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Synthesis Of Polyacetylene And Stabilization Of Polyvinyl Chloride With Polyacetylene

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Abstract: The aim of the research was to investigate the comparative physicochemical properties of the synthesized cis-polyacetylene and the oxidized trans-derivative. During the process, the highest yield was achieved using a catalytic ratio of a Co(NO3)2:LiBH4 compound mixture at a ratio of 4:1 mol with a catalyst concentration of Vcatalizer=0.1%. The synthesis method employed T° solution =-5-0°C, with a slow introduction of pure HC≡CH over a period of t=1.5-2 hours. The reaction temperature was set at T°reaction = 55-40°C. The resulting product was filtered, and the unreacted acetylene and N-methylpyrrolidone were washed out using a solvent to eliminate the catalyst. Analysis of EPR spectra indicated a reduction in QPC from 4.7·1017 spin/g to 3.15·1016 spin/g. Utilizing a torsion balance, the kinetics of oxygen attachment to polyacetylene were examined at various temperatures (25, 75, 100, and 150 °C), revealing the highest oxygen content in polyacetylene by weight (up to 37%) within 15-18 hours. The polyacetylene, synthesized and incorporated into polyvinyl chloride, was used as a stabilizer. Addition of 1% polyacetylene to polyvinyl chloride augmented its thermal stability by 1.5 to 2 times. Its thermal stability was analyzed using thermogravimetric (TGA) and differential thermal analysis (DTA) within the range of 25-250°C through the Paulik devices. The main focus of this study was the synthesis of polyacetylene and the stabilization of polyvinyl chloride utilizing the obtained polyacetylene, while investigating the optimal conditions for this process. Employing Nmethylpyrrolidone as a highly selective solvent in polyacetylene synthesis resulted in a laboratory yield of up to 45.0%, while in an industrial setting at 0°C, it reached up to 38.0%.

Keywords: Synthesized cis-polyacetylene, N-methylpyrrolidone, thermogravimetric, Vcatalizer, Paulik devices, oxygen attachment.

INTRODUCTION:

There are numerous studies devoted to the chemical modification of disubstituted acetylene polymers for the production of gas separation membranes with enhanced resistance to aliphatic hydrocarbons and improved selectivity towards CO_2. Many researchers have investigated the possibility of obtaining $[C_2H_2]$⍰ containing chlorine atoms in the side substituents of poly(1-trimethylsilyl-1-propyne) and poly(4-methyl-2-pentyne) through the chlorination of $C_4H_4ClNO_2$. These reactions are typically carried out under mild conditions to minimize polymer degradation. The resulting polymers exhibit excellent mechanical and film-forming properties, along with high thermal stability. Chlorinated glassy polymers demonstrate stability towards C_5–C_{12} alicyclic and aliphatic hydrocarbons. Incorporation of chlorine into the structure of PTMSP enhances CO_2/N_2 and CO_2/CH_4 selectivity while maintaining high permeability levels [14]. Many researchers also focus on studying the temperature dependence of film conductivity for thermally treated (C_2H_3Cl)⍰, which contains conjugated carbon–carbon double bonds in macromolecules and represents a copolymer of polyvinyl chloride–polyacetylene (PVC–PA). It has been observed that the conductivity can change by up to 10 orders of magnitude with increasing temperature, once the “threshold” concentration of conjugated double bonds and charge carriers (π-electrons) is exceeded. However, instability in the conductivity state is observed within the studied temperature range, and this behavior depends on the concentration of carbon–carbon double bonds and charge carriers. In these experiments, the increase in the concentration of carbon–carbon double bonds is qualitatively monitored by recording photoluminescence and infrared absorption spectra [15]. High-density polyethylene stabilized with 0.5–1.0% antioxidant additives has also been investigated using thermal analysis methods. The antioxidants studied were obtained primarily from natural polyphenols with hexamethylenediamine and a urea adduct, the latter being less stable and easily decomposed with regeneration of the initial compounds [9]. Antioxidants of natural origin are already well studied and widely applied in food products. However, their use in polymers requires further investigation, particularly regarding their physical properties and potential applications in polyolefins and plastics during processing. The relevance of such research arises from the uncertainty associated with phenolic antioxidants. Natural antioxidants are increasingly being considered as stabilizers, although current information on this topic is limited and research results are often contradictory. Therefore, systematic studies on natural antioxidants and an objective analysis of their performance, highlighting both advantages and limitations, are essential [8].

