

UDK 677+687

ISSN 0040-2389

SAVEZ INŽENJERA I TEHNIČARA TEKSTILACA SRBIJE

1868 - 2017



# *tekstilna industrija*

UNION OF TEXTILE ENGINEERS AND TECHNICIANS OF SERBIA

Naučni i stručni časopis tekstilne i odevne industrije

Scientific and professional journal of the Union of textile engineers and technicians of Serbia



# VISOKA TEKSTILNA STRUKOVNA ŠKOLA ZA DIZAJN, TEHNOLOGIJU I MENADŽMENT



# DTM

Starine Novaka 24  
Beograd



**Visoka tekstilna strukovna škola za dizajn tehnologiju i menadžment**, kao sledbenik Više tehničke tekstilne škole osnovana je 30. juna 1958. godine. Odlukom Komisije za akreditaciju i proveru kvaliteta Republike Srbije od 03. maja 2007. godine Viša tehnička tekstilna škola u Beogradu je akreditovana pod nazivom Visoka tekstilna strukovna škola za dizajn, tehnologiju i menadžment. U novom ciklusu akreditacije, Škola je u januaru 2012. godine podnela zahtev za akreditaciju delom postojećih modernizovanih studijskih programa i delom novih studijskih programa koji su nastali kao logičan rezultat istraživanja potreba društva i tekstilne industrije.

Škola se kroz ispunjenje standarda za akreditaciju opredelila da našim studentima obezbedi strukovna znanja koja se mogu primeniti kako u teoriji, tako i u praksi. Naši studenti se praktično obučavaju u preduzećima tekstilne industrije, učestvuju na izložbama, revijama, konferencijama, objavljuju radove u časopisima, aktivno učestvuju u životu i radu Škole.

Škola uspešno saraduje sa Privrednom komorom Srbije, Privrednom komorom Beograda, Savezom inženjera i tehničara, aktivni je član klastera modne industrije FACTS.  
Škola je akreditovala sledeće studijske programe:

## Studijski programi osnovnih strukovnih studija:

- Dizajn tekstila i odece; Tekstilno inženjerstvo; Menadžment u tekstilnoj industriji.

## Studijski programi specijalističkih strukovnih studija:

- Odeća specijalne namene ; Modni menadžment.

 011 32 32 430; 32 33 694

 011 32 34 002

 [www.vtts.edu.rs](http://www.vtts.edu.rs)

 [vtts@eunet.rs](mailto:vtts@eunet.rs)

# UNIVERZITET U NIŠU TEHNOLOŠKI FAKULTET LESKOVAC

Tehnološki fakultet u Leskovcu je **akreditovana visokoškolska ustanova** na kojoj se održava nastava na sva tri nivoa akademskih studija: **osnovnim, master i doktorskim**

U prvu godinu **osnovnih akademskih studija** Tehnološki fakultet upisuje **120 studenata** čije se studiranje finansira iz budžeta Republike Srbije na akreditovanim studijskim programima:



**HEMIJSKE TEHNOLOGIJE**, 60 studenata na studijskim područjima

- Farmaceutsko kozmetičko inženjerstvo
- Ekološko inženjerstvo
- Organska hemijska tehnologija i polimerno inženjerstvo



**PREHRAMBENA TEHNOLOGIJA I BIOTEHNOLOGIJA**, 40 studenata na studijskim područjima

- Prehrambena tehnologija
- Biotehnologija



**TEKSTILNE TEHNOLOGIJE**, 20 studenata na studijskim područjima

- Tekstilno inženjerstvo
- Industrijski dizajn tekstilnih proizvoda

Master studije se realizuju sa istim studijskim programima kao osnovne studije, uz dodatni, akreditovan studijski program - Upravljanje materijalnim i energetske tokovima, od školske 2015/16.

