UDC 665.777.4.66.094.173

SYNTHESIS AND STUDY OF SOME NOVEL β-ARYLAMINO-2-OXY-5-METHYLPROPIOPHENONES AS POLYETHYLENE STABILIZERS

Tanzilya Akchurina[a], Zubeyda Israfilova[a], Nastaran Sadeghian[b], Parham Taslimi[c], Vagif Farzaliyev[a], Afsun Sujayev[a]*, Khuraman Efendiyeva[a]

[a]*Institute of Chemistry of Additives, 1029, Baku, Azerbaijan*
[b]*Bartin University, Faculty of Science, Department of Biotechnology, Bartin, Türkiye*
[c]*Bartin University, Faculty of Science, Department of Molecular Biology and Genetics, Bartin, Türkiye*
***email:** ptaslimi@bartin.edu.tr*

Received 10.01.2024
Accepted 11.03.2024

Abstract: *The number of β-arylamino-2-oxy-5-methylpropiophenones has been synthesized by reacting of β-dimethylamino-2-oxy-5-methylpropiophenone hydrochloric acid salt with aniline derivatives in order to use these compounds as stabilizers for polyethylene. It was shown that the thermal stability of the compounds, depending on the nature of the substituent in the aniline fragment of the molecule was observed in a temperature range between 165 and 213°C. All studied compounds, introduced into polyethylene, increased its resistance to temperature effects. It was revealed that β-arylamino-2-oxy-5-methylpropiophenones had a stabilizing effect due to the suppression of thermo-oxidative degradation of polyethylene. They multiplied the oxidation induction period of polyethylene and reduced the rate of oxidation. Among the compounds studied β-phenoxybenzylamino-2-oxy-5-methylpropiophenone showed the highest stabilizing effect. All studied compounds had sufficient light-stabilizing activity, substantially due the presence in their molecules of a strong intramolecular hydrogen bond IHB (OH ... O = C) of the chelate type between the phenolic hydroxyl proton and the carbonyl oxygen of the acyl group.*

Keywords: *β-arylamino-2-oxy-5-methylpropiophenones, thermo-oxidative, stabilizer, degradation, polyethylene.*
DOI: 10.32737/2221-8688-2024-2-187-196

1. Introduction

Nowadays it's almost impossible to imagine our life without polymeric materials, since having many useful properties such as low thermal conductivity, high mechanical strength, elasticity, etc. at a low price; they have a wide range of applications. However, during processing and storage under the influence of external factors (light, water, temperature, atmospheric oxygen, etc.), polymers undergo physical and chemical changes, i.e. "aging". As a result, the destruction of polymer chains or their undesirable crosslinking occurs and they become weaker [1]. In a real situation, various aging factors can simultaneously affect polymer. Thermal stability - the ability of a material to maintain desirable properties such as stability, strength and elasticity at a given temperature - is essential for a polymer. Among the chemical processes occurring in polymers during aging, the role of thermooxidative destruction — the destruction of polymer molecules under the influence of heat and oxygen is very important. Many polymers are used to operate at elevated temperatures, resulting in intense thermal and thermal oxidative aging of polymers [2, 3].

Stabilization of polymers is a rather complex problem, so to protect polymers from destruction, along with the influence of various aging factors, the chemical and physical structure of polymers should be taken into account [4]. The main stabilization method to increase polymer's resistance to various factors affecting under-processing, storage and operational conditions is the introduction of special additives into a polymer, so-called stabilizers, which reduce the rate of chemical processes responsible for polymer aging [5, 6].

Antioxidants, the most important group of stabilizers, are used to protect almost all polymeric materials by preventing or slowing down oxidative processes. These include phenols, aromatic amines, aminophenols, hydroxylamines, and aromatic multinuclear hydrocarbons [7].

The use of light stabilizers is also important to protect the polymer from degradation by sunlight. Hindered amine light stabilizers (HALS) are derivatives of 2,2,6,6-tetramethylpiperidine and they are highly effective against light aging in most polymers. To protect the polymer from light exposure, UV absorbers are also used, which are mainly represented by benzophenone derivatives. According to studies, the synergistic compositions of an UV absorber and a HALS light stabilizer exhibit the maximum effect on polymer stabilization [8, 9].

Oxo-containing amines also belong to compounds that can be used to stabilize polymeric materials. Thus, it is known that 2-hydroxy-4-aminobenzophenone is applied as a UV stabilizer, and various derivatives of aminobenzophenones are used for the thermal and light stabilization of polyolefins [6, 10]. The development of more efficient and thermally resistant stabilizers continues to be relevant. Oxo-containing amines such as amino ketones are also of interest in this aspect.