METHODS

1. Materials

The research objectives included:

- Studying the potential use of polyacetylene in regulating gaseous environments.
- Reducing the consumption of antioxidants.
- Utilizing N-methylpyrrolidone as an effective solvent in the synthesis of polyacetylene.
- Investigating the kinetics of atmospheric oxygen addition to the synthesized polyacetylene using torsion balances at temperatures of 25, 75, 100, and 150°C.

For the synthesis of (CH)x, the following were used: CaC2, H2O, N-methylpyrrolidone, catalyst – Co(NO3)2, salts of Ni, Na BH4, LiBH4, or LiAlH4 at V=0.1% of the total volume of the solution.

2. Methods

During the experiment, an organic solvent is poured into a three-necked flask and maintained at a temperature of -5 to 0°C. It is stirred while adding Co(NO3)2 or Ni salts as catalysts and reducing agents. Other catalysts like NaBH4, LiBH4, and LiAlH4 can also be used (in an amount of 0.1% of the total solution volume).

Calcium carbide is purified from various additives and moisture and then dried. Pure acetylene is slowly introduced into the solvent-cooled system over 1.5-2 hours.

The absorption of C_2H_2 by the solvent is monitored using a vessel for releasing bubbles of CH2 gas and through the output of the main product, (C2H2)n, based on the resulting effect. Subsequently, the temperature is slowly raised from -55 to -40°C until a solid gel is obtained. The obtained suspension undergoes filtration and is washed with N-methylpyrrolidone to remove residual C2H2 and catalysts. The polyacetylene paste obtained in the solvent is further processed. This process is repeated twice to completely purify the product. C2H2 is effectively absorbed by C5H9NO at a temperature of -20°C. These data are presented in Table 1 [8].

Table 1. The solubility of C_2H_2 in C_5H_9NO at different temperatures, °C.

Temperature, °C	0	5	10	15	25	50	75	100
Solubility of C_2H_2	65	56,6	49,2	42,2	32,3	15,3	7,6	4,2

In this synthesis, the most effective solvent N-methyl pyrrolidine was used, and the quantitative yield of the polymer is achieved at an average temperature (about 0 °C), which is apparently due to the ease of absorption of acetylene by this solvent (2- table). The use of N-methyl pyrrolidone as a solvent compares favorably in terms of its practicality since this solvent is widely used in the process of obtaining acetylene under the production conditions of the Navoiyazot Joint Stock Company of Uzbekistan.

From Table 2, it can be observed that the polymerization of acetylene in the presence of a low-polarity organic solvent like dioxane holds no practical significance. The yield of the polymer is achieved at ΔT°≈0 °C, which is due to the ease of C2H2 absorption by this solvent (Table 2). The use of C5H9NO as a solvent is practical, as it is employed in the production conditions of the Navoiyazot Joint Stock Company in

Uzbekistan for obtaining C2H2.

Table 2 shows that the polymerization of C2H2 in the medium of the low-polarity organic solvent C4H8O2 is not significant for practical purposes. The authors have established that replacing the solvent increases the product yield but does not alter the physicochemical properties of [C2H2]n [8].

Thus, under the condition of acetylene polymerization at 0 °C in N-methylpyrrolidone and the Co(NO3)2: LiBH4 catalytic system, the yield of the main product was 44-45 g/g catalyst. This fact is very important from the point of view of the technological design of the process and energy saving when cooling the reactors [8].

High efficiency was obtained in the production of polyacetylene by using titanocenealuminum two nuclear complex Cp2Ti(n-H)2AlH(X) and (Cp2Ti)2AlH4X catalyst [1].

In this report the coupling of polyenes that are transformed from n-dotriacontane (nC32H66) through on-surface cascade dehydrogenation on Cu (110) surface, формирующее of polyacetylene (PA) [2].