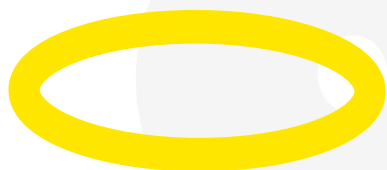
**Doktorske studije se realizuju sa studijskim programom Tehnološko inženjerstvo**



U prvu godinu osnovnih akademskih studija mogu se upisati lica sa završenom srednjom školom u četvorogodišnjem trajanju i položenim prijemnim ispitom. Kandidati koji konkurišu za upis polažu prijemni ispit iz jednog od sledeća tri predmeta: **Matematika, Hemija ili Fizika**, po izboru.

Kandidati koji konkurišu na studijsko područje Industrijski dizajn tekstilnih proizvoda polažu prijemni ispit iz jednog od sledeća četiri predmeta: **Matematika, Hemija, Fizika ili Crtanje**, po izboru. Prijemni ispit obuhvata programske sadržaje koji su izučavani u srednjoj školi u četvorogodišnjem trajanju.

**TEHNOLOŠKI FAKULTET U LESKOVCU**, Bulevar oslobođenja 124  
tel: centrala 016/247-016; studentska služba 016/242-560  
[www.tf.ni.ac.rs](http://www.tf.ni.ac.rs)  
e-mail: [tehfak@ni.ac.rs](mailto:tehfak@ni.ac.rs)



**ST. GEORGE®**

11040 BEOGRAD, SENJAČKA 24  
TEL. +381 11 369 10 08 FAX +381 11 265 34 41  
STGEORGE\_BGD@YAHOO.COM ANDRE.CALIJA@YAHOO.COM



**OPŠIRNIJE**

**87** STR.



**YEXIAO YX-152**

KOMPJUTERIZOVANA RAVNOLETEĆA MAŠINA  
DETALJNIJE O MAŠINI NA STRANI 87



1868 - 2017

Naučni i stručni časopis tekstilne industrije UDK 677+687 ISSN 0040-2389  
Scientific and professional journal of the Union of textile engineers and technicians of Serbia

Godina LXIV • Broj 3 • Beograd 2017 • Strana 1-88 • Tiraž 120

Izdavač: SAVEZ INŽENJERA I TEHNIČARA TEKSTILACA SRBIJE

11000 Beograd, Kneza Miloša 7a/II, tel: 064 15 03 053

e-mail: casopistekstilnaindustrija@gmail.com

Tekući račun: 295-1201292-77 Srpska banka

Štampa: M studio, Stara Pazova

**Predsednik Izdavačkog saveta:** Stanko Kiš, dipl. ing.

**Redakcioni savet:** Prof. dr Snežana Urošević, Prof. dr Dragan Đorđević,  
dr Ana Jelić-Aksentijević, dr Danijela Paunović, dr Goran Savanović, dipl.ing, dr Gordana Čolović

**Glavni i odgovorni urednik:** Prof. Dr Snežana Urošević

**Lektor:** Bojana Pejčić, M.Sc.

**Tehnički urednik:** ing. Aleksandar Sokolović

**Dizajn korica:** ing. Aleksandar Sokolović

## REDAKcioni ODBOR:

Dr Ana Jelić-Aksentijević	DTM, Beograd
Dr Biljana M. Pejić	DTM, Beograd
Dr Biljana Popović	DTM, Beograd
Dr Branislava Lazić	DTM, Beograd
Dr Božidar Stavrić	Tehnološko-metalurški fakultet, Beograd
Dr Danijela Paunović	DTM, Beograd
Dr Dragan Đorđević	Tehnološki fakultet, Leskovac
Dr Dušan Trajković	Tehnološki fakultet, Leskovac
Dr Gordana Čolović	DTM, Beograd
Dr Gordana Kokeza	Tehnološko-metalurški fakultet, Beograd
Dr Ineta Nemeš	Tehnički fakultet „Mihajlo Pupin“ Zrenjanin
Dr Jovan Stepanović	Tehnološki fakultet, Leskovac
Dr Koviljka Asanović	Tehnološko-metalurški fakultet, Beograd
Dr Nada Štrbac	Tehnički fakultetu u Boru, Bor
Dr Nemanja Kašiković	Fakultet tehničkih nauka, Novi Sad
Dr Slobodan Pokrajac	Mašinski fakultet, Beograd
Dr Snežana Urošević	Tehnički fakultet u Boru, Bor
Dr Suzana Đorđević	Visoka tehnološko umetnička strukovna škola, Leskovac
Herbert Kranjc	Pančevo
Mr Katarina Nikolić	DTM, Beograd
Mr Marina Kocareva Ranisavljev	DTM, Beograd
Mr Mira Reljić	Institut CIS Srbije, Beograd
Zvonimir Paunović	Škola za dizajn tekstila, Beograd
Jelena Lazarević	Škola za dizajn tekstila, Beograd

