How to Cite
Doniyor, P., & Khabibulla, P. (2021). Applied research of tensile strength of the paired yarns during the assembly winding process. *International Journal of Engineering & Computer Science*, *4*(1), 7-18. https://doi.org/10.31295/ijecs.v4n1.1761

Applied Research of Tensile Strength of the Paired Yarns during the Assembly Winding Process

Parpiev Doniyor
Ph.D., Department of Technology of products of textile industry, Namangan Institute of Engineering and Technology, 160115, Namangan, Uzbekistan
Corresponding author email: parpiev_doniyor@mail.ru

Parpiev Khabibulla
Associate Professor, Department of Technology of products of textile industry, Namangan Institute of Engineering and Technology, 160115, Namangan, Uzbekistan
Email: parhabib@mail.ru

Abstract---*The article deals with the practical process of measuring the tensile strength of yarn on wrapping machines, the technological process of adding and wrapping yarns in preparation for twisting, the implementation of these processes, wrapping machines used in textile enterprises for the production of modern twisted yarn. During the experiments, the tension of yarns of several linear densities was tested. Also identified weight loads during the additional wrapping process in the preparation of terry and ground warp yarns for weaving processes.*
Keywords---*linear density, package, roller, spool, strength, tension, winding, yarn.*

Introduction

To produce a smooth and high-quality, defined yarn that meets the applicable standards, it is very important that the yarns being added at the same tension. The main step in preparing individual yarns for twisting is the process of assembly winding these individual yarns in pairs. In this process, there is an attempt to equalize the tension of two or more individual yarns, ie $P_1=P_2=$ .... $=P_n=const$, on the other hand, this process is to harmonize the values of the paired individual yarns as much as possible both in terms of linear densities (T_{yarn}) and their stiffness (R_{yarn}). The technological processes of assembling and winding yarns in preparation for twisting are now mainly performed on assembly winding machines. The implementation of these processes is carried out in winding machines in the textile industry, which is designed to produce almost all modern assorted yarns.

As mentioned above, one of the main tasks of the yarn preparation process is to achieve uniform tension of individual yarns (Chapman, 1971; Kärrholm et al., 1955). An analysis of the literature shows that very little research has been done to analyze the tension of individual and paired yarns. Theoretically, reducing the tension variance of individual yarns should lead to positive results in all cases. However, the experimental study of yarn tension in new modern yarn preparing machines for twisting designed to produce high-speed yarns and a wide range of yarns may provide an opportunity to test the adequacy of many theoretical views on the subject (Tozhimirzaev et al., 2020; Parpiyev & Meliboyev, 2020). In classical literature, yarns obtained by pairing two or more individual yarns at the same tension in a winding machine are referred to as combined yarns (Meliboev & Parpiev, 2020; Meliboev et al., 2020). Most assembly winding machines are equipped with a specially designed yarn tensioner at the same distance from the additional yarn conductor, in which two or three individual yarns are joined at the same tension and the added yarns are rolled in a cylindrical form (Meliboev et al., 2020; Parpiev & Meliboev, 2020).

Material and Methods

The applied research was carried out on the current production modes of SSM TW2-D assembly winding machines in the preparation department of “ART Soft Holding” LLC in Namangan, Uzbekistan. In this study, we used a special strain gauge, an analogue-to-digital converter (hx711), and an electrical device with an Arduino 2560 platform to study the tensile strength of individual strands in practice (Christ et al., 2018; Saura & Torne, 2009). The strain gauges were mounted at an angle α to the horizontal axis between the tensioning device and the yarn conductor connecting the individual yarns (Figure 1). Experimental research was carried out at “RARFEN” LLC in Namangan on the assembling and winding of yarns for warp yarns of terry towels, which are made in a ring-spun yarn in T_{yarn} = 29.4 tex linear density.

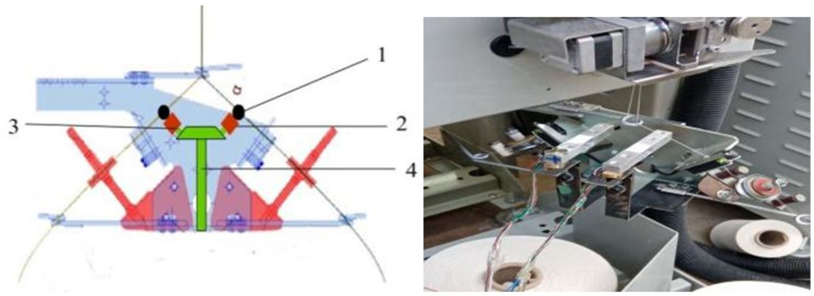

Figure 1. A strain gauge mounted on a tension control device 1- friction-reducing roller, the 2- strain gauge, 3-device for fastening the strain gage to the ground, 4- a base attached to a tension control device and serving as a base for the strain gage

Taking into account the fact that for the first time in the practical measurement of yarn tension in assembly-winding machines, the following information is provided: the structure, operation, and results of an electrical device consisting of a special strain gauge, analogue-to-digital converter (hx711) and Arduino 2560 platform. A strain gauge (Figure 2) is a device that measures the tension of yarn based on the electricity through deformation (Korabayev et al., 2018; Ahmadjanovich et al., 2020; Turdialiyevich & Khabibulla, 2020; Tozhimirzaev et al., 2020). This sensor can operate with an error of 0.03 - 0.25% and can detect voltage forces up to a maximum of 1000 Newtons. The device operates at a voltage of 3-12 volts in the operating mode. With a rated output voltage of 1-1.5mV, it can operate at outdoor temperatures of -200 and +600 degrees Celsius.

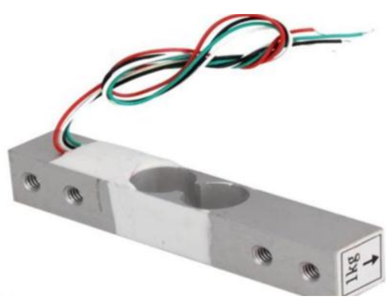

Figure 2. General view of the strain gauge

A detailed description of the sensor can be seen in Table 1.