In the study below, polyacetylene was obtained through the grafting reaction with amylose. Initially, the functionalized organic compound, derived from NH3, (C2H2)n, was synthesized via Rh-catalyzed copolymerization of a protected amino-substituted monomer C2H2 (tert-butyl propargylcarbamate) with N-propargylethanamide, followed by deprotection [3]. Achiral N-propargylamide monomer of acetylene monomers and Chiral N-propargylsulfamide were copolymerized separately with Triton X-100 as an emulsifier with a catalyst (nbd)Rh+B−(C6H5)4. The obtained copolymers showed high stability and optical activity [4]. Contains pyridinium side groups (PPyA-MX, X = Br and I),Polyacetylene-based compounds with macromolecular structure were synthesized [5].

Ni(MeCN)6(BF4)2 and AlEt2Cl co-catalysts were used in the synthesis of (C8H6)n из C_2H_2. Once can note that the activity of Ni(MeCN)6(BF4)2 and AlEt2Cl on the process is significantly higher than their individual effects [6].

The presence of an active unsaturated conjugated bond in the main chain of polyacetylene allows for the incorporation of organic compounds, derivatives of NH3, organic substances containing a C-Hal bond, organic and inorganic compounds where H and O atoms are covalently bonded, and salt groups [7]. This leads to the production of functionally active new polymers such as alloprenes, C2H4OCx, simple R–O–R' oligomers, as well as highmolecular-weight antioxidants [8], stabilizers [9], corrosion inhibitors [10], surface-active polyquaternary salts, and others.

RESULTS

Table 2. Conditions for the synthesis of polyacetylene

№	Gases	Before saturation,%	After 1 hour absorption%	After 2 hours absorption%	After 3 hours absorption%
1	Vinyl chloride	10,1	12,26	13,6	13,6
2	Vinylacetylene	0,2	0,16	0,14	0,16
3	Acetaldehyde	0,05	0,04	0,03	0,04
4	Chloroprene	0,5	0,34	0,39	0,60
5	Hydrocyanic acid	1,8	0,40	0,44	1,5
6	Acrylonitrle	0,7	0,13	0,15	0,4
7	Acetylene	82,9	80,47	79,26	78,8
8	Nitrogen	7,2	1,55	1,55	1, 21

From the research findings, it became evident that the LiBH4 compound's strong reductive properties significantly contribute to enhancing process productivity. Furthermore, this reaction offers optimal efficiency and process control, aligning with the design of the proposed reactor intended for production at JSC "Navoiyazot." Currently, JSC "Navoiyazot" incinerates approximately ≈400 m3/h of emitted gases daily, which contaminate the atmospheric air [8]. The composition of this gaseous mixture is detailed in Table 3.

The table shows that the main components of this mixture are acetylene (up to 83%) and vinyl chloride (up to 10%), other components are present in relatively small amounts. To isolate acetylene from acetylene-containing gases under industrial conditions, it was passed through N-methylpyrrolidone at a temperature of about 0°C.

From Table 3, it is evident that the primary components of the mixture are: C_2H_2 (83%) and C_2H_3Cl (10%), with the remaining constituting a negligible amount. To extract C_2H_2 from the gases containing it in industrial production conditions, they are passed through C5H9NO at approximately T°≈0 °C. The absorption process of the constituent gases by the solvent was monitored using gas chromatography (Table 3) [8].

Table 3. Change of composition of the gas mixture because of passing it through Nmethylpyrrolidone.

№	Solvent	Temperature, °C	The ratio of catalysts, g		Product yield, g/g catalyst	
			$Co(NO_3)_2$	$LiBH_4$	Lab. Cond.	Indus. Cond.
1	N-methylpyrrolidone	-5-0	0,10 0,05 0,025	0,025 0,05 0,10	45,0 40,0 29,0	38,0 32,0 22,0
2	Dimethylformamide	-5-0	0,10 0,05 0,025	0,025 0,05 0,10	39,0 26,0 25,0	27,0 17,0 21,0
3	Dioxan	-5-0	0,10 0,05 0,025	0,025 0,05 0,10	8,0 3,6 1,8	3,0 1,9 0,7

As a result of experiments, the authors found that the yield of (CH)X decreases, but the presence of other impurities as a result of the absorption of C2H4O, C4H5Cl, HCN and other substances does not completely suppress catalysis. The isolated polyacetylene was chlorinated, and the chloropolyacetylene formation process proceeded without any complications.

