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The study of physical and mechanical properties of fabrics for production of special clothes

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S u m m a r y. Detailed below is an experimental study of physical-mechanical and protective properties of special fabrics exposed to the effects of organic solvents.
K e y w o r d s: physical-mechanical properties , organic solvents, special clothes for mechanics on car repairs.

INTRODUCTION

The protective functions of special clothes depend substantially on the material selected for their production. Nowadays the advanced technologies allow manufacturing clothes of improved safety, which provide protection from the effect of aggressive media. The analysis of standards applied to special clothes showed that there is no clear classification of protective clothes on their purpose of function. This results in a very ambiguous specification of standard values of clothes. We have to distinguish certain blocks to combine products of fabrics that can provide protection for occupational groups including the same or similar hazardous factors according to the possibility of causing damage.

OBJECTS AND PROBLEMS

For actual labour conditions at car service stations and motor transport companies it is typical to have not just one but several acting hazardous and harmful production factors: mechanical damages, oil products, high and low temperatures, electric current, dust, toxic substances, acids, alkalis, organic solvents, static electricity and common production dirtying. Hence it became necessary to study special materials of domestic manufacture used in production of a special suit for protection of people working with organic solvents taking into account the antistatic properties as well.Determination of the effect of organic solvents on the change of physical-mechanical and protective values of special materials.

Materials and results of study**.** Special textile materials of domestic batch manufacture and their physical-mechanical, protective, hygienic and antistatic properties were examined in laboratory environment in relation to the resistance to organic solvents. The examination covered fabrics with different fibre composition and various types of impregnation:

- Art. 81415A (oil-lubricant-waterproof, composition: polyester 67%, cotton 33%)
- Art. 18422 AXM (oil-lubricant-waterproof, composition: polyester 67%, cotton 33%)
- Art. 81415 *(lubricant-waterproof,* composition: polyester 67%, cotton 33%*);*
- Art. 81412 *(lubricant-waterproof,* composition: polyester 67%, cotton 33%*);*

The following organic solvents were taken as aggressive medium: acetone and benzine. The basic criteria for assessment of physical-mechanical, protective, hygienic and antistatic properties of materials were surface density[GOST 3811-72], thickness [GOST 12023-93], breaking load [GOST 3813-72], elongation at rupture [GOST 3813-72], rip load [GOST 3813-72], organic solvents and oil products resistance [DSTU GOST 12.220:2004], air permeability [GOST 12088-77].The tests were carried out in

consideration of the European Standard [DSTU EN 1149-1:2003 "Electrostatic properties. Specific surface resistance (testing methods and requirements)" applicable in Ukraine]. The examination was conducted with use of the following equipment: analytical balance VLA-200M, thickness gauge TP 25-II, tension testing machine PT-250-M, air permeability meter VPTM-2, surface electric resistance meter IESTP-1. The properties of examined materials are given in table 1.

Table 1. Physical-mechanical, protective, hygienic and antistatic properties of textile materials

Parameters	Fabric articles Art.			
	81415A	18422AXM	81415	81412
Surface density of fabric, g/m^2	212	225	210	216
Thickness, mm	0,31	0,40	0,30	0,30
Breaking load, N				
warp	1058,0	707,0	965,3	1061,3
weft	670	436	614	604,3
Elongation at rupture, %				
warp	24,5	13,5	20,7	18,5
weft	18,1	13,8	23,0	22,7
Rip load, N				
warp	49,7	30,1	40,2	67,3
weft	42,8	29,4	37,2	49,8
Air permeability, dm^3/m^{2}s	50,17	43,50	57,0	56,5
Water absorbency, %	0,08	0,12	0,09	0,08
Surface electric resistance, ohm	$0{,}13\cdot10^5$	$1{,}66\cdot10^4$	$1{,}66\cdot10^{12}$	$4{,}62\cdot10^{11}$

According to the analysis, all the fabrics have approximately the same thickness and surface density but different strength properties [Chubarova Z.S.,1988]. Rather low water absorbency values can be explained first that these fabrics mainly contain polyester hydrophobic fibres in their composition and second that they are appropriately impregnated. Protective properties of textile materials when contacting organic solvents can be determined by their chemical resistance. The change of the breaking load value of fabrics after their treatment with aggressive substances during certain time is mostly used as chemical resistance criterion. Values of strength were selected as criterion of chemical resistance because they belong to basic parameters used for assessing the degree of connection between the elements of material structure. Reduction or increase of these values after the impact of aggressive substances can indicate the change of this structure. Tables 2, 3, 4 and 5 represent results of the examination how the physical-mechanical and antistatic values of materials changed after being treated with organic solvents.