Table 1
General characteristics of the strain gage

No	Characteristics	Dimensions
1	Nominal load capacity	1000 N
2	Operating voltage	3~12 VDC
3	Maximum operating voltage	15 VDC
4	Nominal output	1,0±0,15 mV/V

5	Fixed output error	0,03% F.S
6	Delay	0,03% F.S
7	Repetition	0,03% F.S
8	The effect of output on temperature	0,01% F.S/C
9	Output impedance	1000±10% Om
10	Input impedance	1115±10% Om
11	Insulation resistance	1000 Om
12	Degree of overload resistance	1,5 kg
13	Constant operating temperature	-200 and + 60 ℃
14	Dimensions	12,7x12,7x80 mm

Analogue signals from the strain gauge are converted using the hx711 analogue-to-digital converter. The strain gauge direct-connection module is equipped with a hx711 - 24-bit signal amplifier manufactured by “Avia semiconductor”. The input multiplexer is equipped with a low-noise programmable chip (based on PGA technology). When channel A of the module is connected to a 5V AVDD analogue power supply, it can amplify the signal 128 or 64 times (using programming), corresponding to a full-scale differential input voltage of ± 20mV or ± 40mV, respectively. The ADC power supply regulator of the hx411 module, which is capable of amplifying the channel signals of the module 32 times, does not require the participation of an external power regulator to provide analogue power to the sensor and does not require programming for internal registers (Amirante et al., 2006; Pan et al., 2011). For all control processes of the hx711, the signals are made through special pins in it (Figure 3 and Figure 4).

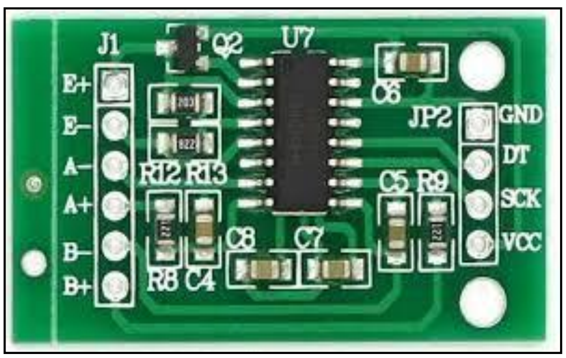

Figure 3. Overview of HX711 module

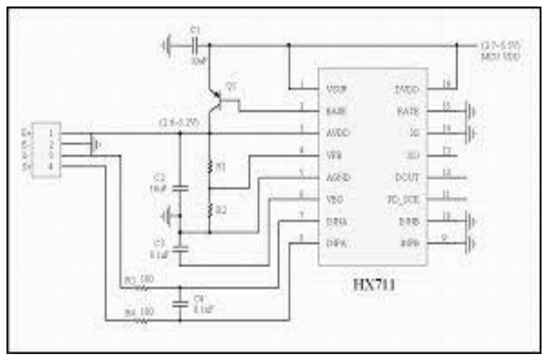

Figure 4. Schematic diagram of the HX711 module

Module characteristics of the module:

- There are two user-selectable differential input channels;
- Ability to amplify the input signal 128, 64 and 32 times, depending on the task in programming;
- the ability to connect the power supply regulator on the chip to the ADC analogue power supply of the strain gauge;
- Simple digital control and serial interface
- Ability to provide selected 10SPS or 80SPS output speed;
- Ability to filter 50 and 60 GHz power at the same time;
- Power supply regulator: normal operation <1.5mA, power drop <1mA;
- Operating voltage range: 2.6 ~ 5.5V;
- Operating temperature range: -40 ~ + 85 ℃;
- Set of 16 pin SOP-16

When using an internal analogue supply regulator, the output voltage of the regulator depends on the external transistor used. The output voltage is VAVDD = VBG * (R_1 + R_2) / R_1 and 100 mV is required below the VSUP voltage to keep this voltage to a minimum. If the analogue supply regulator in the transient module is not used in the study, the VSUP pin can be connected to the AVDD or DVDD, depending on which voltage is higher (Vasarhelyi & Ván, 2006; Demczyk et al., 2002). But in these cases, the VFB pin must be connected to phase zero and this pin becomes BASE NC. In this study, we determined the tensile strength of the yarns by connecting a strain gauge and an analogue-digital converter to the Arduino Uno platform as a system.

Arduino is a convenient platform for the fast creation of electronic constructors and electronic devices. The reason for the widespread use of this platform in the world is the convenience and simplicity of the programming language, as well as the openness of the architecture and programming code (Parpiev & Meliboev, 2020; Parpiev & Meliboev, 2020; Korabayev et al., 2018). The Arduino board consists of AtmelAVR microcontrollers and elements of programming and connection to other circuits. Most boards have a linear voltage stabilizer of + 5V or + 3.3V (Figure 5).