The authors note that the positive changes in the method of obtaining polyacetylene did not affect the basic physicochemical properties of the obtained polymers and their properties are basically identical with the literature data, and most importantly, these polymers are freely chlorinated like the corresponding previously synthesized polyacetylenes.

When studying the basic physicochemical properties of polyacetylene, attention was paid to some features of its interaction with atmospheric oxygen, the absorption capacity of which makes it possible to use such products for various technical needs. We used the ability of polyacetylene to absorb atmospheric oxygen for our purpose. The oxygen scavenging properties of polyacetylene can, in principle, be used for a specific purpose.

Currently, in a number of developed countries, various methods of regulating the gaseous environment of vegetable and fruit storages are widely used in various ways. As you know, perishable food in environments with a reduced amount of oxygen (up to 1-2%) can be stored much longer without deteriorating their main consumer and taste qualities. For these purposes, several methods have been used, but they all have a number of disadvantages that hold them back from widespread introduction into production. For example, there is a method of burning oxygen in a storage room using platinum grids in burners, of course this method has not become widespread due to its high cost.

Gas separation membranes made of polymers, which are known to have different permeabilities for different gases, are of great interest. For removing oxygen from the room, membranes made of polyvinyltrimethylsilane, silicone rubbers and others turned out to be more effective. However, while these methods are also ineffective, since it requires the use of large storage openings for gas separation, which leads to large losses of refrigerant. In recent years, work has been intensified on the application of the Bars system for these purposes, consisting in liquefying nitrogen from the air and supplying it to storage, but so far, due to its high energy intensity, this method has not found its wide application either.

Based on the foregoing and the properties of polyacetylene for the absorption of air oxygen, we have carried out work to study these features and with the aim of using them in deoxygenating a gaseous medium.

Comparative physicochemical properties of pure cis-polyacetylene and oxidized transderivative were investigated. It was found that, according to the results of the EPR spectra, there is a decrease in QPC from 4.7 1017 spin/g to 3.15 1016 spin/g, which testifies in favor of the introduction of air oxygen into the chain of polyconjugated bonds. Along with this, a new broad, less intense signal with a factor g-2.3233 appears (Fig. 1) [11; 12; 13].

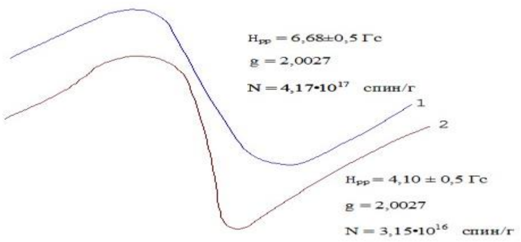

Fig. 1. EPR spectra of polyacetylene (1) and its oxidized derivative (2).

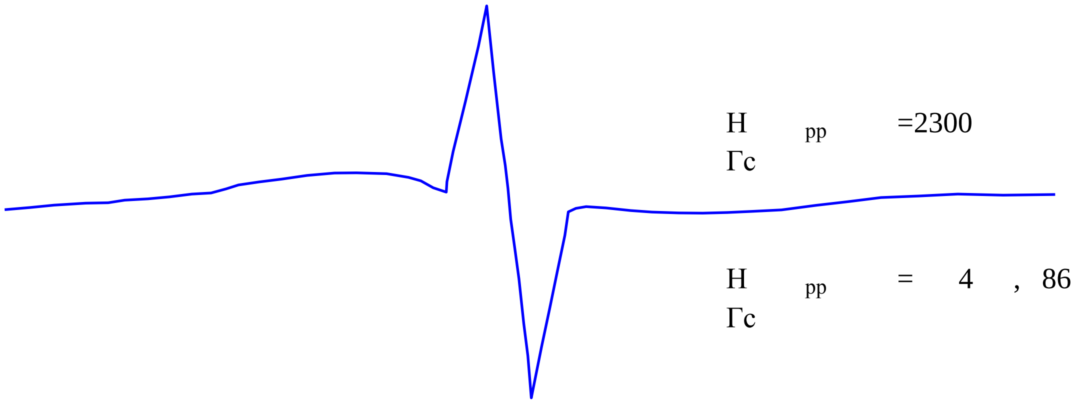

Fig. 2. EPR spectrum of thermally oxidized polyacetylene at a temperature of 120°C.