Table 2. Change of physical-mechanical and antistatic values of the material Art. 81415 A after organic solvents treatment

Parameters	Output data	After treatment	
		acetone	benzine
Breaking load, N			
warp	1058,0	1007,8	1149,0
weft	670,0	591,3	662,0
Elongation at rupture, %			
warp	18,2	19,0	19,2
weft	22,5	22,2	21,9
Aggressive substance impact resistance, %			
warp		95,3	108,8
weft		91,3	98,8
Surface electric resistance, ohm	$0{,}13\cdot10^5$	$0{,}35\cdot10^5$	$0{,}13\cdot10^5$

Table 3. Change of physical-mechanical and antistatic values of the material Art. 18422AXM after organic solvents treatment

Parameters	Output data	acetone	benzine
Breaking load, N			
warp	707,0	625,6	640,0
weft	436,0	390,4	422,0
Elongation at rupture, %			
warp	13,5	11,2	12,2
weft	13,8	14,3	13,0
Aggressive substance impact resistance, %			
warp		88,5	90,5
weft		89,5	96,8
Surface electric resistance, ohm	$1{,}66\cdot10^4$	$0{,}35\cdot10^5$	$1{,}66\cdot10^4$

Table 4. Change of physical-mechanical and antistatic values of the material Art. 81415 after organic solvents treatment

Parameters	Output data	acetone	benzine
Breaking load, N			
warp	965,3	857,5	1006,1
weft	614,0	656,6	656,6
Elongation at rupture, %			
warp	20,7	19,3	21,7
weft	23,0	24,0	24,7
Aggressive substance impact resistance, %			
warp		88,8	102,7
weft		106,9	107,5
Surface electric resistance, ohm	$1{,}66\cdot10^{12}$	$1{,}66\cdot10^{12}$	$1{,}29\cdot10^{12}$

Table 5. Change of physical-mechanical and antistatic values of the material Art. 81412 after organic solvents treatment

Parameters	Output data	acetone	benzine
Breaking load, N			
warp	1061,3	1002,9	1140,9
weft	604,3	568,4	574,9
Elongation at rupture, %			
warp	18,5	18,7	20,0
weft	22,7	22,7	21,3
Aggressive substance impact resistance, %			
warp		94,5	107,3
weft		94,1	95,1
Surface electric resistance, ohm	$4{,}62\cdot10^{11}$	$3{,}33\cdot10^{11}$	$3{,}05\cdot10^{11}$

CONCLUSIONS

According to the testing results, the following conclusion can be made up. The fabric article 81415A has the highest values of breaking loads after treatment with organic solvents and the highest resistance to the impact of aggressive substance. The fabric article 18422 AXM has the lowest values accordingly. The fabric article 81415A, according to the examination results, has the surface electric resistance in compliance with requirements of DSTU EN 1149-1 as well.

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ИССЛЕДОВАНИЕ ФИЗИКО-МЕХАНИЧЕСКИХ СВОЙСТВ МАТЕРИАЛОВ ДЛЯ ИЗГОТОВЛЕНИЯ СПЕЦИАЛЬНОЙ ОДЕЖДЫ

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Аннотация. В статье представлены экспериментальные исследования физико-механических и защитных свойств специальных материалов отечественного производства, используемых при изготовлении спецодежды для защиты слесарей по ремонту автомобилей, работающих с органическими растворителями с учетом антистатических свойств.

Ключевые слова: физико-механические свойства, органические растворители, спецодежда для слесарей по ремонту автомобилей.