ISSN: 2350-0328
International Journal of Advanced Research in Science, Engineering and Technology
Vol. 6, Issue 11 , November 2019

Composite Components of Deformation and Destruction of Woven Synthetic Tapes and Ropes for Load-Lifting Devices in Construction

AbdullayevIbrohim Numanovich, RahmanovBahodir Kushakovich, Allahanov Zokirjon, JurayevUktamjon Shavkatovich, ToshkuziyevaZulfiya Eraliyevna

PhD, docent of department “Construction of buildings and constructions”, Fergana Polytechnic Institute, Fergana city, Uzbekistan.
PhD applicant, assistant of department “Architecture”, Fergana Polytechnic Institute, Fergana city, Uzbekistan.
PhD applicant, assistant of department “Architecture”, Fergana Polytechnic Institute, Fergana city, Uzbekistan.
PhD applicant, assistant of department “Architecture”, Fergana Polytechnic Institute, Fergana city, Uzbekistan.
PhD applicant, assistant of department “DESCRIPTIVE GEOMETRY AND ENGINEERING GRAPHICS”, Fergana Polytechnic Institute, Fergana city, Uzbekistan.

ABSTRACT: Reviewed problems, primal problems and prospects of a research and expansions of production of load gripping devices from woven synthetic tapes and ropes are considered. Offers on effective use them in the hoisting-and-transport inventory operated in various branches of economic activity of the Republic of Uzbekistan are given.
KEYWORDS: hoisting-and-transport inventory, load gripping objects, slings, woven synthetic tapes and ropes, researches, normative and technical documents.

I. INTRODUCTION

Studies of deformation properties of materials are based on the fundamental theory of elasticity and creep [1]. The study of research in the field of deformation properties of woven synthetic tapes and ropes (TSLK) showed the following directions:

- study of fatigue, strength, creep and viscoelasticity;
- study of macrostructure, strength and fracture mechanism [2];
- prediction of deformation processes[3];
- computational and experimental evaluation of mechanical work under deformation [4];
- determination of the influence of the level of pre-deformation on the stiffness of the material [5].
- determination of heat and frost resistance and prediction of viscoelastic processes in conditions of changing temperature;
- determination of resistance to sunlight (ultraviolet), moisture, water and microorganisms.

II. RELATED WORK

At the construction faculty of the Fergana Polytechnic Institute, research is being conducted, both on the study of elastic characteristics of textile slings, and on the production and testing of their technical characteristics.

The main method of studying slings is the study of such deformation characteristics as elasticity, creep and relaxation of woven synthetic tapes from which the load-grabbing slings are actually assembled.[6]

Along with experimental research on the study of the properties and characteristics of synthetic woven tapes, the analysis of the world production of polymeric materials was carried out [7]. In table-1. polymers, which are raw materials for obtaining the starting material, are presented.

ISSN: 2350-0328
International Journal of Advanced Research in Science, Engineering and Technology
Vol. 6, Issue 11 , November 2019

Table 1.

№	Materials	Short name	Other names, trademarks, country of origin
1	2	3	4
1	Polyamide	ПА, PA (eng)	Nylon, Nylon
2	Polyester	PET, PES	Polyester, Dacron, Terylene, Dacron
3	Polypropylene	PP	CBM- Russian
4	Polyethylene	PE	Russar S, Ruslan-Russia
5	Aramid	PPTA	Kvlar-USA, Technora-Japan, Twaron-Netherlands
6	High-molecular polyethylene	HMPE, HPPE	Spektra-Germany, Dyneema-USA, Trevo-Sweden

Of these polymers, the local raw materials are polypropylene and polyethylene produced by UGCC [8]. Experiments were carried out on fibers and threads obtained from this raw material. In table. 2. the characteristics of the properties of fibers and threads are presented in comparison with the known and experimental data.

Table 2.

№	Characteristics	Popular		Experimental	
		Polyethylene	Polypropylene	Primary raw material	
				Polyethylene	Polypropylene
	2	3	4	5	6
1.	Specific gravity of granules, g/sm^3	1.14	0.92	1.05	0.95
2.	Melting point, C°	215	170	205	175
3.	Frost resistance, C°	-50	-20	-50	-25
4.	Operating temperature, C°: - max - min	100 -50	80 -20	100 -50	80 -20
5.	Breaking strength, - fibers' cN/dtec. - threads'	5,2-6,8 6,2-8,2	5,0-6,5 6,1-6,6	5,5-7,5 6,1-8,1	5,0-6,3 6,05-7,0
6.	Elongation at break,%	22-24	20	13,4	15,5
7.	Resistancetosunlight (ultraviolet), 1-10	8	6	8	6
8.	Abrasion resistance (wear), 1-10	8	4	8	5
9.	The modulus of elasticity in tension n/a text.	85-92	65-68	88-25	75-78
10.	Creep in 6 months.%	2,4	2,3	1,15	1,10

From table 2 it can be seen that the indicators of experimental materials are approximately not inferior to the known ones.

