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STUDY OF THE CONDITIONS OF ALKALIZATION AND AMINOLIZATION OF SECONDARY POLYCARBONATE

M. K. Yusupova 1,
M. A. Mamadjonova 2,
S. A. Egamberdiev 3,
I. K. Abduvohidov 4,
Namangan Institute of Engineering Technologies 1
E-mail:malikakhonyusupova@gmail.com
PhD, associate professor, Namangan Institute of Engineering Technologies 2
E-mail:mamadjanovamahfora@gmail.com
Assistant, Namangan Institute of Engineering Technologies 3
E-mail: abduvohidoviqbol572@mail.com
PhD, Andijan State Medical Institute 4
E-mail: iqbolabduvohidov91@mail.com

Abstract
This article presents the process and results of the alkolysis and aminolysis of secondary polycarbonate. The main focus is on the decomposition of secondary polycarbonate (IPC) to the monomer bisphenol A (BPA), and the effect of aminolysis and alcoholysis on the yield of bisphenol A (BPA) is studied. The main physicochemical parameters of the resulting product are presented.

Keywords. Secondary polycarbonate, diethylene glycol, sodium hydroxide, alcoholysis and aminolysis product, physicochemical parameters, IR spectrum.

Introduction

In today's rapidly evolving world of materials science and engineering, polycarbonate manufacturers are leading the way in creating innovative solutions to meet the needs of a variety of industries.

Polycarbonate is a versatile and durable material that can be used in a wide range of applications, from automotive to electronics and medical devices. In this article, we delve into the world of polycarbonate manufacturers, explore the properties of

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this amazing material, and meet the leading companies that are driving innovations in the industry.

Polycarbonate is a thermoplastic polymer known for its exceptional strength, impact strength, and optical clarity. It is also lightweight and resistant to impact and high temperatures, making it an ideal choice for a wide range of applications. Additionally, polycarbonate is easy to mold, allowing for the easy production of complex shapes and designs.

One of the main advantages of polycarbonate is its transparency, which is superior to many other plastics. This makes it an ideal material for applications where clarity and visibility are important, such as optical lenses, safety glasses, and electronic displays. Polycarbonate is also UV-resistant, making it suitable for outdoor use where sunlight can cause other materials to deteriorate.

Polycarbonate manufacturers are constantly pushing the boundaries of this versatile material. They are developing new formulas and manufacturing techniques to improve the performance and versatility of polycarbonate in a variety of industries. Some companies are also incorporating recycled polycarbonate into their manufacturing processes to create more sustainable products and reduce their environmental impact.

The world's leading polycarbonate manufacturers include companies such as Sabic Innovative Plastics, Covestro AG, Teijin Limited, and Bayer MaterialScience. These companies are known for their commitment to quality and innovation and are at the forefront of developing new applications for polycarbonate in industries such as automotive, electronics, and construction.

In the automotive industry, polycarbonate manufacturers are working to replace traditional glass windows with lighter, more impact-resistant polycarbonate windows. This helps improve vehicle fuel efficiency and safety, while reducing manufacturing costs and emissions. In the electronics industry, polycarbonate is used to create lightweight, durable housings for smartphones, laptops, and other electronic devices.

Currently, polycarbonate production is 7.85 million tons per year (2023). The main producing countries are China, the United States, South Korea, Thailand, and Germany.

