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CHARACTERIZATION OF POLYVINYL CHLORIDE FIBRES BY INFRARED SPECTROSCOPIC METHOD

Polyvinyl chloride fibres are such synthetic fibres that have been formed from linear macromolecules by straight-chain polymerization of vinyl chloride. The polyvinyl chloride fibres belong to the oldest commercial synthetic fibres. By polymerization of an aqueous emulsion of monomeric vinyl chloride, the polyvinyl chloride emulsion is obtained which is coagulated under the influence of electrolytes, dried and treated by either a dry or wet spinning process [1]. The chlorine content in such polyvinyl chloride is 55—58%. By after-chlorination of the polyvinyl chloride suspended in tetrachloroethane or carbon tetrachloride, poly-vinyl chloride is obtained with the chlorine content of 64—66%. The properties of the after-chlorinated polyvinyl chlorides improve in many respects: their softening point rises, adhesion disappears, and organic solvent solubility improves. The last fact enables us to obtain after-chlorinated polyvinyl chlorides. By copolymerization of a mixture of vinyl chloride and vinyl acetate, a copolymerizate is obtained, containing up to 86—90% vinyl chloride and 14—10% vinyl acetate. In case of the proper degree of polymerization, an acetone-soluble polymer can be obtained from which copolymer fibres can be produced with the help of the dry spinning process.

In [2], the possibilities of distinguishing polyvinyl chloride fibres and copolymerized fibres of polyvinyl chloride and cellulose acetate were under consideration.

Table 1 presents data about the carbon and hydrogen content in after-chlorinated (Khlorin) and common (Leavin and Clevyl) polyvinyl chloride fibres. The chlorine content can be calculated from the difference. Acetokhlorin fibres contain, besides carbon, hydrogen and chlorine, also oxygen of an acetate group.

In Table 2 the data on the softening ranges and melting points of some polyvinyl chlorides are given.

The goal of this work was to find the possibilities of characterizing common polyvinyl chloride fibres, after-chlorinated polyvinyl chloride and

Table 1

Elemental analysis (C and H) of some investigated polyvinyl chloride fibres

Fibres	C	H
1. Khlorin	34.45	3.74
2. Rhovyl	35.71	4.49
3. Clevyl	36.39	4.12
4. Leavin	38.67	5.01
5. Acetokhlorin	36.53	4.30

Table 2

Softening ranges and melting points of some polyvinyl chloride fibres (°C) [2]

	Common fibres			Chlorinated fibres
	Rhovyl	Clevyl	Leavin	Piviacid
Softening range	72—75	110	130	80—90
Melting point	160	180		
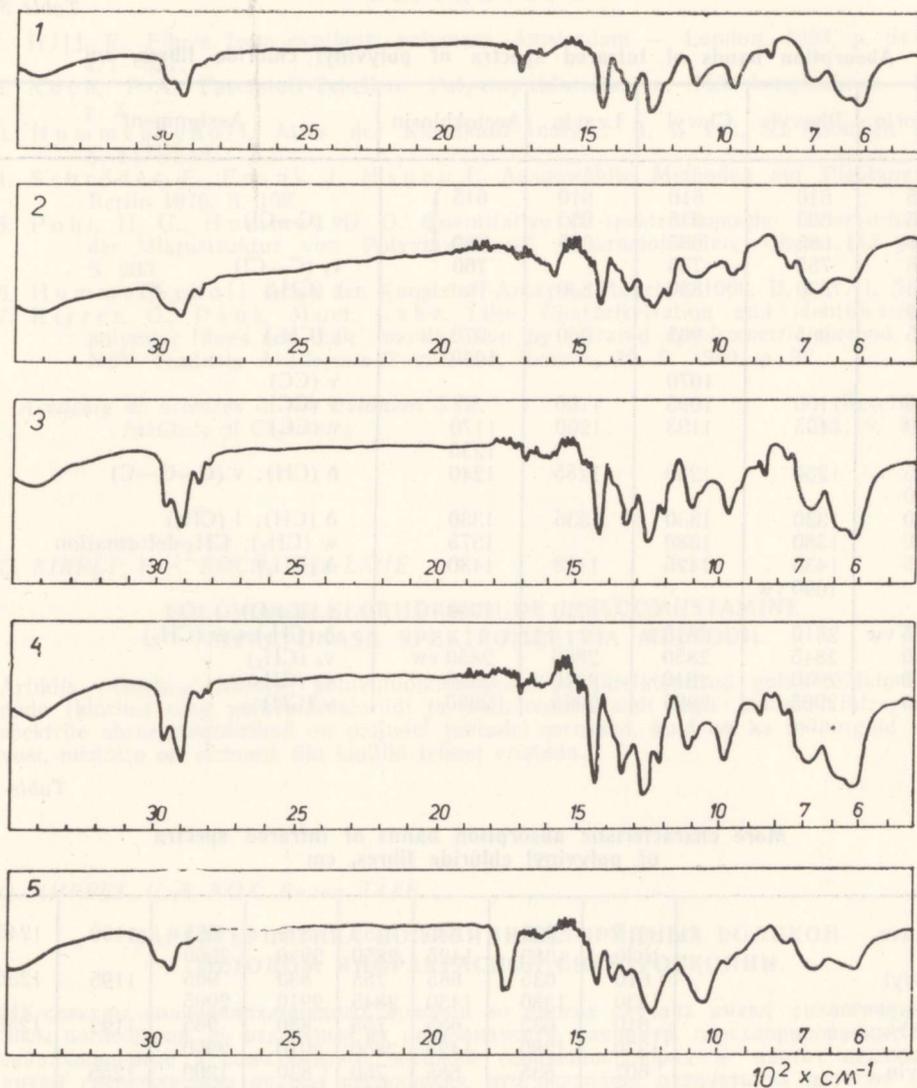
The infrared spectra of some polyvinyl chloride fibres: *1* — leavin, *2* — khlorin, *3* — rhovyl, *4* — clevyl, *5* — acetokhlorin.

fibres from polyvinyl chloride and cellulose acetate (85 : 15%) by the infrared spectroscopic method.