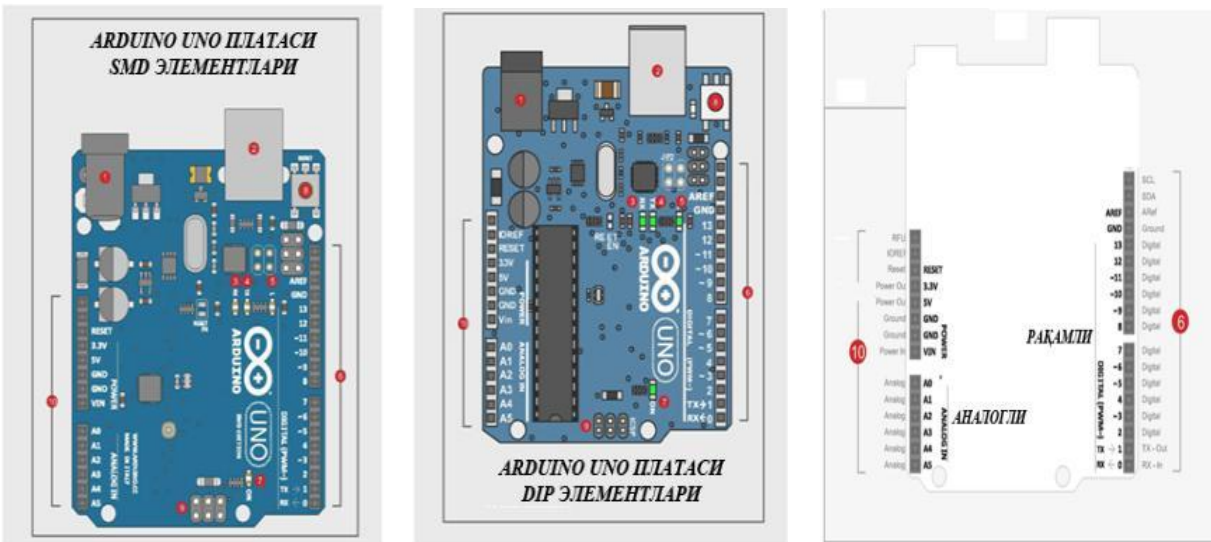

Figure 5. View of the Arduino Uno platform

- The source battery can be used with 9–12 Volt source blocks.
- USB connector (USB port) - the circuit can be used as a source, but can also be used to communicate with a computer.
- Indicator (RX: Receipt) - Used to indicate the reception of information, if specified in the program.
- Indicator (TX: Transmission) - Used to indicate the transmission of information, if specified in the program.
- Indicator (port 13: troubleshooting) - Indicates that everything is working properly when the sketch is running.
- Ports (ARef, Ground, Digital, Rx, Tx) - base voltage, ground, digital ports, data transmission, and reception ports.
- Indicator (source indicator) - Indicates that the Arduino board is supplied with a source.
- RESET - Resetting the Arduino board will cause your program to restart.
- IC SP connector (programming port) - allows programming without the involvement of the board loader.
- Ports (Analogue In, Power In, Ground, Power Out, Reset) - analogue (continuous), input, output, source, ground.

In some quartz versions, the refining process is performed using a ceramic resonator at a frequency of 16 or 8 MHz. The microcontroller is initially loaded with a Boot Loader, so no external programmer is needed. The device can be programmed via USB without using an external programmer. There are several versions of the Arduino platform available today. The Leonardo version is based on the AT mega 32 u 4 microcontrollers. Uno, Nano, Duemi - lanove versions are based on AtmelAT mega328 microcontrollers (Miller & Chinzei, 2002). Older versions of the Diecimila platform and the first working version of Duemilanoves were designed based on AtmelATmegal68. The ArduinoMega 2560 version is built on the ATmega2560 microcontroller. The latest version of ArduinoDue is based on the Cortex microprocessor. The UNO version (Figure 6) is the most widely used version, widely used for small projects. Each of the 14 digital legs of the chip can serve as an input or output. The voltage at the legs of the chip is limited to 5V (Abdalla et al., 2007; O'Brien, 1998).

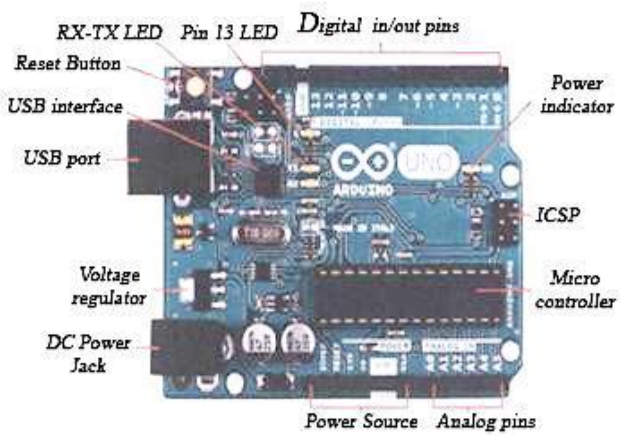

Figure 6. ArduinoUNO board

The maximum current or consumption of one foot is 40 mA. All legs are connected by an internal traction resistor (off by default) and its value is 20-50 k Om. In addition, some Arduino legs can perform the following additional functions:

Table 1
Indicators of Arduino UNO board

No.	Characteristics	Dimensions
1	Microcontroller	ATmega328
2	Operating voltage	5V
3	Source voltage (recommended)	7-12 V
4	Source voltage (limit)	6-20 V
5	Digital inputs / outputs	14 (they can be used as 6 KIM outputs)
6	Continuous outputs	6
7	Maximum current of one output	40 mA
8	The maximum output current of the output is 3.3 V.	50 mA
9	Flash memory	32 KB (ATmega328)
10	SRAM	2 KB (ATteda328)
11	EEPROM	1 KB (ATteda328)
12	Tactile frequency	16 MGs

- Serial interface: 0 (RX) and 1 (TX);
- External delay: legs 2 and 3;
- KIM: legs 3,5,6,9,10 and 11 - can output an 8-bit analogue value in the form of a KIM signal;
- SPI interface: 10 (SS), 11 (MOSI), 12 (MISO), 13 (SCK) legs;
- LED: 13. A built-in LED connected to the leg 13.

The Arduino Uno has 6 analogue inputs (A0-A5), each of which can represent a 10-bit number (1024 different values) in the form of an analogue voltage. The default voltage is measured in the range 0 to 5 V. However, the upper limit of this range can be changed using the AREF leg and the analogue Reference function.

Arduino Uno has recovery protection that protects the computer's USB port from short-circuits and overloads. Although most computers have their protection, the above system provides an additional level of protection. If more than 500 mA of current is discharged from the USB port, this storage system will start and automatically disconnect. To create a yarn tension study system using the parts whose structure and descriptions are given above, we connected the input and output pins of the devices according to the following scheme (Figure 6).

The data from the strain gauges are 5 times per second, or frequency can be n = 300 hertz. A serial port was used to enter the signal data received by the strain gauge and amplified accordingly. The basic settings for this port were performed as shown in Figure 7.