2. Experimental part

2.1. Measurements

IR spectra of the synthesized compounds were recorded using IRS-14 spectrometer in the frequency range 700-3600 cm^{-1} (NaCl, LiF prisms) [11]. The studies were carried out in a microlayer.

The (C, H, N, Hal) microanalyses were performed on a Flash EA 1112 CHNS-O/MAS (CHN Analyzer) instrument. Melting points (uncorrected) were determined with melting point SMP3 (Stuart Scientific).

Thermoanalytical studies of β-arylamino-2-oxy-5-methylpropiophenones and their compositions with Medium Density Polyethylene (MDPE) 30107-62 grade were carried out on OD-102T derivatograph of the Paulik system (Hungary) in a dynamic heating mode with a heating rate of 5°C /min. Calcined alumina served as a standard.

The unambiguous parameters of thermogravimetric (TG) curves were used as criteria for assessing the stability of the studied compounds and their compositions with polyethylene against temperature effects, i.e., temperatures corresponding to equal parts of their mass loss with increasing temperature, determined from thermogravimetric (TG) curves, for example, $T_{5\%}$, $T_{10\%}$, $T_{50\%}$; as well as the temperatures in which the exothermic effect of their thermal oxidation begin according to the differential thermal analysis (DTA) curves – T_{DTA} were received.

The compositions were obtained in the following way: the investigated compounds were dissolved in acetone and added with stirring to the calculated amount of powdered polyethylene. After evaporation of acetone and drying of the resulting mass in a drying oven at room temperature, a weighed portion of the sample was taken.

Evaluation of the effectiveness of the synthesized compounds as polyethylene stabilizers was carried out by several methods indicated below.

Preliminary assessment of the light-stabilizing properties of the synthesized compounds was conducted on the basis of UV-spectra recorded using SF-4A and SF-8 spectrophotometers.

Atmosphere resistance of the stabilized polymer composition was determined in IP-1-3 artificial weather apparatus equipped with two PRK-2 mercury-quartz lamps at 50°C (GOST 10226-62). The protection factors values for unstabilized polyethylene before aging are taken as 1.00.

The effectiveness of the studied compounds in polyethylene as stabilizers was also assessed by the oxidation induction period. The induction period was determined on an oxidizing unit at a temperature of 200°C and a pressure of 200 mm Hg in an oxygen atmosphere. The effect of thermal oxidation of the studied compounds was determined by a change in the oxidation induction period of polyethylene by a decrease in oxygen pressure. At the same time, the kinetics of oxidation was determined from the drop in oxygen pressure in the system.

For comparison, unstabilized MDPE and compositions containing industrial light stabilizers Benzon-OA and Benazole MBKh were tested.

2.2. Synthesis of polyethylene stabilizers

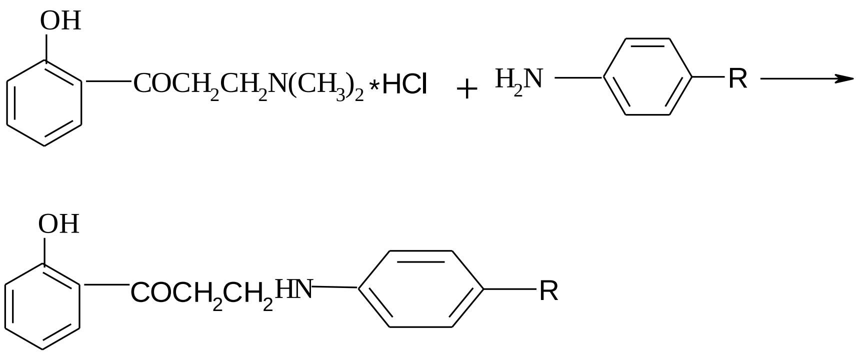
(*General chemistry*)

Obtaining the hydrochloric acid salt of β-dimethylamino-2-oxy-5-methylpropiophenone used in this work was described earlier [12].

β-Anilino-2-oxy-5-methylpropiophenone (comp.1). A mixture of 0.1 g mole of β-dimethylamino-2-oxy-5-methylpropiophenone hydrochloric acid salt and 0.09 g mole of aniline was heated in 50 ml of an aqueous-alcoholic solution (1:1 ratio) at 60°C for 1.5-2 h. The separated solid mass was filtered off and re-crystallized from isooctane to give a crystalline substance with melting point 86°C.

3. Results and discussion

The article presents the results of the synthesis and studies of thermal stability, and the stabilizing efficiency of a number of β-arylamino-2-oxy-5-methylpropiophenones obtained by the reaction of β-dimethylamino-2-oxy-5-methylpropiophenone hydrochloric acid salt with aniline derivatives in an aqueous alcoholic medium at 80 °C according to the **Scheme 1**.