## INTERNACIONALNI REDAKcioni ODBOR:

Dr Bruno Završnik	Ekonomsko poslovna fakulteta, Maribor
Dr Goran Demboski	Tehnološko-metalurški. fakultet, Skopje
Dr Isak Karabegović	Tehnički fakultet, Bihać
Dr Svetlana Janjić	Tehnološki fakultet u Banjoj Luci, Bosna i Hercegovina
Dr Simona Jevšnik	Tehnološki fakultetu u Banjoj Luci
Dr Sorak Miloš	Tehnološki fakultet, Banja Luka
Mr Almina Duraković	Fakultet za dizajn, Trzin, Slovenija
Dr Damjana Celcar	Fakultet za dizajn, Trzin, Slovenija
Dr Zoran Stjepanović	Fakulteta za strojništvo, Maribor
Dr Liliana Indrie	Faculty of Energy Engineering and Industrial Management, University of Oradea, Romania
Dr Zlatina Kazlacheva	Faculty of Technics and Technologies, Trakia University, Bulgaria
Mr Sanja Risteski	Tehnološko-tehnički fakultet, Štip, Makedonija
Dr Elsayed Elnashar	Faculty of Specific Education, Kafrelsheikh University, Egypt
Dr Lubos Hes	Faculty of Textiles, Technical University of Liberec, Czech Republic
Dr Rajiv Padhye	Centre for Advanced Materials and Performance Textiles, RMIT Fashion and Textiles, RMIT University, Australia
Dr Boris Mahltig	Hochschule Niederrhein, Faculty of Textile and Clothing Technology Monchengladbach, Germany
Dr Rajkshore Nayak	School of Fashion & Textiles, RMIT University, Australia
Dr Emilia Visileanu	National Research and Development Institute for Textiles and leather, Bucharest, Romania

## SADRŽAJ

Reč urednika .....	3
Gordana Petrović, Snežana Urošević, Darjan Karabašević, Mladen Maksimović	
<b>STANJE I PERSPEKTIVE RAZVOJA TEKSTILNE INDUSTRIJE U SRBIJI .....</b>	<b>4</b>
Mina Paunović	
<b>STRATEGIJSKO UPRAVLJANJE MODNIM BRENDOM NA OSNOVU TEORIJE LIČNOSTI POTROŠAČA .....</b>	<b>9</b>
Dudás Tünde, Bogdanka Čurčić Tandi	
<b>UTICAJ TEKSTILNIH PROIZVODA U OČUVANJU ZDRAVLJA .....</b>	<b>19</b>
Silvana Zhezhova, Sanja Risteski, Vineta Srebrenkoska, Sonja Jordeva, Vanga D. Kuzmanoska	
<b>DEFINING THE TIME-LOSS IN PROCESS OF PRODUCTION MAN SHIRT .....</b>	<b>33</b>
Miodrag Đorđević, Viktorija Stanković	
<b>SILE ZATEZANJA PREĐE U FUNKCIJI DINAMIKE KRETANJA IGALA KOD RAVNO KULIRNIH MAŠINA .....</b>	<b>38</b>
Maja Jankoska, Goran Demboski	
<b>INFLUENCE OF FABRIC STRUCTURE AND FINISHING ON WOVEN FABRICS TEARING STRENGTH AND ABRASION .....</b>	<b>42</b>
Subrata Das, Indhumathi V., Indupriya M, Rajeev, K.	
<b>BIO-POLISHING OF COTTON/BAMBOO KNITTED FABRIC .....</b>	<b>49</b>
Vesti.....	55
Vesti iz sveta .....	61
Tržište tekstila .....	68
Uputstvo autorima .....	88