Further thermal oxidation for several hours does not lead to noticeable changes in the EPR signals (Fig. 2). Using a torsion balance, the kinetics of the addition of air oxygen to polyacetylene was studied under various thermal conditions (Fig. 3).

At temperatures of 25, 75, 100 and 150 °C, a regular increase in the rate of oxygen addition is observed. But at a temperature of 150 °C, the process of decomposition of the oxidized polymer takes place. Therefore, when oxygen is absorbed, the optimal temperature is about 120 °C, at which the maximum oxygen content (up to 37%) of the own weight of polyacetylene is observed in 15-18 hours.

The same process was considered with the help of the system derivatograph F. Paulik, I. Paulikh. L. Erdey at a heating rate of 0.6 °C/min, and three sections were established on the derivatography TGA curve (Fig. 4).

Within the range of 20-100 °C, no significant changes in the weight of the sample were observed; however, starting from 100 to 150 °C, an intense absorption of atmospheric oxygen occurs and, reaching a value of 30-37% of the gain, a decrease in the weight of the sample is observed, associated with the release of carbon dioxide at a temperature °C and it was found that it takes about 18 hours to reach the initial state (Fig. 5).

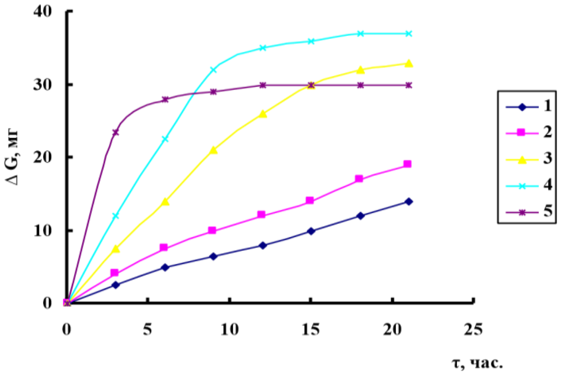

Fig. 3. Dependence of the absorption of air oxygen by polyacetylene on time (°C): 1 - 25, 2 - 75, 3 - 100, 4 - 120, 5 - 150.

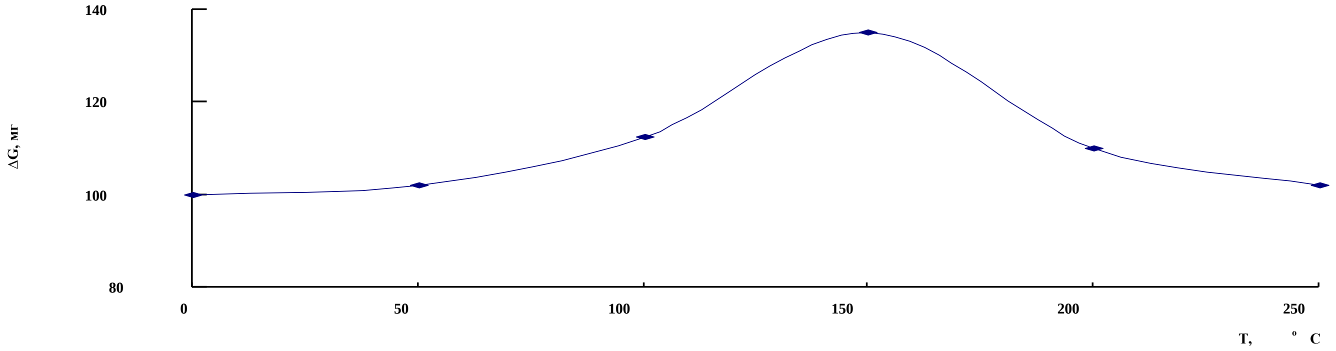

Fig. 4. Derivatographic dependence of the oxidation and decomposition process in air.