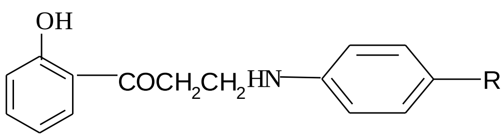


where R = H (1), CH_3 (2), NCS (3), OC_6H_5 (4), Cl (5), Br (6), COOH (7), NO_2 (8)

Scheme 1. The synthesis of β-arylamino-2-oxy-5-methylpropiophenones (1-8).

The remaining β-arylamino-2-oxy-5-methylpropiophenones were similarly obtained, and their properties are presented in **Table 1**.

Table 1. Characteristics of β-arylamino-2-oxy-5-methylpropiophenones with the general formula of



Comp. No	R	Melting point, T°C	Elemental composition, %							
			Found				Calculated			
			C	H	N	Hal	C	H	N	Hal

1	H	86(isooctane)	77.18	7.25	4.95	–	77.46	6.67	5.49	–
2	CH_3	78(alcohol)	76.02	7.35	5.25	–	75.84	7.06	5.20	–
3	NCS	82(alcohol)	71.44	6.89	4.58	–	71.58	6.67	4.91	–
4	OC_6H_5	103(alcohol -toluene)	75.42	6.03	3.89	–	76.06	6.09	4.03	–
5	Cl	90(alcohol)	66.52	5.87	4.83	12.33	66.32	5.56	4.95	12.23
6	Br	89(alcohol-water)	57.58	5.38	4.02	23.70	57.49	4.79	4.19	23.95
7	COOH	188(alcohol-water)	68.22	5.68	4.56	–	67.63	5.85	4.66	–
8	NO_2	181(alcohol)	64.40	5.14	9.22	–	63.99	5.37	9.32	–

The obtained compounds are crystalline substances, soluble in acetone, alcohol, and insoluble in water. The composition and structure of β-arylamino-2-oxy-5-methylpropiophenones were confirmed by the data of elemental analysis and IR spectra (See SM).

The IR spectra of compounds 2-8 in the region of out-of-plane bending vibrations of the CH benzene ring have absorption bands corresponding to 1,2,4- and 1,4-substitution, and the spectrum of compound 1 also contains absorption bands which characterizes mono-substituted benzene ring. The 1640 cm^{-1} band characterizes the CO group involved in the strong intramolecular hydrogen bond (IHB) with the neighboring hydroxyl group. This is evidenced by the shift of the absorption band of the OH-group to the region of stretching vibrations of the C-H aromatic ring (3200-3000 cm^{-1}). $\nu_{S-C\equiv N}$=2062,95 cm^{-1} is the absorption band of rhodanide group in 3rd compound. ν_{C-H}=2923.90 cm^{-1} is the absorption band of valence titrations of C-H bonds in CH_3 and CH_2 groups of the given compound and solvent (vaseline oil). The absorption bands in the region 3390-3370 cm^{-1} correspond to the stretching vibrations of the N-H-group. Along with the above, in the region 1600-1580 cm^{-1} there are bands characteristic of bending vibrations of the N-H-group. The absorption bands at 730 and 690 cm^{-1} are related to the vibrations of the C–CI and C–Br bonds, respectively (compounds 4 and 5). Antisymmetric and symmetric stretching vibrations of the NO_2 group (compound 6) give absorption bands in the region 1520 and 1350 cm^{-1}, respectively. The absorption band of the COOH group is observed at 1560 cm^{-1}.

Table 2. Thermogravimetric data of β-arylamino-2-oxy-5-methylpropiophenones

Comp. No	**R**	$T_{5\%}$	$T_{10\%}$	$T_{20\%}$	$T_{50\%}$
		^{0}C			
1	H	195	220	233	265
2	CH_3	165	177	194	242
3	NCS	175	190	205	283
4	OC_6H_5	170	193	214	250
5	Cl	167	183	197	220
6	Br	169	185	200	225
7	COOH	213	230	241	286
8	NO_2	200	215	231	260

In the process of synthesizing organic compounds that are proposed as potential stabilizers for polymeric materials, along with other operational properties, the thermal stability of the stabilizers needs to be ensured, which allows them to operate in the required temperature conditions. Some data on the thermo-chemical transformations of the synthesized compounds are given in **Table 2, Figure 1**. As can be seen from the Table 2 their thermal stability (according to the $T_{5\%}$ parameter) is observed in the temperature range 165 °C to 213 °C.