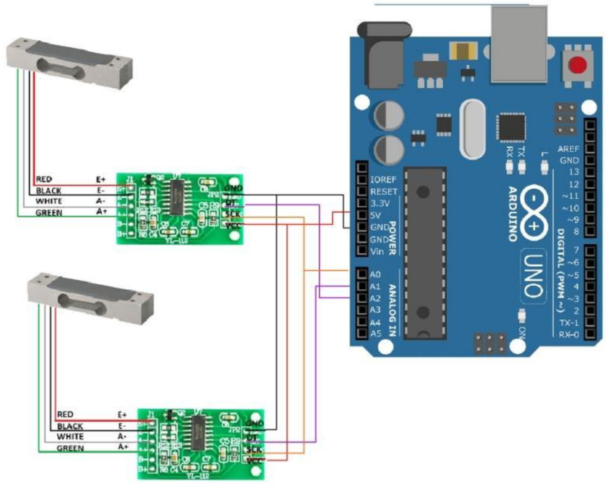

Figure 7. General schematic diagram of the measuring system

Results and Discussion

According to the plan of practical research, experiments were carried out by changing the initial tensile forces applied to the yarn in determining the tensile strength of individual yarns using a strain gauge. To do this, the initial tension of the load placed of the yarn was changed by placing the loads m_1 = 8.4 grams, m_2 = 14.3 grams and m_3 = 20.4 grams, attached to the tensioning device 2, shown in Figure 7. In the first variant, i.e. with a load of 8.5 grams on the tensioning device, the tensile strength of individual threads at intervals of 0.2 seconds for *t*=10 seconds was determined on separate sensors. The results of the experiment are given in Figure 8. When a load of 8.5 grams was applied to the tensioner, the tensile strength of the threads was determined for 10 seconds and the following graph was obtained (Figure 8).

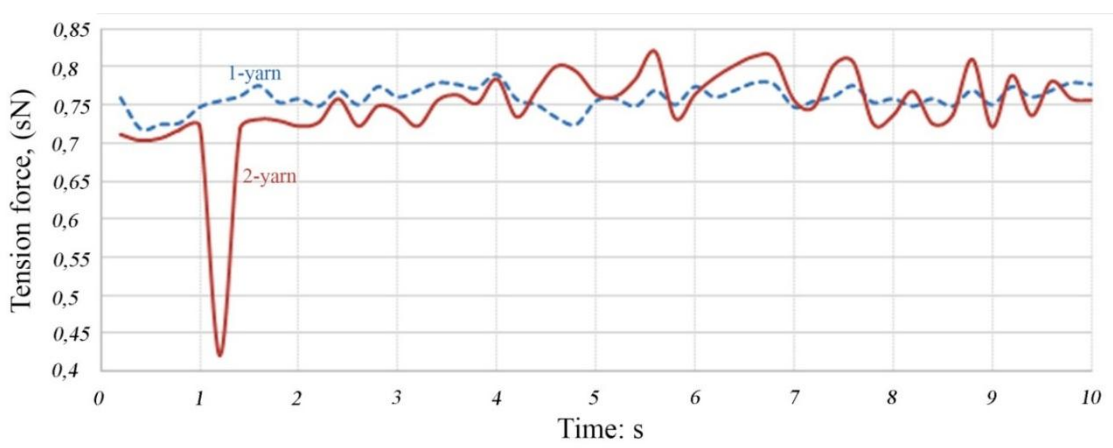

Figure 8. Graph of tensile strength of individual yarns at a load of 8.5 grams on a tensioner

We then changed the initial tension on the yarn and changed the weight of the washers to 14.3 g. and the yarn conductor device was reset to this setting (Tresanchez et al., 2010). The values of individual yarns detected in the strain gauge are given in Figure 9 below. In Figure 9, to determine the true law of variation of yarn tension, the initial tension value of the yarn was tested experimentally when a load of 20.4 g was applied to the tensioner, and the results are given in Figure 9:

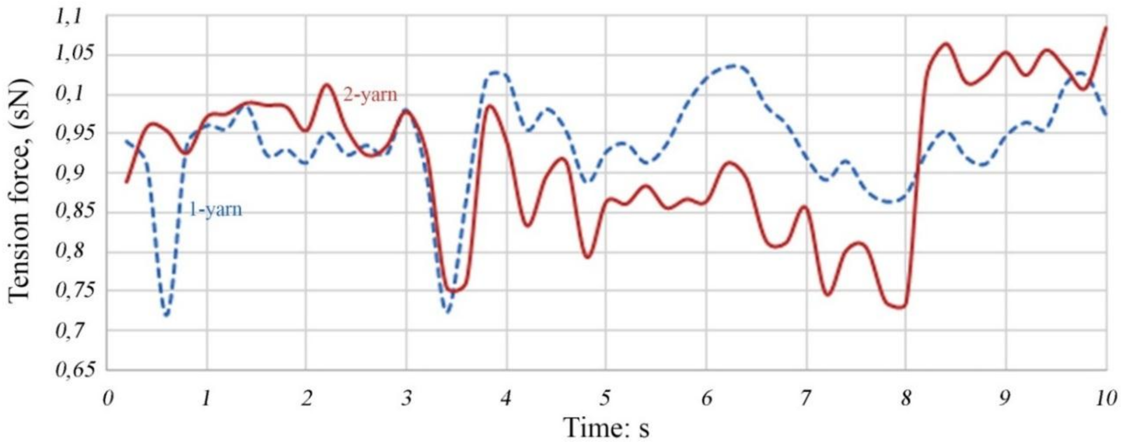

Figure 9. Graph of tensile strength of individual yarns at a load of 14.3 grams on a tensioner

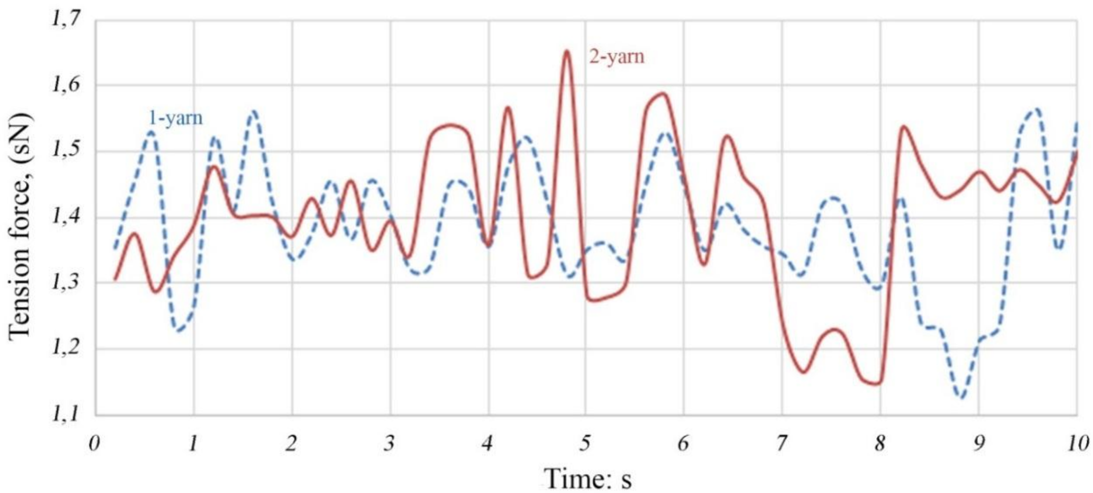

Figure 10. Graph of tensile strength of individual yarns at a load of 20.4 grams on a tensioner

According to the plan of practical research, experiments were carried out by changing the initial tensile forces applied to the yarn in determining the tensile strength of individual yarns using a strain gauge. To do this, the initial tension of the load placed of the yarn was changed by placing the loads m_1 = 8.4 grams, m_2 = 14.3 grams and m_3 = 20.4 grams, attached to the tensioning device 2, shown in Figure 10.