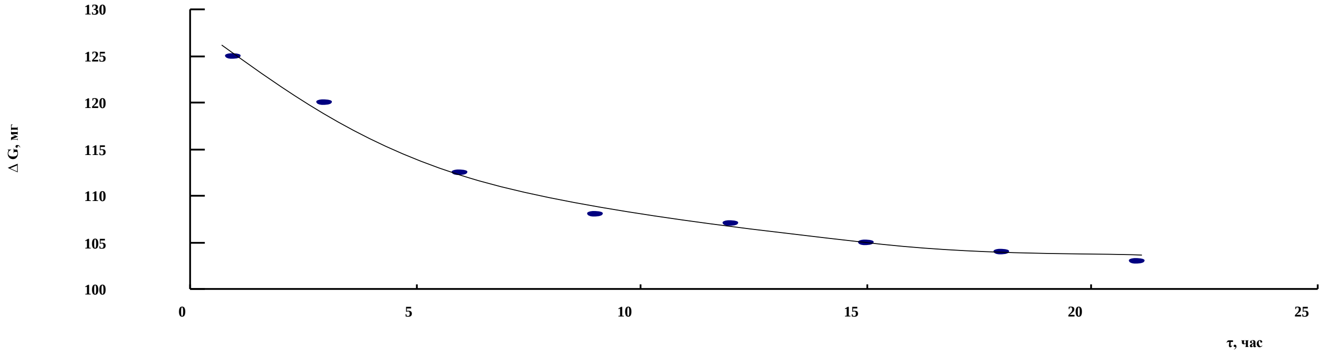

Fig. 5. The time dependence of the weight losing of oxidized polyacetylene at a temperature of 200 °C was studied by the authors.

From the aforementioned, it is evident that polyacetylene could be effectively utilized to regulate gaseous environments in specialized storage facilities, absorbing atmospheric oxygen and releasing anhydride carbonate at specific temperatures.

Currently, PVC plastics rank second globally in annual production, following materials based on low-density polyethylene. During processing, polyvinyl chloride is blended with numerous additives (heat stabilizers, plasticizers, pigments, etc.), including toxic heavy metals.

Acetylene and its derivatives have been extensively studied due to several positive properties, including their simple structure, availability, high reactivity, and the unique physicochemical properties of derived materials. Incinerating waste made from polyvinyl chloride materials in some cases allows for the conversion of these metals into non-toxic compounds. However, the potential presence of toxic heavy metals in fly ash remains a significant environmental concern. Furthermore, the extensive use of polyvinyl chloride composite materials in manufacturing water supply products necessitates the exclusion of toxic heavy metals. Hence, finding non-inferior substitutes for toxic additives in polyvinyl chloride is an urgent priority.

Polyacetylene was used to stabilize polyvinyl chloride, obtained through the polymerization of acetylene in an organic solvent using a catalytic system. It is known that when stored in the air, polyacetylene absorbs oxygen and increases in weight up to 30-37% over an extended period. A similar reaction occurs when polyacetylene interacts with gaseous chlorine, hydrogen chloride, and others. Studies have shown that the thermal degradation of PVC primarily results in the release of gaseous hydrogen chloride. Thus, employing compounds with conjugation systems, particularly polyacetylenes, as stabilizers appears to be a promising direction. Research indicates that incorporating only one percent of polyacetylene into polyvinyl chloride compositions increases dynamic thermal stability by a factor of 1.5 to 2 (Table 4).

Table 4. Influence of the introduced polyacetylene in PVC-composition on the time of inhibition of its thermo-oxidative destruction (T - 190°C).

Polyvinylchloride, g	Polyacetylene, g	t, min.
10	0,2	8
10	0,3	10
10	0,5	11
10	1,0	15

Table 4 shows the results obtained by the authors. The inhibition time for PVC controls without stabilizer is 3 minutes [11]. In the study of the effect of polyacetylene on the torque of the PVC composition during processing, a decrease in the relaxation and plasticization time under the influence of the introduced additive was found.