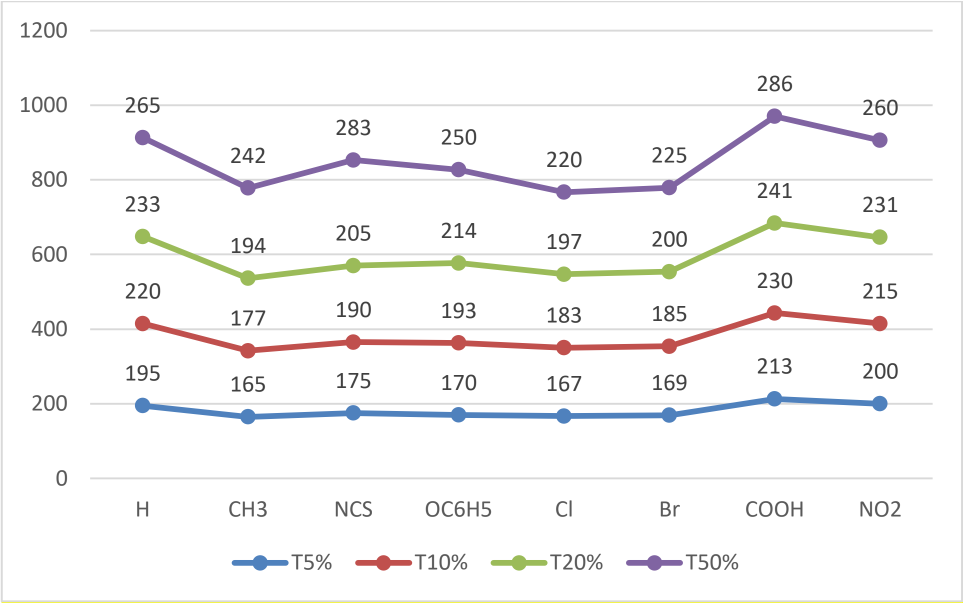


Figure 1. Thermogravimetric data of β-arylamino-2-oxy-5-methylpropiophenones

A review of the thermal stability parameters of the studied β-arylamino-2-oxy-5-methylpropiophenones has shown that their stability at elevated temperatures depends on the nature of heteroatoms and functional groups in the aniline fragment of the molecule.

From the data of thermal studies, it follows that the introduction of a methyl radical, chlorine and bromine atoms, as well as functional groups such as methoxy-, oxyphenyl- leads to a slight decrease in thermal stability, and carboxy- or nitro-groups - to an increase in the thermal stability of the corresponding β-arylamino-2-oxy-5-methylpropiophenones. For example, the decomposition temperature ($T_{5\%}$) of compounds 3, 7, and 8 (see Table 2) containing methoxy-, carboxy-, or nitro-groups was 175 °C, 213 °C, and 200 °C, respectively, versus 195°C for β-anilino-2-oxy-5-methyl-propiophenone (comp.1). Semi-destruction ($T_{50\%}$) of the studied compounds was achieved at 220 °C – 286 °C.

A preliminary assessment of the light-stabilizing properties of the synthesized compounds based on the analysis of the spectral characteristics and the nature of the curves has shown that the studied compounds absorb sunlight in the range of 250-400 nm, and the absorption intensity is much higher than that for Benzone-OA-potential light stabilizer, and, therefore, they should have light stabilizing properties.

The results of testing the aging of the samples are shown in Table 3.

Table 3. Aging results of samples on IP-1-3 at 50° C

Compositions	Concentration, % w.	Protection coefficient after aging 100 and 200 h (100/200)	
		σ_p, кgf/cm^2	Δℓ/ℓ, %
MDPE unstabilized *	–	0.39/0.32	0.5/0.01
MDPE + comp.1 (H)	0.2	0.86/0.68	0.03/0.02
	0.5	0.96/0.71	0.03/0.02
	0.8	0.96/079	0.03/0.03
MDPE + comp.3 (NCS)	0.2	0.75/0.61	0.03/0.02
	0.5	0.89/0.72	0.03/0.03
	0.8	0.89/0.82	0.03/0.04
MDPE + comp.4 (OC_6H_5)	0.2	0.86/0.71	0.03/0.03
	0.5	1.03/0.86	0.03/0.03
	0.8	1.00/0.96	0.03/0.03
MDPE + comp.5 (Cl)	0.2	0.71/0.61	0.02/0.02