**President of the Publishing Council:** Stanko Kiš, dip.ing.

**Editorial Council:** Snežana Urošević, Ph.D., Dragan Đorđević, Ph.D.

Ana Jelić-Aksentijević, Ph.D., Danijela Paunović, Goran Savanović, Ph.D., dipl.ing, Gordana Čolović, Ph.D.

**Editor in Chief:** Snežana Urošević, Ph.D

**Translation:** Bojana Pejčić M.Sc.

**Technical Editor:** Aleksandar Sokolović, ing.

**Cover design:** Aleksandar Sokolović, ing.

## EDITORIAL BOARD:

Ana Jelić-Aksentijević Ph.D.	DTM, Belgrade
Biljana Pejčić Ph.D.	DTM, Belgrade
Biljana Popović, Ph.D.	DTM, Belgrade
Branislava Lazić, Ph.D.	DTM, Belgrade
Božidar Stavrić Ph.D.	Faculty of Technology and Metallurgy, Belgrade
Danijela Paunović Ph.D.	DTM, Belgrade
Dragan Đorđević Ph.D.	Faculty of Technology, Leskovac
Dušan Trajković Ph.D.	Faculty of Technology, Leskovac
Gordana Čolović Ph.D.	DTM, Belgrade
Gordana Kokeza Ph.D.	Faculty of Technology and Metallurgy, Belgrade
Ineta Nemeš Ph.D.	Technical Faculty „Mihajlo Pupin“ Zrenjanin
Jovan Stepanović Ph.D.	Faculty of Technology, Leskovac
Koviljka Asanović Ph.D.	Faculty of Technology and Metallurgy, Belgrade
Nada Štrbac Ph.D.	Technical Faculty, Bor
Nemanja Kašiković Ph.D.	Faculty of Technical Sciences, Novi Sad
Slobodan Pokrajac Ph.D.	Faculty of Mechanical Engineering, Belgrade
Snežana Urošević Ph.D.	Technical Faculty, Bor
Suzana Đorđević Ph.D.	Technological artistic college, Leskovac
Herbert Kranjc	Pančevo
Katarina Nikolić Mr	DTM, Belgrade
Marina Kocareva	
Ranisavljev Mr	DTM, Belgrade
Mirjana Reljić Ph.D.	Institut CIS Srbije, Belgrade
Zvonimir Paunović	School for design textile, Belgrade
Jelena Lazarević	School for design textile, Belgrade
Bruno Završnik Ph.D.	Faculty of Economics and Business, Maribor
Goran Demboski Ph.D.	Faculty of Technology and Metallurgy, Skoplje
Isak Karabegović Ph.D.	Tehnički fakultet, Bihac
Svjetlana Janjić Ph.D.	Technical Faculty, Banja Luka
Simona Jevšnik Ph.D.	Technical Faculty, Banja Luka
Sorak Miloš, Ph.D.	Technical Faculty, Banja Luka
Mr Sanja Risteski	Štip, Makedonija
Mr Almina Duraković	Faculty of Design, Trzin, Slovenia
Damjana Celcar Ph.D.	Faculty of Design, Trzin, Slovenia
Zoran Stjepanović Ph.D.	Faculty of Mechanical Engineering, Maribor
Liliana Indrie Ph.D.	Faculty of Energy Engineering and Industrial Management, University of Oradea, Romania
Zlatina Kazlacheva Ph.D.	Faculty of Technics and Technologies, Trakia University, Bulgaria
Elsayed Elnashar Ph.D.	Faculty of Specific Education, Kafrelsheikh University, Egypt
Lubos Hes Ph.D.	Faculty of Textiles, Technical University of Liberec, Czech Republic
Rajiv Padhye Ph.D.	Centre for Advanced Materials and Performance Textiles, RMIT Fashion and Textiles, RMIT University, Australia
Boris Mahltig Ph.D.	Hochschule Niederrhein, Faculty of Textile and Clothing Technology Monchengladbach, Germany
Rajkishore Nayak Ph.D.	School of Fashion & Textiles, RMIT University, Australia
Emilia Visileanu Ph.D.	Nacional Research and Development Insitute for Textiles and leather, Bucharest, Romania