ISSN: 2350-0328
International Journal of Advanced Research in Science, Engineering and Technology
Vol. 6, Issue 11 , November 2019

III. TEXT INPAINTING

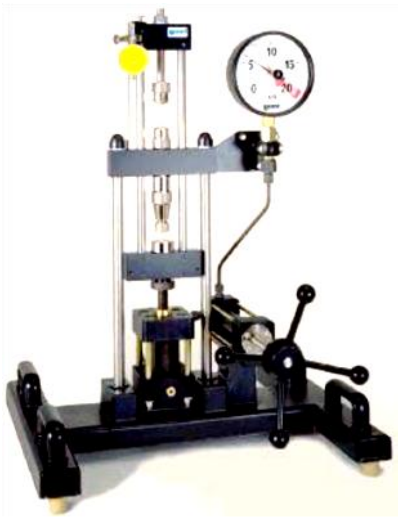
According to the designed scheme, the tape is made, which is based on local materials: - the basis is a polypropylene thread with a density of 400 Tex. (1 Tex.the weight of 1000 m of yarn in grams); beyond that, the ducks adopted a thread of plastic, the harness – twisted wire, with a density of 250 Tex. The width of the tape is 60 mm, its density (number of threads) on the basis of-96 to 60 mm, linear density of 180 g/m.

Using rings and hooks of the Russian production applied for lifting of cargoes by weight – - a ring-to 8 tons; hooks-to 2 tons, (with factor of safety margin 1 : 7, 4 x branch sling was made. Loops of tapes of a sling were sutured according to GOST [9]. Permissible research load capacity 4x branch sling 4 t., i.e. 1 t. for each branch.

Full-scale tests of TSLK slings were based on modeling of real conditions of their operation. In use the line is the number of cycles "load–endurance–loading" was 10, and the holding time under load was no more than 10 min. For full-scale testing of slings used Foundation blocks FBS–24.3,6.- T with mounting loops, weighing 1.0 t. on the lower and upper sharp corners of the blocks were fixed designed and manufactured by the author polyethylene pads with guide grooves having a R=20 mm radius rounding.

To lift the blocks used ZIL truck crane with crane mechanism "Ivanovets" with Qmax=16 tons. equipped with a dynamometer-DPU-200-2 with the price of division 1kn. With a permissible load capacity of 4x branch sling 4T., their loading was carried out up to 8 t. loading of slings was carried out with the lifting of the load at 5-10 cm from the ground surface, with endurance at maximum load for 600 sec. And with the number of cycles N=10.

A test bench was used to study the process of damage accumulation in the tape materialGUNT 20 VP–300 (picture-1).



Picture-1.Testing bench GUNT 20 VP–300

The sample of undamaged tape was loaded to a predetermined value and kept in this state until destroyed. The time from the moment the load reaches the set value to failure was recorded. Working part length of tape sample was 200 mm. To produce a homogeneous stress state of the working part of the samples provided such fastening of the specimen in the grips of the test rig, to its destruction occurred in the working part in the region of uniform deformation field. As a result of the analysis of possible ways of fastening of a tape in captures of the test bench the effective way of its fixing on the basis of the combined clamp is offered. The device allows you to fill the tape without distortions and folds, which ensures its uniform deformation during loading. Preliminary tests on existing grips do not allow, firstly, to avoid skew, and therefore uneven loading of the fibers of the tape base and, secondly, often lead to the destruction of the tape in the clamping cheeks, which distorts the value of the true breaking force and requires repeated tests.

To secure the sample in the grip, the end of the tape is wrapped around a cylindrical sleeve and tucked into a through groove, where it is fixed and clamped with two plates. The parallelism of the cylindrical bushings ensures uniformity of the stress-strain state of the belt in the working part. (Picture-2).

ISSN: 2350-0328
International Journal of Advanced Research in Science, Engineering and Technology
Vol. 6, Issue 11 , November 2019

Picture-2.Device for fastening the tape during the tear test.

The relative error of the load measurement did not exceed ±1% of the measured value. Working part length of tape sample was from 100 to 200 mm. it is important to take into account possible errors due to the presence in the feed manufacturing defects, the type and quantity of which is regulated by. Defects in the form of Nedosekin in 1-2 threads can most significantly affect the decrease in the strength of the tape.

IV. EXPERIMENTAL RESULTS

The results of the TSLK sling tests are summarized in table-3, the obtained values of the breaking force "P" and its standard deviation "σ".Destructive stress for samples of tape in the initial state, with defects and cut from the slings after operating time - in table-4.

Results of field tests TSLK slings
Table-3

№ sling	Number of samples	N, cycle's	Pmax,kH	t., c.	Note
1	1	10	18,0	600	Without destruction
2	1	10	15,0	480	Without destruction
3	2	10	15,0	480	Without destruction
4	3	10	15,0	300	Without destruction
5*	1	8	15,0	300	Tape break
6**	1	5	12,0	300	The gap left on the ribbon on the hook

***–** numbers of slings with defects, and
**** –** numbers of slings with operating time – before the test programPmax = 80 и 60 kH, N = 8 and 5 cycle's., tвыд. = 300 c.