	0.5 0.8	1.02/0.84 0.96/0.91	0.03/0.03 0.03/0.03
MDPE + comp.6 (Br)	0.2 0.5 0.8	0.89/0.68 0.96/0.75 0.93/0.84	0.03/0.02 0.03/0.03 0.03/0.03
MDPE + comp.7 (COOH)	0.2 0.5 0.8	0.82/0.71 0.86/0.75 0.93/0.79	0.03/0.03 0.03/0.03 0.05/0.03
MDPE + comp.8 (NO_2)	0.2 0.5 0.8	0.86/0.79 1.00/0.89 1.00/0.93	0.03/0.03 0.03/0.03 0.03/0.03
MDPE + Benazole MBKh	0.5	0.93/0.82	0.03/0.03
MDPE + Benzone OA	0.5	0.92/0.83	0.03/0.03

* The protection coefficient value for unstabilized polyethylene before aging is taken as 1.00

As can be seen from Table 3 the introduction of β-arylamino-2-oxy-5-methylpropiophenones into polyethylene leads to a noticeable increase in the protection coefficients of the polymer. So, if after 200-hour aging unstabilized polyethylene is destroyed, then for compositions containing 0.2wt.% of the stabilizer the strength factor is 0.61-0.79, and for compositions containing 0.8 wt.% of the stabilizer this indicator makes 0.79-0.96. In this case, the relative elongation of the samples containing even 0.2 wt.% of the compounds remained practically unchanged during the entire test period. The results of aging of the samples showed that the investigated β-arylamino-2-oxy-5-methylpropiophenones were more effective than the standard stabilizers Benazole MBKh and Benzone-OA. Compositions containing the synthesized compounds had the best indicators also on dielectric properties, and on the rest, they were at the level of Benazole MBKh.

The stabilizing properties of β-arylamino-2-oxy-5-methylpropiophenones depend on the nature of the substituent in the aniline fragment of the molecule, where the predominance of β-phenylamino-2-oxy-5-methylpropiophenone (comp.4) can be distinguished by the effectiveness of the action.

Studies have shown that all the compounds have sufficient light-stabilizing activity, which is apparently due to the presence in their molecules of a strong intramolecular hydrogen bond BBC (OH ... O = C) of the chelate type between the phenolic hydroxyl proton OH and the carbonyl oxygen of the acyl groups.

The thermoanalytical data of PE presented in Table 4 before and after 100 hours of light aging has shown that aging, as expected, leads to deterioration in the thermoanalytical properties of unstabilized polyethylene, the thermogravimetric parameters of which shift to a lower temperature range.

Table 4. Thermal analysis data of stabilized medium-pressure polyethylene before and after 100 h light aging.

Sample	Before aging				After aging (100 h)			
	$T_{ДТА}$*	$T_{10\%}$	$T_{20\%}$	$T_{50\%}$	$T_{ДТА}$*	$T_{10\%}$	$T_{20\%}$	$T_{50\%}$
	°C							
PE unstabilized	210	360	388	417	194	342	367	394
PE+0.5% comp.1((H)	213	367	400	423	210	361	395	417
PE+0.5% comp.2(CH_3)	214	390	420	444	211	385	410	438
PE+0.5% comp.3(NCS)	225	398	416	438	224	395	415	442
PE+0.5% comp.4(OC_6H_5)	230	407	430	437	230	408	428	437
PE+0.5% comp.5(Cl)	216	372	410	433	215	371	412	436

PE+0.5% comp.6(Br)	215	373	405	428	213	375	407	430
PE+0.5% comp.7(COOH)	217	380	416	438	215	378	412	436
PE+0.5% comp.8(NO_2)	223	404	425	430	222	400	424	432

T_{DTA}^{*} - the onset temperature of exothermic reaction of thermal oxidation

The data of DTA curves (Figure 2) also record a decrease in the oxidation onset temperature of unstabilized polyethylene after aging (210°C before aging, 194°C after aging):