The thermal stability of polyvinyl chloride compositions was studied by thermogravimetric (TGA), differential thermal analysis (DTA) on a Paulik. Paulik and Erdey are on 5 air withing the range of T°n=25-250 °C co Vheating= =5 °C/min. Thermal stability time, itc, the time to the onset of HCl evolution was determined by the method of changing the color of the Congo-red indicator with time. The melt flow rate index of polyvinyl chloride compositions was determined by the melt flow rate of (MFR) method by measuring the melt flow rate through a calibrated nozzle at a certain pressure. The plasticizing properties of the compositions were studied at Brabender.

The study of the physicochemical and technological properties of vinyl chloride composites using polyacetylene with partial replacement of industrial thermal stabilizers BMR-9, TOCS showed that the thermal stability of the proposed composite at a temperature of 190 ° C is 40-45 minutes. The plasticization time is reduced in comparison with standard samples, and the melt flow rate does not change (Table 5). Thermooxidation of PVC compositions increases significantly with the introduction of polyacetylene with partial replacement of the industrial stabilizer with a simultaneous reduction in mixing of components. However, the MFI decreases with increasing polyacetylene content (Table 5).

Table 5. Effect of heat stabilizers on the properties of compositions

№	Name of components and properties of compositions	Standard recipe	1	2	3	4
1	PVC S-70	100	100	100	100	100
2	Belgorod chalk	3,85	3,85	3,85	63,85	3,85
3	BMR-9	2,00	2,00	1,50	1,75	1,00
4	TOSS	1,00	0,50	0,50	0,50	0,50
5	Stearic acid	0,15	0,15	0,15	0,15	0,15
6	Polyacetylene		0,50	0,75	1,00	1,25
7	Plasticizing time, min. MFR, g/10 min	17	16	14	15	13
8	Thermal stability at 190 °C	45	40	45	50	50

Table 4 shows the results obtained by the authors. The stabilizing effect of polyacetylene is due to the binding of the released HCl during the thermal oxidative decomposition of PVC. In addition, the thermal stabilizer promotes the absorption of labile chlorine atoms, which increases the thermal stability of the polymer [14; 15].

The thermal oxidative destruction of the initial PVC and its composition was studied by derivatographic analysis (Fig. 6).

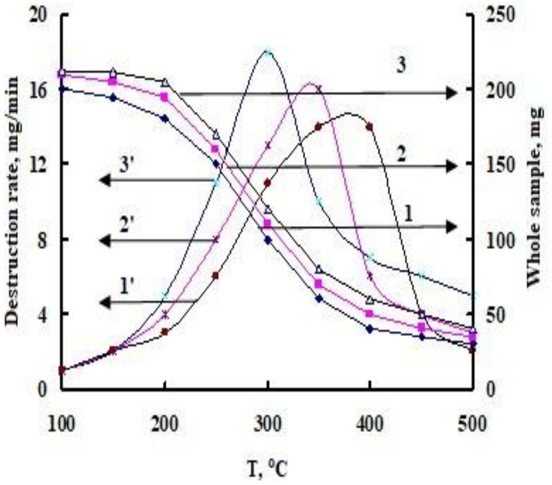

Fig. 6. Analysis of DTGA 1, 2, 3 and TGA 1', 2', 3' thermal oxidation of PVC and its thermostabilized 1-PVC; 2-standard of the composition of 3-polyacetylene.

The nature of the TGA curves is evidenced by the multistage process. At the first stage of destruction in the case of initial PVC up to 300 ° C, the process of dehydrochlorination dominated accompanied by the formation of double and cross carbon bonds. A further increase in temperature leads to the rupture of the C-C bonds of the macro chain with the formation of low molecular weight compounds of various lengths and carbonization of the polymer residue. The mixture of an industrial stabilizer with polyacetylene introduced into the PVC composition obviously affects mainly the first stage of polymer degradation. In this case, the thermal stability of PVC increases markedly with a simultaneous decrease in gross dehydrochlorination [16].