## CONTENT

Editorial Council .....	3
Gordana Petrović, Snežana Urošević, Darjan Karabašević, Mlađan Maksimović	
<b>STATE AND PERSPECTIVES OF DEVELOPMENT OF TEXTILE INDUSTRY IN SERBIA</b> .....	4
Mina Paunović	
<b>STRATEGIC MANAGEMENT OF FASHION BRANDS ON THE BASIS OF THEORY OF PERSONALITY CONSUMER</b> .....	9
Dudás Tünde, Bogdanka Čurčić Tandi	
<b>THE ROLE OF TEXTILES IN HEALTH PRESERVATION</b> .....	19
Silvana Zhezhova, Sanja Risteski, Vineta Srebrenkoska, Sonja Jordeva, Vanga D. Kuzmanoska	
<b>DEFINING THE TIME-LOSS IN PROCESS OF PRODUCTION MAN SHIRT</b> .....	33
Miodrag Đorđević, Viktorija Stanković	
<b>YARN TENSION FORCES IN THE FUNCTION OF NEEDLES MOVEMENT DYNAMICS IN FLAT WEFTING MACHINES</b> .....	38
Maja Jankoska, Goran Demboski	
<b>INFLUENCE OF FABRIC STRUCTURE AND FINISHING ON WOVEN FABRICS TEARING STRENGTH AND ABRASION</b> .....	42
Subrata Das, Indhumathi V., Indupriya M., Rajeev, K.	
<b>BIO-POLISHING OF COTTON/BAMBOO KNITTED FABRIC</b> .....	49
News and information .....	55
World news .....	61
Textile market .....	68
Instructions for Autors .....	88
THE FINANCING OF THE JOURNAL PARTICIPATION IN THE MINISTRY OF EDUCATION, SCIENCE AND TEHNOLOGICAL DEVELOPMENT	

# DEFINING THE TIME-LOSS IN THE PROCESS OF PRODUCING A MEN'S SHIRT

Silvana Zhezova<sup>1</sup>, Vineta Srebrenkoska<sup>1</sup>, Sonja Jordeva<sup>1</sup>,  
Vanga D. Kuzmanoska<sup>1</sup>, Sanja Risteski<sup>1</sup>

<sup>1</sup>University "Goce Delčev", Štip, Faculty of Technology,  
Miro Baraga bb., Probištip, R. Macedonia, e-mail: silvana.zezova@ugd.edu.mk

Naučni rad

UDK: 687.241: 65.015.13

**Abstract:** *The main goal of every apparel manufacturing company is to create production without losses, because that is the only way to be competitive on the global market. During the last decade, the clothing manufacturing companies have faced high competition from the low labor force countries, as well as constant increase of production costs. The main role of the quality control is constantly monitoring of the production process and detecting the defects and the reasons for their appearance. By detecting the reasons for defects occurrence, it is possible to take the appropriate corrective measures. In this paper we are testing a model of cotton men's shirt with long sleeves and by the method "PBD-picture of business day" the time-losses for four selected sewing operation have been determined. On the basis of the obtained results it can be concluded that the greatest time losses during the day time are found in the operation of hemming and sewing the pocket to the front part stitched on the ordinary machine.*