In the second option, i.e. with a load of 8.5 grams on the tensioner, for t = 20 seconds at intervals of 0.2 seconds, for a wrap T_{yarn} = 25 tex linear density yarn of soft terry towel spun at the Art Soft Holding the tensile strength of the individual yarns obtained in the rotor spinning machine was determined in separate sensors. The results of the experiment are given in Figure 11. When a load of 8.5 grams was placed on the tensioner, the tensile strength of the yarns was determined for 20 seconds and a graph was obtained (Zambrano et al., 2017).

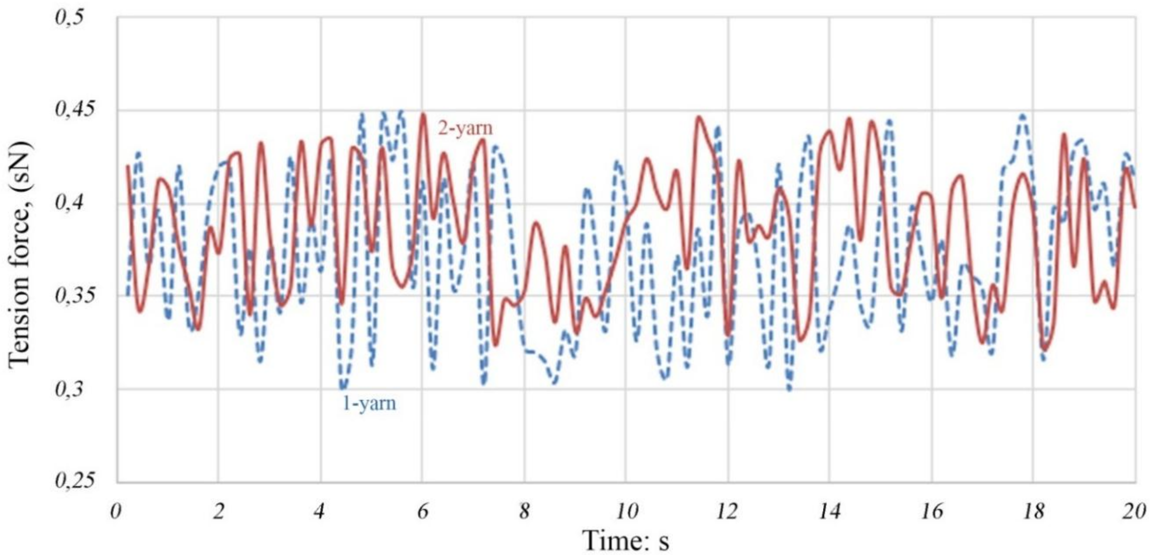

Figure 11. Graph of tensile strength of individual yarns at a load of 8.5 grams on a tensioner

We then changed the initial tension on the yarn and changed the weight of the washers to 14.1 grams, and the yarn conductor device was re-adjusted at this parameter. The values of individual yarns detected in the strain gauge are given in Figure 12 below. When a load of 14.1 grams was applied to the tensioner, the tensile strength of the threads was determined for 20 seconds and a graph was obtained.

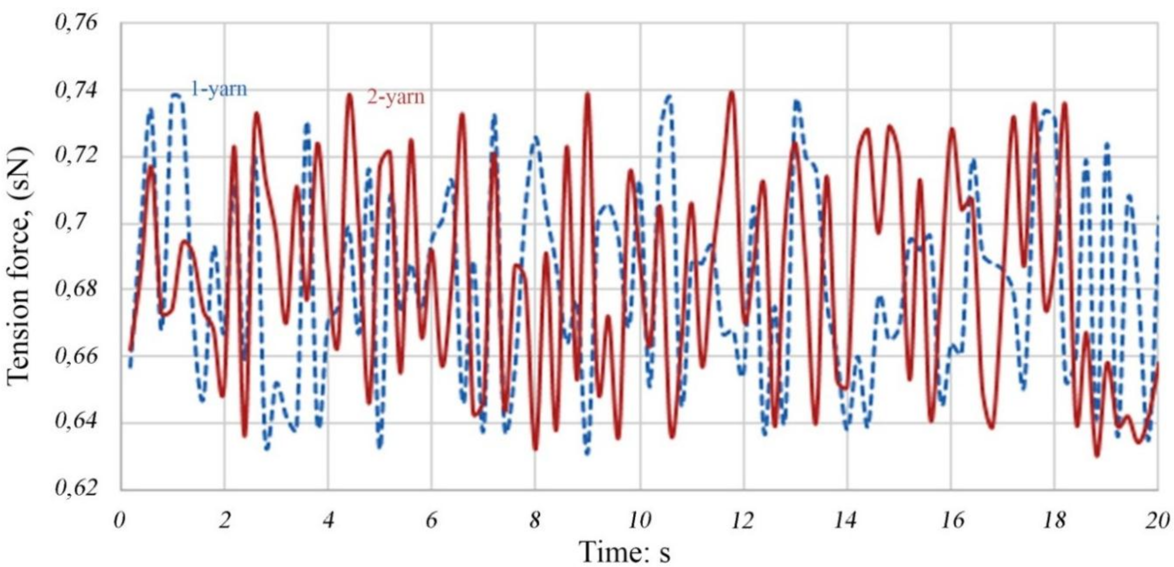

Figure 12. Graph of tensile strength of individual yarns at a load of 14.1 grams on a tensioner

To determine the true law of changes in the tension of the yarn, the state of the initial tension value of the yarn at a load of 20.4 grams on the tensioning device was studied experimentally, the results are given in Figure 13. When a load of 20.4 grams was applied to the tensioner, the tensile strength of the threads was determined for 20 seconds and a graph was obtained.