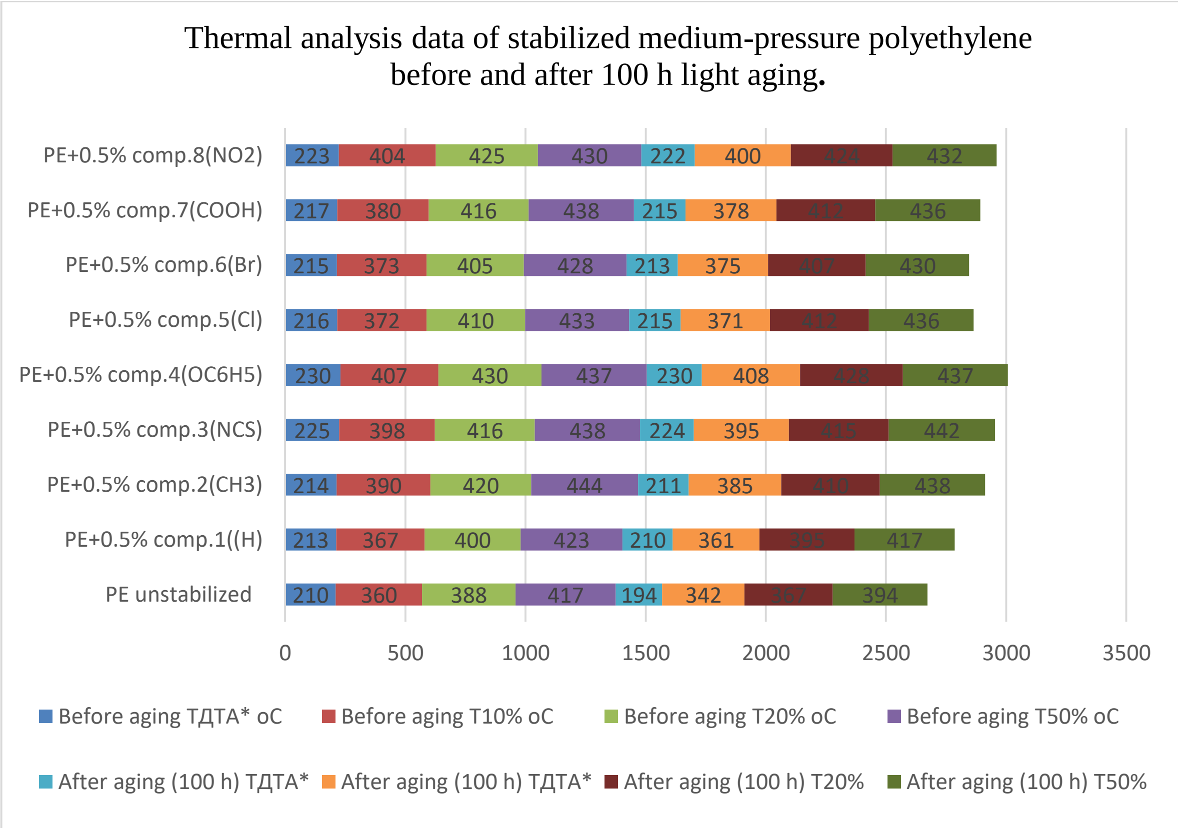


Figure 2. Thermal analysis data of stabilized medium-pressure polyethylene before and after 100 h light aging**.**

All investigated compounds increase the stability of polyethylene against temperature effects, and the most effective in this action are compounds 4, 3, and 8. For example, the onset temperature of the exothermic reaction of unstabilized polyethylene thermal oxidation at 210 °C increased to 230, 225, or 223 °C in the case of stabilization of polyethylene with compounds 4, 3, or 8 at a concentration of 0.5 wt.%, while the $T_{10\%}$ parameter for the same samples increased from 360°C to 407 °C, 398 °C, 404 °C, respectively.

The same pattern is observed for the studied samples after aging, and the difference between the thermoanalytical parameters of unstabilized PE and PE with synthesized compounds is higher here, which indicates the effectiveness of the stabilizing properties of β-arylamino-2-oxy-5-methylpropiophenones.

The onset of oxidation of polyethylene with all the studied compounds compared with the initial polymer (210 °C) is shifted on the DTA curves to higher temperature ranges (213 °C-230 °C) before aging, the same pattern is observed after aging: 194 °C versus 210 °C-230 °C. It follows from the data presented that the synthesized compounds increase the thermal-oxidative stability of polyethylene both before and after 100 hours of light aging.

Consequently, β-arylamino-2-oxy-5-methylpropiophenones have a stabilizing effect largely due to the suppression of thermo-oxidative degradation of polyethylene.

Studies of the synthesized compounds as stabilizers of polyethylene aging has shown that β-arylamino-2-oxy-5-methylpropiophenones significantly increase the oxidation induction period of polyethylene.

So, if unstabilized polyethylene begins to oxidize after 15 minutes, then with the addition of 0.5 wt% of the studied compounds the oxidation induction period increases to 940 (comp.4), 820 (comp.3), 620 (comp.5), 540 (comp.7), 400 (comp.8) min.

The studied compounds also effect on the oxidation rate. The study of the kinetics of the oxidation process shows that for unstabilized polyethylene, the decrease in oxygen pressure becomes equal to 10 mmHg after15 min, whereas, with the introduction of the studied compounds into polyethylene, the rate of its oxidation significantly decreases. For example, for compound 7 a decrease in oxygen pressure was observed after 80, for compound 3 - after 140, for compound 4 - after 210 min.