**Keywords:** shirt, sewing, production, time-loss.

## DEFINISANJE VREMENSKIH GUBITAKA U PROCESU PROIZVODNJE MUŠKE KOŠULJE

**Apstrakt:** *Glavni cilj svake tekstilne kompanije je da stvori proizvodnju bez gubitaka, jer je to jedini način da bude konkurentna na globalnom tržištu. Tokom poslednje decenije, fabrike tekstila suočavaju se sa velikom konkurencijom iz zemalja gde je radna snaga jeftina, kao i sa stalnim porastom troškova proizvodnje. Glavna uloga kontrole kvaliteta jeste stalno praćenje proizvodnog procesa i otkrivanje nedostataka i razloga za njihovo pojavljivanje. Uz otkrivanje pravih razloga za pojavu nedostataka moguće je preduzeti odgovarajuće korektivne mere. U ovom radu uzet je model pamučne muške košulje sa dugim rukavima i metodom „PBD – slika radnog dana“ utvrđeni su vremenski gubici za četiri odabrane operacije šivenja. Na osnovu dobijenih rezultata može se zaključiti da se najveći vremenski gubici u danu javljaju u operaciji porublivanja i šivenja prednjeg džepa na običnoj mašini.*

**Ključne reči:** košulja, šivenje, proizvodnja, gubitak vremena.

### 1. INTRODUCTION

The apparel companies are often faced with requests for manufacturing small work orders and various articles. That leads to a more flexible system of work, good knowledge of the technological process of manufacturing clothing units, a degree of qualification and expertise from the operators and correct distributing of the manufacturing line from them [1]. It is of great importance for the technologists to be

familiar with the tools in the technology process, like machines, devices and tools, transporting devices etc. The ever-increasing amortization requires good knowledge of their possibilities, ways for problem solving and the developing trends. Technical preparation of the clothes is the basis of the sewing manufacturing. It contains constructive, technological and operational preparation. The primary goal of the technological preparation is to create a technological analysis for manufacturing clothes, a study of labor

and time, creating plans of the technological process, as well as rationalization and simplifying of the work [2, 3].

The development of each object is performed by a sequence of operations [4]. The technology for clothes production investigate the working assets (machines), materials for garments production, as a flow of the clothing unit through the technological process [5]. The technology for clothes production belongs to the mechanical technology as the technology of spinning, weaving and knitting.

According to the main stages of production the technology for clothes production are divided into:

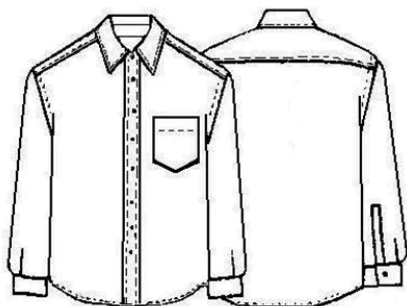
- Technical preparation
- Technological process of clothing production.

The aim of the technical preparation is to explore the possibilities of production, characteristics and supply of basic and auxiliary materials that affect the quality of work. Planning is an essential function of management. The work of each department in a production unit must be coordinated if work is to flow smoothly, and the master schedule provides the means to do this [6]. Load and capacity planning require the planner to quantify two variables - the load and the capacity - and from them to determine the time requirements for manufacture. The time required and the delivery dates required by the customer must both be satisfied [6,7]. For this purpose it is necessary to make a plan of operations for the manufacture of a given type of clothing.

In this paper has been presented a model of man shirt, his description and four specific operations were selected for recording losses of time.

**Formulating problem**

The man shirt is made of 100% cotton with classic pattern with one pocket on the left side, eight buttons, and long sleeves that end with slit (figure 1). The time for shirt production on a different type of machines and data processing for sewing of the analyzed model are given in table 1 and table 2. The plan of



**Figure 1.** Model of men's shirt

technological operations requires 15 workers and time of 8 working hours per day.