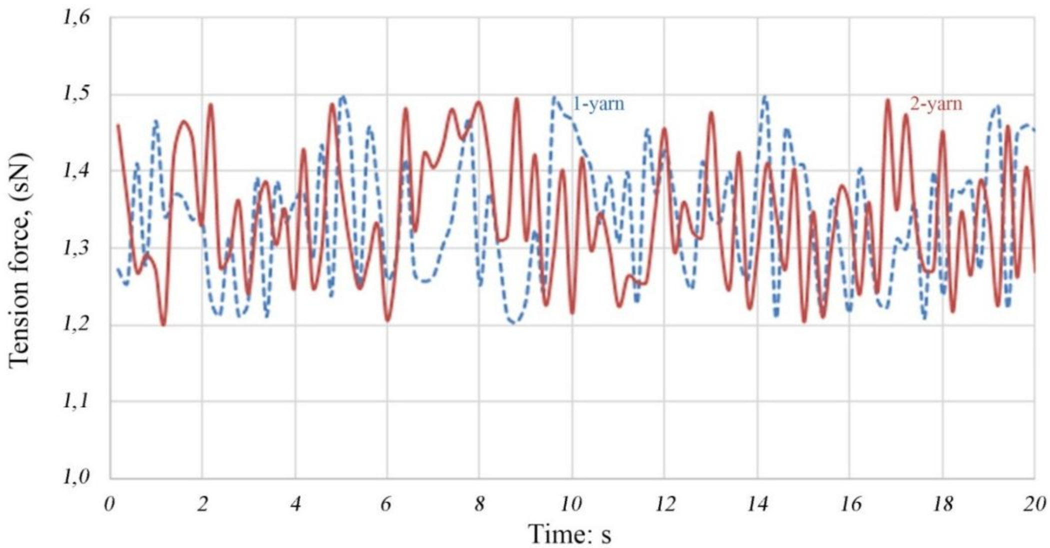

Figure 13. Graph of tensile strength of individual yarns at a load of 20.4 grams on a tensioner

In the second option, i.e. with a load of 8.5 grams on the tensioner, for t = 20 seconds at intervals of 0.2 seconds, for a ground wrap T_{yarn} = 29.4 tex linear density yarn of terry soft towel spun at the Art Soft Holding the tensile strength of the individual yarns obtained in the rotor spinning machine was determined in separate sensors. The results of the experiment are given in Figure 14. When a load of 8.5 grams was placed on the tensioner, the tensile strength of the yarns was determined for 20 seconds and a graph was obtained.

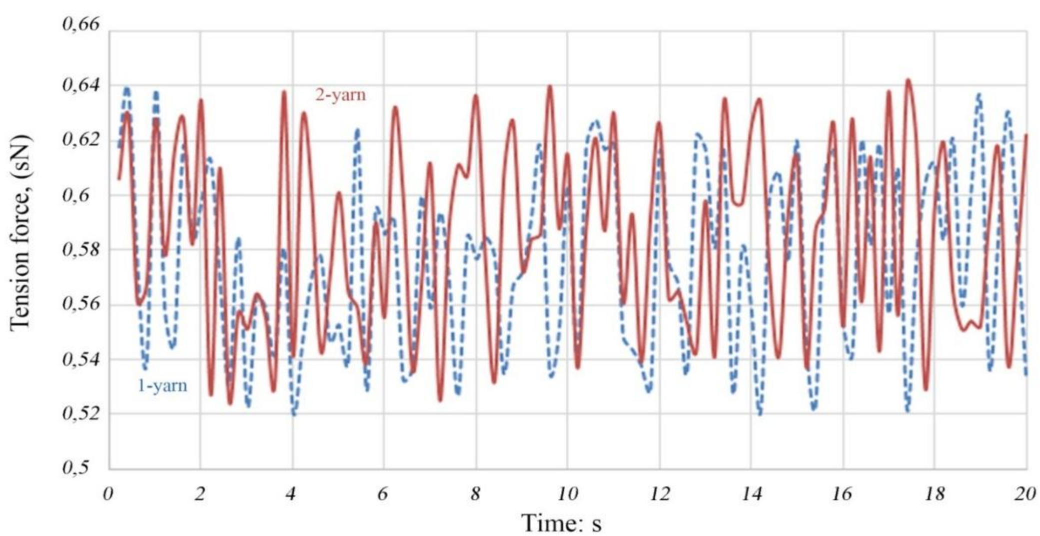

Figure 14. Graph of tensile strength of individual yarns at a load of 8.5 grams on a tensioner

We then changed the initial tension on the yarn and changed the weight of the washers to 14.1 g. and the yarn conductor device was reset to this setting. The values of individual yarns detected in the strain gauge are given in Figure 15. When a load of 14.1 grams was applied to the tensioner, the tensile strength of the threads was determined for 20 seconds and a graph was obtained. In Figure 15, to determine the true law of variation of yarn tension, the position of the initial tension value of yarn under the load of 20.4 g on the tensioning device was studied experimentally, the results of which are given in Figure 16.

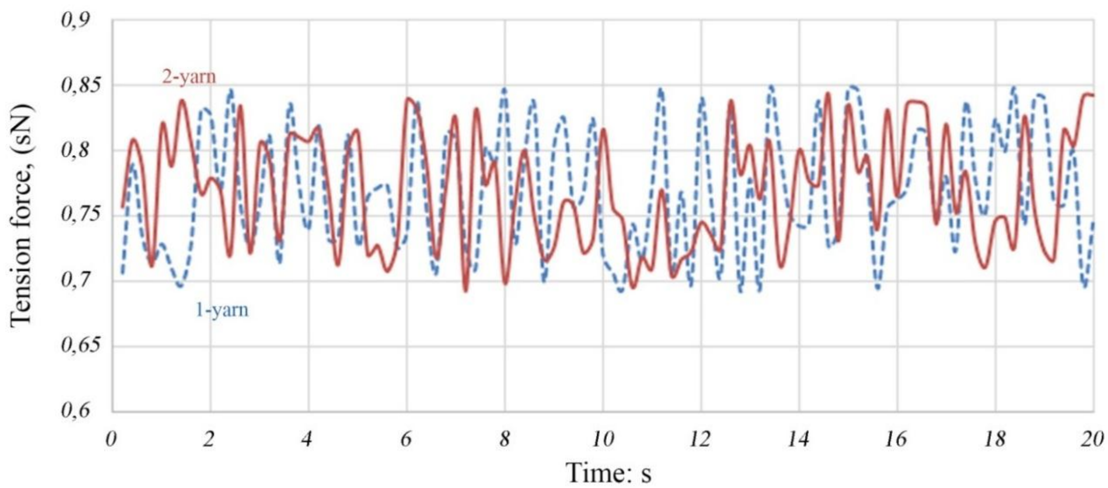

Figure 15. Graph of tensile strength of individual yarns at a load of 14.1 grams on a tensioner