4. Conclusions

By the interaction of the hydrochloric acid salt of β-dimethylamino-2-oxy-5-methylpropiophenone with aniline derivatives a new series of compounds - β-arylamino-2-oxy-5-methylpropiophenones has been synthesized as polyethylene stabilizers.

The thermoanalytical studies of β-arylamino-2-oxy-5-methylpropiophenones have shown that the thermal stability of these compounds, depending on the nature of the substituent in the aniline fragment of the molecule, lies within the temperature range of 165°-213°C, and their semi-destruction ($T_{50\%}$) - in the range of 200°-286°C. All studied compounds, introduced into polyethylene, increase its resistance to temperature effects, as well as its thermal oxidation onset temperature.

β-arylamino-2-oxy-5-methylpropiophenones have a stabilizing effect largely due to the suppression of thermo-oxidative degradation of polyethylene.

It has been found that with the introduction of an oxyphenyl group into the aniline fragment of the molecule, the highest antioxidant efficiency of the compound is achieved - the induction period of polyethylene stabilized by it increases 62 times, and the oxidation rate decreases 14 times.

The light-stabilizing activity of the studied compounds is largely due to the presence in their molecules of a strong intramolecular hydrogen bond IHB (OH ... O = C) of the chelate type between the phenolic OH proton and the carbonyl oxygen of the acyl group. The studied compounds are superior to industrial light stabilizers Benzon-OA, Benazol MBKh in terms of light-stabilizing efficiency.

Thus, the results of the studies carried out have shown that the synthesized β-arylamino-2-oxy-5-methylpropiophenones are effective light stabilizers, and unlike Benazole MBC, they also exhibit the properties of a heat stabilizer and, therefore, can be used under the conditions of both processing and storage of polyethylene.

Conflict of interest statement

The authors declare that there are no conflicts of interest.

References

1. Gijsman P. Polymer Stabilization, Editor(s): Kutz M., In Plastics Design Library, Applied Plastics Engineering Handbook (Second Edition), William Andrew Publishing, 2017, ISBN 9780323390408, p. 395-421.
2. Malík J., Kröhnke Ch. Polymer stabilization: present status and possible future trends // Comptes Rendus Chimie, 2006, V. 9, (11–12), p. 1330-1337.
3. Allen N., Edge M. Perspectives on additives for polymers. 1. Aspects of stabilization // J. Vinyl Addit Technol., 2021, V. 27(1), p. 5-27.
4. Wypych G. 11 – Principles of stabilization. Editor(s): George Wypych, PVC

Degradation and Stabilization (Third Edition), ChemTec Publishing, 2015, ISBN 9781895198850, p. 287-412.
5. Valentina M., Pierfrancesco C., Veronica A. "Polymer additives". Physical Sciences Reviews // 2017, V. 2(6), 20160130.
6. Zweifel H., Maier R., Schiller M. Plastic Additives Handbook. 6 E, Hanser Publications Okio, 2009, ISBN: 9781569904305, 1248 p.
7. Al-Malaika S. Antioxidants: an Overview. In: Pritchard G. (eds) Plastics Additives Polymer Science and Technology Series, Springer, Dordrecht, 1998, 1, p. 55-72.
8. Arnaboldi P., Davis L., Samuels S., Zenner J., Vulic I. A Revolutionary Light Stabilizer System for Polyolefins and Other Resins // Polymers and Polymer Composites, 2002, 10, p. 93-99.
9. Allen N. Light and UV stabilization of polymers. In: Pritchard G. (eds) Plastics Additives, Polymer Science and Technology Series, Springer, Dordrecht, 1998, 1, p. 427-441.
10. Akchurina T., Sardarova S., Efendiyeva Kh., Eyvazova I., Farzaliyev V., Sujayev A. Synthesis and study of aroylethyl(ethyl)-xanthates as stabilizers of polymeric materials. Applied Petrochemical Research, 2021, 11, p. 327–333.
11. Bellamy L. The infra-red spectra of complex molecules. London: Methuen & Co. Ltd, New York: John Wiley & Sons, Inc.]. 2000, 592 p.
12. Kuliyev A., Guseinov M., Sardarova S., Iskenderova T. Alkylation with Mannich bases. Synthesis and research of morpholino-piperazino derivatives of oxypropiophenones // J. Org. Chem., 1972, V. 8(6), p. 1301-1304.