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Literature Review

Polycarbonate (PC) is a high-performance engineering plastic widely used in compact disc manufacturing, glass industry, automobile industry, medical devices, food packaging and so on.[1] With the rapid growth of polycarbonate production and sales, more and more computer waste is generated. Although these computer wastes are non-toxic, they are natural and harmless. It may cause serious environmental pollution and waste of resources. From the perspective of resource conservation and sustainable development, chemical recycling of discarded personal computers is still an important issue and has attracted worldwide attention.[2,3] Several chemical methods have been thoroughly studied, including thermal pyrolysis,[4-6] glycolysis,[7,8] hydrolysis [9-11] and aminolysis [12,13]. Some good results have been achieved with high conversion and high yield, but there are also many disadvantages such as low purity of bisphenol (BPA), slow reaction rate, non-recyclable catalyst and harsh reaction conditions, resulting in high cost and high energy consumption. Compared with these methods, aminolysis, especially methanolysis, is a more important approach for PC recycling due to its mild reaction conditions and relatively easy access to raw monomers. Various catalysts including concentrated bases or superbases (NaOH, [14,15] DBU [16] and TBD [17], ZnO-NP/NBu4Cl nanoparticles, [18] mesoporous molecular sieves (CaO, SrO, BaO)/SBA-15 (ref. - 19BASCO2 and CaO, SrO, BaO) 20) and some ionic liquids ([Bmim]Cl,21[Bmim]OAc,22[Bmim]Cl-2.0FeCl3,23[HDBU][LAc] [24] and [HDBU][Im] [25]) have been used to catalyze the methanolysis of PC and have several advantages. BPA[14,21–25] is a solid catalyst that is easy to separate[18,20], requires low temperatures (60, 70 ºC)[14,22,25] and short reaction times. [24] However, the equipment also has disadvantages such as corrosion, [14,15] labor-intensive operation and large volumes of wastewater. The synthesis process of toluene, or THF catalyst and ionic liquids is very complex, expensive, metal ions contaminate the product [23] and are not biodegradable. As a result, since the above-mentioned methods are not environmentally friendly, finding a new simple, environmentally friendly and inexpensive synthesis process still remains an unsolved problem in this field.

Alcoholysis process inert nitrogen in the environment, mixer, thermometer and return refrigerator with equipped four oral in the flask made increased. In the flask washed and dried particles (0.3-0.5 mm) secondary polycarbonate (used) auto

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headlights, polymer roof disks and h. to) 69.15 and diethylene glycol (DEG) 80.84 g (MIC ratio: DEG = 1: 3 mol / unit. measurement Catalyst as sodium hydroxide (NaOH) VPK. Then the reaction mixture was stirred and nitrogen was continuously bubbled through the reaction mass. The temperature slowly increased went, the process 116 oC when it arrives VPK scream Then the reaction mixture was heated to 190 ° C and kept for 6 h. As a result of the reaction, a dark yellow product was obtained (Figure 1).

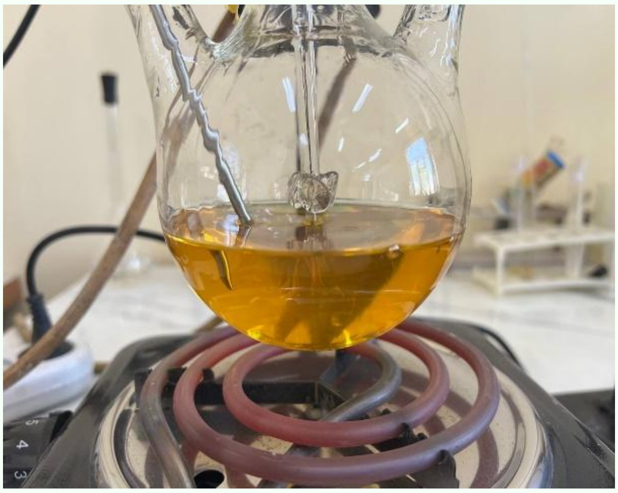

Figure 1. Alcoholysis product synthesized at 190°C for 6 hours.

Then, by continuing the process and increasing the duration to 10 hours, a product of a rich orange color was obtained, having the color of the alcoholysis product (Figure 2).

Figure 2. Alcoholysis product synthesized at 190°C for 6 hours.