When a load of 20.4 grams was applied to the tensioner, the tensile strength of the threads was determined for 20 seconds and a graph was obtained Figure 16.

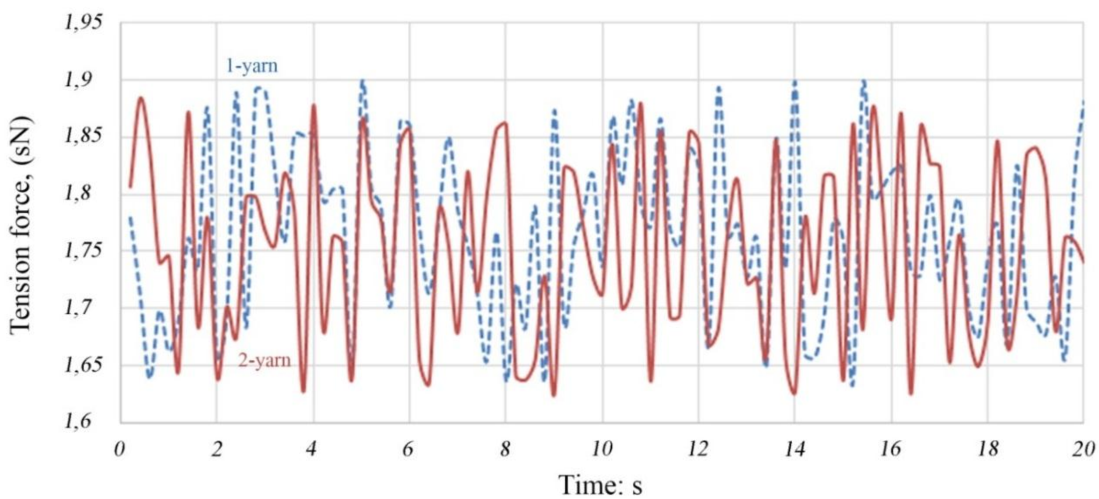

Figure 16. Graph of tensile strength of individual yarns at a load of 20.4 grams on a tensioner

The main goal of the experimental study was not to optimize the average tensile strength of the paired individual yarns but to optimize the technological parameters of the spinning machine by practically determining the difference between their tensile values over some time. For this purpose, in all experimental variants, the differences in the magnitudes of the stresses over 10 seconds were determined, and based on the results, the square mean values of the differences were determined using the following formula (1):

$$\overline{X}_{кв} = \sqrt{\frac{1}{n}\sum_{i=1}^{n} X_i^2} \quad (1)$$

The values obtained from the experimental results are shown in the histogram (Figure 17):

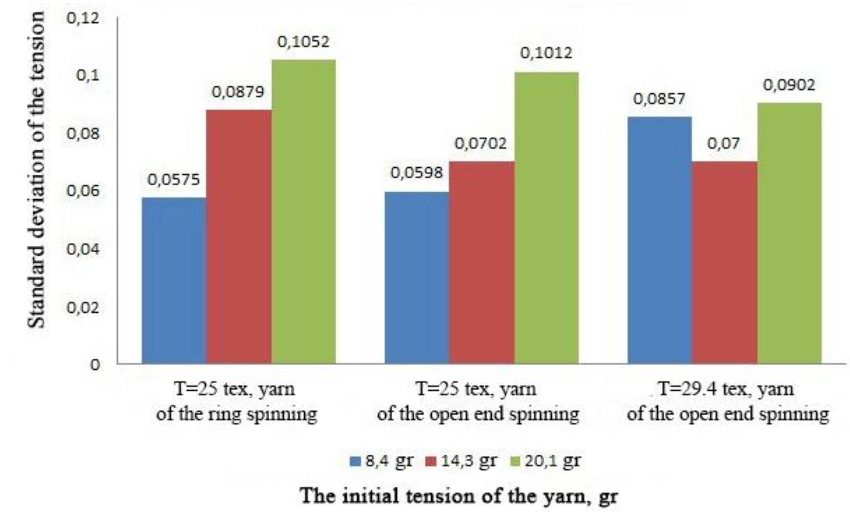

Figure 17. Tensile strength differences under the load of the device

From the histograms in Figure 17, it can be seen that the loads are 8.4 g to avoid excessive stress on the yarns under the influence of the loads applied to the individual yarns being joined was determined to be appropriate and vice versa the tension of the individual yarns increases under the load 20.1 gr. This will inevitably lead to additional elongation of the yarns and breakage of the yarns where the yarns are stretched during the weaving process. Therefore, in the process of joining the yarns, it is important to select the loads according to the linear density of the yarns.

Conclusion

During the experiments, the tension of yarns of several linear densities was tested. Also, the loads in the assembling winding process in the preparation of terry and ground warp yarns for weaving processes noted the above results. The results of the statistical processing of the experimental data show that there is a law that the difference between the stresses of the individual yarns increases with the increase in the number of loads on the tensioning device, i.e. the initial tension applied to the yarn. Determining the optimal value of the initial tension is expedient if this dependence is used as a basis for finding the machining parameters of the machine for individual yarns of appropriate linear density. The analysis showed that as the mass of the washers in the tensioning device increases, the average value of the tension of the yarn section from the washer to the spool increases theoretically approximately equal to the amount of tension determined by the Euler formula.

Acknowledgments
We take this opportunity to thank all the people who have supported and guided us during the completion of this work.

