2000.

[20] Arct, D. M.; Rabek J. F. and Ranby B.; "*Studies on Modified Benzotriazoles as Photostabilizers for Poly Vinyl Chloride*"; Eurp.Polym.J.; Vol.17; pp 1041-1048; 1981.

[21] Harris, E. W. and Kratochoil, B.; "*Introduction to Chemical Analysis*"; New York; pp 572 -599; 1981.

[22] R. Fox and T. Price; "*Photodegradation of α-Methyl Styrene in Solution*"; J. Polym. Soc. Vol. A3; pp 2303-2311; 1965.

[23] R. Salovey and H. Bair; J. Apple Polym.Sci.;Vol. 14; pp 731; 1970.

[24] Anton, P., C.; Dobois, J.; Mur. M. G.; Audouin, L. and Verdu, J.; "*Photo Aging of Rigid PVC-111, Different Thickness*" Profile Polym. Degrad. Stab.; Vol.60; pp 275-281; 1998.

[25] Al-Derzi, N. W.; "*Induced Photodegradation of Thermoplastic Polymers by Molybedenum (VI) Complexes*"; Ph. D. Thesis; Al-Technology University; (2004).

[26] Pickett, J., E.; "Permanence of Uv absorbers in plastics and coating"; 1997.

[27] J., Pospisil, W. D., Habicher, S. Nespurek;" Optimisation of activity Permanence and Durability of absorbers " polym. & polym. Composites .: Vol. 8 ; pp.519-527 : 2000 .

[28] C.R. Beaton "Photostabilizing milled wood lignin with benzotrazoles and nitroxide "Photochem. Photobiol.: Vol.73 ; pp .605-610 :2001.

[29] Bojinov. V" Synthesis andproperties of adducts of a hindered amineand2-hudroxyphenyl benzotriozole as novel polymer stabilizers", Photochem. Photobiol.: Vol.1 ; pp. 340-346 : 2002.

[30]Rana, I. F.; "*Photostabilization of Thermoplastic Polymers by 2-Amino-5-Thiol 1, 2, 3-Thiadiazol*"; Ph. D. Thesis; Al-Mustansiriyah University; (2008).

## الخلاصة

تم من خلال هذا البحث تحضير قواعد شف (1-6) وذلك بتكاثف الألديهايدات الأروماتية:
(benzaldehyd, salicylaldehyde,
ρ-methoxybenzaldehyde,
ρ-ydroxybenzalsehyde, 2-amino pyridin
مع 2− أمينو بيريدين (2-furan carboxyladehyde

شخصت قواعد شف المحضرة من خلال مطيافية الأشعة تحت الحمراء (FTIR) والأشعة البنفسجية، المرئية (Uv.Vis)، التحليل الدقيق للعناصر (C. H. N.) وبعض الخواص الفيزيائية الأخرى كقياس درجة الانصهار. إستخدمت قواعد شف كمضافات إلى رقائق PVC لدراسة تأثيرها في الاستقرارية الضوئية لبوليمر PVC التجاري، وتم متابعة سرعة التجزئة والاستقرارية الضوئية لرقائق بسمك (40μm) والحاوية على المضافات المحضرة بنسبة وزنية (0.3%) مع زمن التشعيع بقياس قيم معاملي الكاربونيل (Ico) والبولين (Ipo). إستخدم في تشعيع الرقائق البوليمرية ضوء بطول موجي (313nm) وبدرجة حرارة $40^{o}C$. كذلك تم دراسة تركيز المضافات في المدى بين (0.1−0.5) % على التجزئة والتثبيت الضوئي لرقائق PVC، وأظهرت النتائج أن سرعة التثبيت الضوئي تزداد بزيادة تركيز المضاف. كما تم دراسة تأثير سمك الرقائق البوليمرية على التجزيئة والتثبيت الضوئي، ووجد أن زيادة سمك الرقائق البوليمرية تقلل سرعة التجزئة الضوئية.

وأظهرت النتائج أن جميع المضافات تعمل كمثبتات ضوئية لبولي فينايل كلورايد وحسب الترتيب التالي :
[2] > [5] > [4] > [6] > [3] > [1]> PVC

وفقا النتائج العملية المستحصلة تم اقتراح الميكانيكة والتي تعتمد علي تركيب المضافات كممتصات للاشعة فوق البنفسجية وصائدات الجذور الحرة.