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Table 2. Effect of time on the alcoholysis process

PC:DEA, mol el.sv./mol ratio	Amount of acid groups mgKOH/g	Hydroxyl number mgKOH/g
6 hours	427.3	698.5
10 hours	286.2	511.6

The results presented in the table show that when the duration of alcoholysis was increased from 6 to 10 hours, the number of acids and hydroxyl numbers in the synthesis product decreased. It was found that as the duration increased, the yield of decomposition of secondary polycarbonate to monomer increased. When the aminolysis process was carried out under the same conditions, a product with the following properties was obtained.

Table 2. Effect of time on the aminolysis process

PC:MEA, mol el.sv./mol ratio	Amine number mgKOH/g	Hydroxyl number mgKOH/g
6 hours	567.6	897.64
10 hours	356.8	623.36

Then, an IR spectrum was obtained to analyze the resulting product. Figure 3.

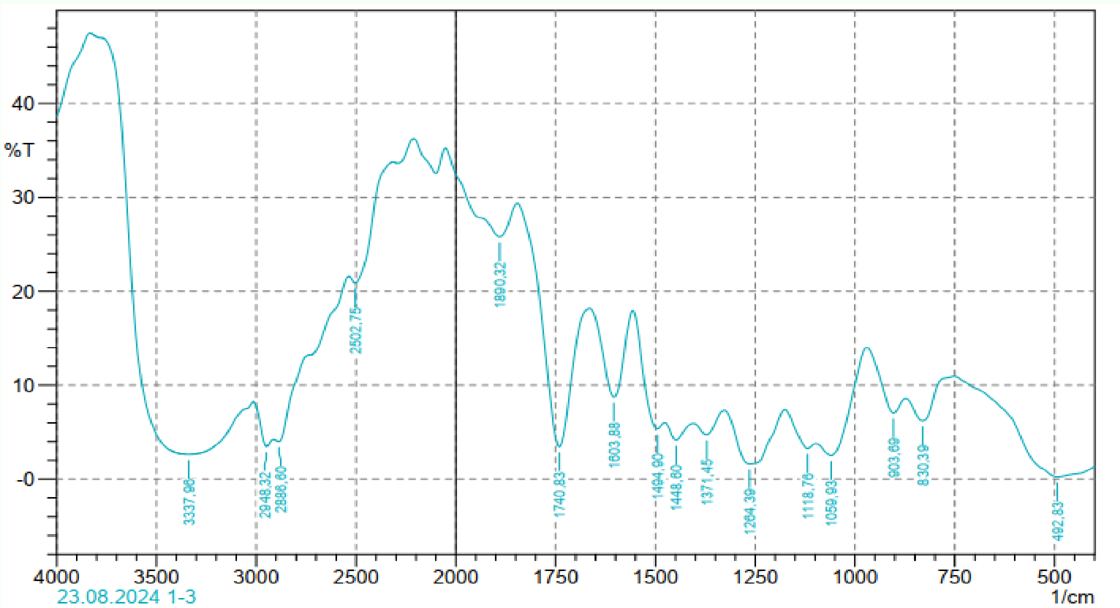

Figure 3. IR spectrum of the product obtained at 190 oC for 10 hours.

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IR-spectroscopy analysis showed that the obtained product contained ethylene carbonate (1890.3 cm-1) and linear carbonate bands (1740.83 cm-1). The FT-IR spectrum was consistent with the NMR data.

Discussion of the results obtained

The composition, structure and properties of the products formed when applying the alcoholysis and aminolysis processes of diethylene glycol and monoethanolamine with secondary polycarbonate were studied (Tables 1 and 2).
The physicochemical properties of the target products obtained in different ratios, the increase in the duration of the alcoholysis of secondary polycarbonate with diethylene glycol and aminolysis with monoethanolamine, and the number of hydroxyl groups and acid groups in the final product were determined.
Conclusion.
Thus, the effect of alcoholysis and aminolysis conditions on the synthesis of secondary polycarbonate with diethylene glycol and monoethanolamine at different molar ratios was studied. It was found that the mass fraction of nitrogen in the final product leads to a change in the number of hydroxyl groups.
We will focus further research on the isolation of bisphenol-A from the obtained product.

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