References

Abdalla, F. H., Mutasher, S. A., Khalid, Y. A., Sapuan, S. M., Hamouda, A. M. S., Sahari, B. B., & Hamdan, M. M. (2007). Design and fabrication of low cost filament winding machine. *Materials & design*, *28*(1), 234-239. https://doi.org/10.1016/j.matdes.2005.06.015

Ahmadjanovich, K. S., Lolashbayevich, M. S., & Tursunbayevich, Y. A. (2020). Study Of Fiber Movement Outside The Crater Of Pnevmomechanical Spinning Machine. *Solid State Technology*, *63*(6), 3460-3466.

Amirante, R., Del Vescovo, G., & Lippolis, A. (2006). Flow forces analysis of an open center hydraulic directional control valve sliding spool. *Energy Conversion and Management*, *47*(1), 114-131. https://doi.org/10.1016/j.enconman.2005.03.010

Chapman, B. M. (1971). An apparatus for measuring bending and torsional stress-strain-time relations of single fibers. *Textile Research Journal*, *41*(8), 705-707.

Christ, M., Braun, N., Neuffer, J., & Kempa-Liehr, A. W. (2018). Time series feature extraction on basis of scalable hypothesis tests (tsfresh–a python package). *Neurocomputing*, *307*, 72-77. https://doi.org/10.1016/j.neucom.2018.03.067

Demczyk, B. G., Wang, Y. M., Cumings, J., Hetman, M., Han, W., Zettl, A., & Ritchie, R. O. (2002). Direct mechanical measurement of the tensile strength and elastic modulus of multiwalled carbon nanotubes. *Materials Science and Engineering: A*, *334*(1-2), 173-178. https://doi.org/10.1016/S0921-5093(01)01807-X

Kärrholm, M., Nordhammar, G., & Friberg, O. (1955). Penetration of alkaline solutions into wool fibers determined by changes in the rigidity modulus. *Textile Research Journal*, *25*(11), 922-929.

Korabayev, S. A., Matismailov, S. L., & Salohiddinov, J. Z. (2018). Investigation of the impact of the rotation frequency of the discretizing drum on the physical and mechanical properties of. *Central Asian Problems of Modern Science and Education*, *3*(4), 65-69.

Korabayev, Sh.A., Djurayev, D.A., Matismailov, S.L. (2018). Perfection of Designs and Theoretical Bases of Calculating Roller Tubes for Yarning. I*nternational Journal of advanced research in Science, Engineering and Technology*. *5*(12), 7583-7588.

Meliboev U.X., & Parpiev D.X. (2020). Theoretical study of yarn mechanics in spinning machines. *Mechanical problems. Tashkent*, 3, 128-133.

Meliboev, U. Kh., Parpiev, Kh., Parpiev, D. Kh., & Tozhimirzaev, S. T. (2020). Influence Of Yarn Preparation Technology On The Qualitative Indicators Of Twisted Thread. Universum: *Engineering Sciences*, (6-2 (75)).

Miller, K., & Chinzei, K. (2002). Mechanical properties of brain tissue in tension. *Journal of biomechanics*, *35*(4), 483-490. https://doi.org/10.1016/S0021-9290(01)00234-2

O'Brien, T. K. (1998). Interlaminar fracture toughness: the long and winding road to standardization. *Composites Part B: Engineering*, *29*(1), 57-62. https://doi.org/10.1016/S1359-8368(97)00013-9

Pan, X., Wang, G., & Lu, Z. (2011). Flow field simulation and a flow model of servo-valve spool valve orifice. *Energy Conversion and Management*, *52*(10), 3249-3256. https://doi.org/10.1016/j.enconman.2011.05.010

Parpiev D.Kh., Meliboev U.Kh. (2020). A device for giving the same tension to single threads when they are folded on reed-winding machines. International scientific and practical Internet conference of young scientists and students "Resource-saving technologies of light, textile and food industries". Ukraine. 35-39.

Parpiev D.X., & Meliboev U.X. (2020). Practical study of the tension of paired yarns in the weaving process. *BukhMTI Scientific Journal of Science and Technology Development*. Buxoro. (5), 195-202.

Parpiev, D. Kh., & Meliboev, W. Kh. (2020). Experimental study of the tension of twisted threads in the process of spinning. *Scientist of the XXI century* , (12-1), 17-25.

Parpiyev D., & Meliboyev U. (2020). The effect of the strength of single yarns on the quality of doubling yarns in the process. *Scientific and Technical Journal of Namangan institute of engineering and technology*. Namangan, 6(3), 228-235.

Saura, S., & Torne, J. (2009). Conefor Sensinode 2.2: a software package for quantifying the importance of habitat patches for landscape connectivity. *Environmental modelling & software*, *24*(1), 135-139. https://doi.org/10.1016/j.envsoft.2008.05.005

Tozhimirzaev, S. T., Meliboev, U. Kh., & Parpiev, Kh. (2020). Investigation of the effect of the speed of the carding release on the quality properties of the yarn. *European Journal of Technical and Natural Sciences*, (4), 7-14.

Tozhimirzaev, S. T., Parpiev, H., & Parpiev, D. Kh. (2020). Influence of speed modes of the take-up drum on yarn quality. *Internauka*, (15-1), 95-101.

Tresanchez, M., Palleja, T., Teixidó, M., & Palacín, J. (2010). Measuring yarn diameter using inexpensive optical sensors. *Procedia Engineering*, *5*, 236-239. https://doi.org/10.1016/j.proeng.2010.09.091

Turdialiyevich, T. S., & Khabibulla, P. (2020). The Influence Of Top Flat Speed Of Carding Mashine On The Sliver And Yarn Quality. *European Journal of Molecular & Clinical Medicine*, *7*(7), 789-797.

Vasarhelyi, B., & Ván, P. J. E. G. (2006). Influence of water content on the strength of rock. *Engineering Geology*, *84*(1-2), 70-74. https://doi.org/10.1016/j.enggeo.2005.11.011

Zambrano, M. I., Veliz, E. A. R., Ormaza, G. F., & Laz, G. L. (2017). Comparison between the Material Improvement of the Megarok and San José Quarries, Applying the AASTHO Standards. *International Research Journal of Engineering, IT and Scientific Research*, *3*(5), 50-57.