**Table 1.** Time of sewing on different types of machines

No.	Sewing	Time (min)
1.	Time of sewing on ordinary sewing machine	12,3
2.	Time of sewing on a special sewing machine	1,29
3.	Time of sewing on the sewing automate	3,10
4.	Time for handwork	3,50
5.	Total time of sewing	20,19

**Table 2.** Data processing for making the list for sewing men's shirt

Daily capacity based on 15 workers and 8 hours	356,61 units
Daily working time	480 minutes
Savvy Group	1,35 minutes
Daily capacity per worker	23,77 units
Number of ordinary sewing machine	9,13 machine
Number of special sewing machine	0,96 machine
Number of sewing machine ATM	2,30 machine
Number of assets for handwork	2,60 machine

From the list of technological operations are selected four operations that are given below:

1. Sewing a plate to the rear part;
2. Hemming and sewing the pocket to the front part;
3. Sewing the sleeves and
4. Assembling the front and rear parts.

Determination of loss of time is performed using the method "PBD-picture of business day", with chronometer. Any disturbance of the working process is recorded, and the time measured with the chronometer as an element is inserted in the recording sheet for the time losses. Time losses are grouped into several groups, eg. non-work for lack of (electricity, material, tools, etc.), due to various queues, machine defects, indiscipline of the operators, etc. In the following tables (3-6) are presented time and percentage of losses for the selected technological operations.



**Table 3.** Time losses and percentage of loss for sewing a plate to the rear part

	Cause of losses	Time loss (s)				Average	Percent of loss %
		day I	day II	day III	day IV		
1	Preparing for work	300	210	260	330	275	15,8
2	Tearing of the thread	99	110	98	105	103	5,9
3	Changing the needle	-	100	-	-	25	1,5
4	Talking with colleagues	600	350	140	200	322,5	18,5
5	Changing thread in shuttle	150	130	120	135	133,75	7,7
6	Making phone calls	-	700	-	300	250	14,4
7	Problems with machine	-	800	620	-	355	20,3
8	Not at working position	250	360	300	200	277,5	15,9
	Total (sec)	1399	2760	1538	1270	1741,75	100
	Total (minutes)	23	46	26	21		
	%	3,3	6,6	3,7	3		<b>4,15</b>

**Table 4.** Time loss and percentage of loss for hemming and sewing the pocket to the front part

	Cause of losses	Time loss (s)				Average	Percent of loss %
		day I	day II	day III	day IV		
1	Preparing for work	500	-	350	400	312,5	13,1
2	Tearing of the thread	160	98	-	84	85,5	3,5
3	Changing the needle	-	-	-	110	27,5	1,5
4	Talking with colleagues	500	490	530	620	535	22,3
5	Changing thread in shuttle	270	330	370	300	317,5	13,2
6	Making phone calls	400	-	-	-	100	4,2
7	Problems with machine	800	-	-	1400	550	23
8	Not at working position	300	-	270	150	180	7,5
9.	Waiting for work	230	320	270	310	282,5	11,8
		3160	1238	1790	3374	2390,5	100
	Min	53	21	30	56		
	%	7,6	3	4,3	8		<b>5,7</b>

**Table 5.** Time loss and percentage of loss for sewing the sleeves

	Cause of losses	Time loss (s)				Average	Percent of loss %
		day I	day II	day III	day IV		
1	Preparing for work	-	450	-	300	187,5	10,9
2	Tearing of the thread	400	290	300	240	307,5	17,9
3	Changing the needle	-	-	-	-	0	0
4	Talking with colleagues	300	500	250	-	262,5	15,3
5	Changing thread in shuttle	250	400	320	300	317,5	18,6
6	Making phone calls	180	60	-	-	60	3,5
7	Problems with machine	-	-	-	360	90	5,3
8	Not at working position	130	-	-	70	50	2,9
9	Waiting for work	450	1000	300	-	437,5	25,6
		1710	2700	1170	1270	1712,5	100
	Min	28	45	19	21		
	%	4	6,4	2,7	3		<b>4,03</b>