Figure presents the infrared spectra of some polyvinyl chloride fibres.

Table 3 compares our data about the absorption bands of infrared spectra of polyvinyl chloride fibres with those of some authors such as Krimm, Tasumi, Shimanouchi and H. U. Pohl [3] and E. Schröder et al. [4].

The absorption bands of infrared spectra of polyvinyl chlorides in the regions 615, 639 and 680—685 cm^{-1} are characteristic of the CHCl stretching. According to H. U. Pohl and D. O. Hummel [5] these bands can be separated into single ones in the regions 603, 613, 624, 636, 647, 677 and 696 cm^{-1}. The absorption bands at 835 and 960—965 cm^{-1} correspond to the —CH$_2$ rocking. An absorption band at 930 cm^{-1} is typical of the after-chlorinated polyvinyl chlorides (Khlorin), the infrared spectra of other common polyvinyl chlorides contain no such absorption band.

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Table 3

Absorption bands of infrared spectra of polyvinyl chloride fibres, cm^{-1}

Khlorin	Rhovyl	Clevyl	Leavin	Acetokhlorin	Assignment
615	610	610	610	615	
635	635	635	635		ν (C—Cl)
680	685	685	685	680	
755	755	755		760	ν$_s$ (C—Cl)
830	830	830	830		r (CH$_2$)
930					
965	965	965	960	970 vw	r (CH$_2$)
				1050	
		1070			ν (CC)
1080	1100	1095	1100		ν (CC)
1190	1195	1193	1200	1170	ν (CC)
				1235	
1245	1250	1250	1255	1240	δ (CH); ν (C—O—C)
1280					
1330	1330	1330	1335	1330	δ (CH); t (CH$_2$)
1380	1380	1380		1375	w (CH$_2$); CH$_3$-deformation
1425	1430	1425	1428	1430	δ (CH$_2$)
	1690 vw				
			1710	1750	ν (C=O)
2815 vw	2810	2810			δ (CH$_2$)+w (CH$_2$)
2850	2845	2850	2860	2850 vw	ν$_s$ (CH$_2$)
2920	2910	2910	2910	2920	ν$_s$ (CH$_2$)
2960	2965	2965	2965	2960	ν (CH)

Table 4

More characteristic absorption bands of infrared spectra of polyvinyl chloride fibres, cm^{-1}

Khlorin	615	635	680	755	830	965	1190	1245
	1330	1380	1425	2850	2920	2960		
Rhovyl	610	635	685	755	830	965	1195	1250
	1330	1380	1430	2845	2910	2965		
Clevyl	610	635	685	755	830	965	1193	1250
	1330	1380	1425	2850	2910	2960		
Leavin	607	635	685	750	830	1200	1255	
	1335	1380	1428	2850	2910	2965		
Acetokhlorin	615		680	760		970	1170	1240
	1330	1375	1430	1750	2850	2920	2960	

The absorption bands at 1080—1100 cm^{-1} are due to the C—C stretching. The absorption bands at 1245—1255 cm^{-1} correspond to the C—H bending. The interpretation of other absorption bands is given in Table 3.

The acetate structure in Acetokhlorin is characterized by the C=O stretching at 1745 cm^{-1}, the CH$_3$-deformation at 1375 cm^{-1} and the C—O—C stretching at 1240 cm^{-1} [6]. Both infrared spectra and elemental analyses were performed by the previously described method [7].

Table 4 shows the most characteristic absorption bands of polyvinyl chloride fibres, on the basis of which after-chlorinated and common polyvinyl chlorides and acetate groups containing polyvinyl chlorides (Acetokhlorin) can be characterized and distinguished.

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POLÜVINÜÜLKLORIIDKIUDUDE ISELOOMUSTAMINE
INFRAPUNASE SPEKTROMEETRIA MEETODIL

Artiklis vaadeldud harilike polüvinüülkloriidkiudude, järelklooritud polüvinüülkloriidkiudude (kloriin) ning polüvinüülkloriidi ja tselluloosatsetaadi segu kiudude infrapunaste spektrite absorptsiooniribad on paljudel juhtudel sarnased, kuid on ka mõningaid erinevusi, mistõttu on võimalik üht kiuliiki teisest eristada.

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ХАРАКТЕРИСТИКА ПОЛИВИНИЛХЛОРИДНЫХ ВОЛОКОН
МЕТОДОМ ИНФРАКРАСНОЙ СПЕКТРОСКОПИИ

ИК-спектры поливинилхлоридных волокон во многих случаях имеют аналогичные полосы поглощения, но отдельные их разновидности, например, перехлорированные поливинилхлоридные и сополимерные волокна (поливинилхлорид + ацетат целлюлозы) имеют специфические полосы поглощения, что позволяет отличать их друг от друга.