Destruction of the tape sample in the initial state and after operating time
Table-4

Sample status	Number of samples	P,kH	σ, kH
Source	12	15,5	1,2
Original, defective tape	10	15,0	0,75
After the operating time, the tape sling №6 Table-3	7	10,0	3,2

As a result of tests, regardless of the structural homogeneity of the tape, several types of destruction were obtained[10].Typical destructions are divided into 2 groups:

ISSN: 2350-0328
International Journal of Advanced Research in Science, Engineering and Technology
Vol. 6, Issue 11 , November 2019

- rupture of the warp threads along the normal to the direction of action of the applied force;
- at an angle of 25-30° to the axis of the applied load.

There is no correlation between the magnitude of the ultimate load and the type of failure. The deformation diagrams of the tapes are almost linear, only at loads close to destructive, there is a slight nonlinearity.

The zone of destruction, at static rupture of tapes not always occurred on a location of defects. As can be seen from the results (table.4), the strength of defective samples is slightly lower than that of non-defective samples. The decrease in the strength of tapes with technological defects relative to tapes without defects was-up to 3 %, for tapes after operating time - up to 25-30 %.

This decrease is almost imperceptible for slings tested with less overload from the level of nominal operational load capacity, and even more so from the normative-permissible load capacity. Thus, the residual strength of the sling tapes after tenfold loading with a load of 18.0 kH, which is 50% higher than its nominal load capacity, with endurance at maximum load for 480 s. practically, coincides with the strength of the tape in its original state. To assess the effect of the tape holding time under load on the strength, the samples were stretched to a pre-selected force and sustained under this load until rupture. At the same time, the time from the moment of loading to rupture was fixed.

V. CONCLUSION

According to the results obtained, it is possible to estimate the accumulated damage of the tape during exposure at constant load, which is the ratio of the damaged volume of fibers " FP "together with the total number of fibers in the section of the tape "F". And the destructive load of the tape without damage will be Pp = σpF, and the damaged tape –

Pр.п. $=\sigma$(F–Fп), где“σ” – breaking stress. On these dependencies, tape damage can be estimated using the formula:

$$\frac{F\text{п}}{F} = 1 - \frac{\text{Pр.п.}}{\text{Pр}}, \qquad (1)$$

Damage to the tape at a load of 15.0 kN was 1.5 %, at 10.0 kN-12.4 %. In the first case, the tape broke after 100 s. after reaching the specified load level, in the second case after 720 s. the accumulation of damage under load occurs unevenly in time.

The estimated assessment of the carrying capacity of the sling showed that the permissible weight of the transported cargo for the manufactured tapes is 10 kN (the calculation includes a six-fold safety margin of the sling, i.e. theoretically the maximum weight of the lifted cargo at break can reach 15.0 kN.). Shown in table.3.the results show that the accumulation of damage in the belts with a limited number of loading cycles-5 can lead to destruction at a load of 12.0 kN.A single load, close to the destructive, but acting for a short time, do not reduce the strength of the tape.

REFERENCES

[1] Ржаницын А.Р. Теория ползучести. – М.: Стройиздат, 1968.– 416 с.
[2] Берестнев В.А., Флексер Л.А., Лукьянова Л.М. Макроструктура волокон и элементарных нитей и особенности их разрушения. М.:Легкая и пищеваяпромышленность., 1982. с.248.
[3] Каланчук О.Э., Лебедева С.В., Пушкарь Д.В. Разработка компьютерных методов анализа деформационных свойств полимеров и прогнозирования деформационных процессов //кн.: V Международная конференция “Микромеханизмы пластичности, разрушения и сопутствующих явлений, 2- 17 июня 2010 г. г.Тамбов, Россия, с. 127.
[4] Макаров А.Г., Сталевич А.М. Деформационно–восстановительные процессы синтетических материалов //В сб.: Труды международной научно-технической конференции “Новое в технике и технологии текстильной и легкой промышленности”, Витебск, 2000, с. 55-58.
[5] Попов Л.Н., Маланов А.Г., Слуцкер Г.Я., Сталевич А.М. Вязкоупругие свойства технических тканей // Хим. волокна.– 1993, №3, с.42-44.
[6] Abdullayev I., Ahmedov J., Rahmanov B., “Innovations in Construction Technology: Production and Application in Uzbekistan of Slings Made of Textile Tapes and Combined Ropes”, International Journal of Advanced Research in Science, Engineering and Technology, 06-10, 2019, ps no: 11076-11082
[7] Цобкалло Е.С., Тиранов В.Г., Громова Е.С. Влияние уровня предварительного деформирования на жесткость синтетических нитей // Хим. волокна, №3, 2001. С. 45-48.
[8] www.remera.ru
[9] Info.uz.com
[10] ГОСТ 16218.5-82. Изделия текстильно-галантерейные. Метод определения разрывнной нагрузки и разрывного удлинения при растяжении. –Введ. 01.07.83.
[11] Suleimanova L.A., Rahmanov B.K., Kocherchenko V.V., Solodov N.V. "Promising directions of development of technology of rigging works using slings on textile basis." Journal of BGTU named after V.G. Shukhova, № 7. 2018 BGTU, Russia, FerPI, Uzbekistan.