**Table 6.** Time loss and percentage of loss for assembling the front and rear parts

	Cause of losses	Time loss (s)				Average	Percent of loss %
		day I	day II	day III	day IV		
1	Preparing for work	370	200	150	250	242,5	11,8
2	Tearing of the thread	-	120	-	-	30	1,5
3	Changing the needle	130	150	-	-	70	3,4
4	Talking with colleagues	300	493	620	650	515,75	25,1
5	Changing thread in shuttle	270	300	250	350	292,5	14,3
6	Making phone calls	100	-	-	-	25	1,2
7	Problems with machine	-	-	-	1000	250	12,2
8	Not at working position	400	-	-	-	100	4,9
9	Waiting for work	-	-	530	170	175	8,5
10	Collecting finished units	650	-	320	430	350	17,1
		2220	1263	1870	2850	2050,75	100
	Min	37	21	31	47		
	%	5,3	3	4,4	6,7		<b>4,85</b>

According to the results presented in the tables 3-6, for time loss and the percentage of loss for different types of operations, it can be concluded that the most important causes that influence on percentage of time loss is the way of working (preparation for work, talking with colleagues, waiting for work, not at work position). Talking between the operators during the production process participate with high percentage of time loss (Table 3-6) - 18,5 %; 22,3%; 15,3%; 25,1% respectively. In general, preparing for work and talking with colleagues are the operations with the higher time loss. With a better way of working, the total time loss can be significantly reduced. The management of the company should find a way to eliminate the high percentage of time loss as a result of talking with colleagues during the production process. The total time loss for four specific operations that were selected for recording are shown in Table 7. The greatest time loss are found in the operation hemming and sewing the pocket to the front part stitched on ordinary machine with 5,7 % of loss.

**Table 7.** Time loss for different operations, and percentage of loss for different types of operations.

Operations (loss of time)	Working unit	Applied machine	Time (sec.)	Percentage of loss (%)
Sewing a plate to the rear part	Sewing unit	Ordinary machine	1741,75	4,15
Hemming and sewing the pocket to the front part;	Sewing unit	Ordinary machine	2390,5	5,7
Sewing the sleeve	Sewing unit	Special machine	1712,5	4,03
Assembling the front and rear parts	Sewing unit	Special machine	2050,75	4,85

## CONCLUSION

The total time for sewing the presented model of a men's shirt on different type of machines is 20,19 min. Daily capacity of the production unit is 356,61 apparel units and daily working time is 480 min with rhythm group of 1,35 min. On the basis of the obtained results it can be concluded that the greatest time loss in terms of day-time are found in the operation hemming and sewing the pocket to the front part stitched

on ordinary machine with 5,7 % of loss, and the smallest time loss are found in operation sewing the sleeve on special machine with 4,03 % of loss.

## REFERENCES

- [1] Cooklin G., Hayes S. G., McLoughlin J., Introduction To Clothing Manufacture, Blackwell Publishing Ltd, (2006) pp 85 – 99.
- [2] Mehta P. V., Bhardwaj S. K., Managing quality in the apparel industry, Nacional institute of fashion technology, (1998), pp 235- 243.
- [3] Hergeth H., Target costing in the textile complex, Journal of Textile and Apparel, Technology and Management, 2, 4, 1-9 (2002).
- [4] Alison C., A brief history of sewing machines. <http://EzineArticles.com/73917> Accessed: (February 2017).
- [5] Coffin D. P., Shirtmaking: Developing Skills for Fine Sewing. The Taunton Press, Inc. Printed in USA. (1998).
- [6] Jacobs-Blecha C., . Ammons J.C, Schutte A., Smith T., Cut order planning for apparel manufacturing, IIE Transactions, Springer 30, 1(1998) pp 79-90.
- [7] Wallace T.F., Stahl R. A., Master scheduling in the 21st century: for simplicity, speed, and success, T.F. Wallace & Company, USA, (2003) pp 85-98.

Rad primljen: 24.02.2017

Rad prihvaćen: 3.05.2017.