BƏZİ YENİ B-ARİLAMİNO-2-OKSİ-5-METİLPROPİOFENONLARIN POLİETİLEN STABİLİZATORU KİMİ SİNTEZİ VƏ TƏTBİQİ

T.X. Akçurina[a], Z.T. İsrafilova[a], N. Sadegian[b], P. Taslimi[c], V.M. Fərzəliyev[a], Ə.R. Sucayev [a]*, X.Q. Əfəndiyeva[a]

[a]Azərbaycan Respublikası Elm və Təhsil Nazirliyinin Aşqarlar Kimyası İnstitutu, Bakı, Azərbaycan
[b]Bartın Universiteti, Təbiət fakültəsi, Biotexnologiya bölməsi kafedrası, Bartın, Türkiyə
[c]Bartın Universiteti, Təbiət fakültəsi, Molekulyar Biologiya və Genetika kafedrası, Bartın, Türkiyə

Xülasə: β-dimetilamino-2-oksi-5-metilpropiofenon xlorid turşusu duzunun anilin törəmələri ilə reaksiyasından polietilen stabilizatorları kimi istifadə etmək üçün bir sıra β-arilamino-2-oksi-5-metilpropiofenonların sintez edilmişdir. Göstərilmişdir ki, molekulun anilin fraqmentindəki əvəzedicinin təbiətindən asılı olaraq birləşmələrin istilik davamlılığı 165-213°C temperatur intervalında müşahidə olunur. Polietilenə daxil edilən bütün tədqiq olunan birləşmələr onun temperatur təsirlərinə qarşı müqavimətini artırır. Müəyyən edilmişdir ki, b-arilamino-2-oksi-5-metilpropiofenonlar polietilenin termooksidləşdirici dağılmasının qarşısını aldıqlarına görə stabilləşdirici təsirə malikdirlər. Onlar polietilenin oksidləşmə induksiya müddətini artırmış, oksidləşmə sürətini isə azaltmışdırlar. Tədqiq olunan birləşmələr arasında b-fenoksibenzilamino-2-oksi-5-metilpropiofenon ən yüksək stabilləşdirici təsir göstərmişdir. Bütün tədqiq edilmiş birləşmələr kifayət qədər işıq stabilləşdirici aktivliyinə malikdirlər, bu isə onların molekullarında fenolun hidroksil protonu ilə karbonil qrupundakı əsas karbona birləşmiş oksigen arasında xelat tipli güclü molekuldaxili hidrogen rabitəsinin (OH ... O = C) olması ilə əlaqədardır.

Açar sözlər: β-arilamino-2-oksi-5-metilpropiofenonlar, termooksidləşdirici, stabilizator, deqradasiya, polietilen.

СИНТЕЗ И МЕТОДИКА НЕКОТОРЫХ НОВЫХ В-АРИЛАМИНО-2-ОКСИ-5-МЕТИЛПРИОФЕНОНОВ КАК СТАБИЛИЗАТОРОВ ПОЛИЕТИЛЕНА

Т.Х. Акчурина[a], З.Т. Исрафилова[a], Н. Садегиан[a], П. Таслими[c], В.М. Фарзалиев[a], А.Р. Суджаев[a], Х.К. Эфандиева[a]

[a]*Институт Химии Присадок Министерства Науки и Образования Азербайджанской Республики*
[б]*Университет Бартина, Факультет естественных наук, Кафедра биотехнологии, Бартин, Турция*
[c]*Университет Бартина, Факультет естественных наук, Кафедра молекулярной биологии и генетики, Бартин, Турция*

Резюме: Реакцией солянокислой соли β-диметиламино-2-окси-5-метилпропиофенона с производными анилина синтезирован ряд β-ариламино-2-окси-5-метилпропиофенонов с целью использования этих соединений в качестве стабилизаторов полиэтилена. Показано, что термостабильность соединений в зависимости от природы заместителя в анилиновом фрагменте молекулы наблюдается в интервале температур от 165 до 213°C. Все изученные соединения, введенные в полиэтилен, повышали его устойчивость к температурным воздействиям. Выявлено, что β-ариламино-2-окси-5-метилпропиофеноны оказывают стабилизирующее действие за счет подавления термоокислительной деструкции полиэтилена. Они увеличили индукционный период окисления полиэтилена и снизили скорость окисления. Среди изученных соединений наибольший стабилизирующий эффект проявил β-феноксибензиламино-2-окси-5-метилпропиофенон. Все исследованные соединения обладали достаточной светостабилизирующей активностью, в значительной степени обусловленной наличием в их молекулах прочной внутримолекулярной водородной связи (OH...O=C) хелатного типа между фенольным гидроксильным протоном и карбонильным кислородом ацильной группы.

Ключевые слова: β-ариламино-2-окси-5-метилпропиофеноны, термоокислитель, стабилизатор, деградация, полиэтилен.