Heterometallic hydride titanium-aluminum compounds Cp2Ti(ν-H)2 AlH(X) and

(Cp2Ti)2Alh4x are highly efficient catalysts for C_2H_2 polymerization. The complex Cp2Ti(μH)2 alh2 demonstrates activity in this reaction at concentrations of 2.2–3.2 M in ethertoluene solutions. The mechanisms of olefin isomerization and C_2H_2 polymerization are similar, and the compositions and structures of the active centers in these processes are close. The (CH)X, formed with the participation of substances accelerating the addition of H2 to unsaturated organic compounds (cis-isomers) after I doping, has σ=1.5–2.0 · 104 Ohm−1 cm−1 [1].

As investigated by the authors, industrial polymers contain antioxidants adapted for specific uses and stabilizers, essential components of polymeric materials. Stabilizing …— CH2—CH2—CH2—CH2... requires the use of stabilizers or their combinations. Increased temperatures, shear forces, and the presence of O2 are the main factors in polyethylene breakdown during processing. These factors lead to thermo-mechanical or thermo-oxidative degradation of the polymer in the presence of O2. The autophotocatalytic free radical chain reaction, involving initiation, propagation, and termination, includes alkyl, alkoxy, peroxi-, and hydroxyl radicals. Researchers are also investigating the corrosion inhibiting abilities of oligomeric derivatives of natural polyphenols. It has been demonstrated that oligomeric corrosion inhibitors based on them with urea adducts in a salt medium effectively protect Fe-C alloys from corrosion, while derivatives of gossypol with cyanamide trimers exhibit effective protection in acidic environments [8].

Researchers have already synthesized diblock copolymers through a stoichiometric reaction involving functionalized poly(phenylvinylsulfoxide) with a chain-end functionalized N(CH3)3 and the chain-end functionalized polystyrene, incorporating carboxylation in the chain to connect the two polymer segments via ionic bonding. Subsequent thermal treatment transformed the poly(phenylvinylsulfoxide) into new polyacetylene segments, creating AB-type ionic bond diblock copolymers and asymmetric star-branched polymers with three AB2 arms consisting of polyacetylene and polystyrene segments. These polymers exhibited a periodic lamellar morphology in their films. Researchers are attempting to extract nanoscale sheet-like layers of polyacetylene as well [3].

As also determined by the authors based on experimental data, the assertion that an increase in the proportion of carbon double bonds (polyacetylene fragments) in polyvinyl chloride macromolecules formed during extended thermal treatment, aligns with photoluminescence data and infrared spectra of the films. Heating the initial polyvinyl chloride film with a glass transition and softening temperature of 15−85°C decreased resistance by 2−3 times while maintaining its dielectric properties. Thermally treated polyvinyl chloride films, forming conjugated C bonds associated with π-e−n, can transition from low to high conductivity as temperature increases [15].

CONCLUSIONS

The experimental results demonstrated the effective utilization of polyacetylene in regulating gaseous media within specialized storage facilities. This polymer exhibits the ability to absorb atmospheric oxygen and release carbonic anhydride at specific temperatures. Furthermore, when employed as a thermal stabilizer for PVC, polyacetylene reduces the consumption of antioxidants and improves several essential physical and mechanical properties of the corresponding compositions.

In this study, N-methylpyrrolidone was used as an effective solvent for the synthesis of polyacetylene. The application of N-methylpyrrolidone significantly increased the yield of polyacetylene, reaching 45.0% under laboratory conditions and up to 38.0% under industrial conditions at 0 °C. This increase in yield is presumably related to the solvent’s enhanced capacity to absorb acetylene.

The kinetics of atmospheric oxygen addition to the synthesized polyacetylene was investigated using torsion balances at 25, 75, 100, and 150 °C. The results showed a steady increase in the rate of oxygen uptake up to 100 °C with rising temperature. However, at 150 °C, decomposition of the oxidized polymer was observed. Thus, the optimum temperature for oxygen absorption was determined to be around 120 °C, where polyacetylene reached the maximum oxygen content (up to 37% of its mass) after 15–18 hours.

Polyacetylene synthesis was carried out using a Latinger catalyst. The obtained product was immediately subjected to chlorination to yield chloropolyacetylene. Further investigations in this direction are currently in progress.

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