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Industrial Knitted Sleeve Filters

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ABSTRACT: In given article versions of filtering textile cloth are considered and the significance of formations of filtering filler knitted sleeves explored. A new method of producing highly efficiently knitted composite sleeve has been created in which the fraction in the density of the mass area is achieved at 50%. The new method was tested in the production environment of the "Gani Rahimov Ishonch" (Samarkand city) by modernizing existing-equipment and samples are obtained via a pilot production.

KEYWORDS*:* filtration, textile fabrics, cleaning, sleeve, filler, filled knitted filter, composites.кompozicion sleeve, surface density, textile linen, method.

I.INTRODUCTION

Within the conditions of globalization and technical progress, in many countries emissions from developing sectors such as oil and gas, construction, mining, machinery, textile, chemical, pharmaceutical, atomic energy and other industries, due to imperfection of filtering and cleaning systems make unfriendly influence on humans, animals and plants.

Problems of labour conditions are closely related to the level of technique and technology, and improvement level of emission cleaning and decontamination.

Gravitational dust collector is known as the first device to extract solid particles from dust flow. Consequently, cyclones have appeared, and in late 20th century eddy dust collectors were invented in Germany, England, starting from 90s in Russia. Development of high-speed computers and calculation algorithms caused the invention of high-efficient centrifugal dust collectors. Although, according to data analysis of scientific and practical researches [1-2] the efficiency of dust collectors and cyclones could be doubled by application of textile filtering elements.

Modern cleaning systems are related to such definitions as «filtration» and «filtering». Filtration is a process of motion of drop liquids and gases through porous systems in nature, while filtering is dividing process of dissimilar materials by porous septum separated only with phases.

Porous septum consists of fibrous, most of the times textile fabrics (nonwoven, woven and knitted) with different structures [2], composites with dispersive and fibrous materials, modified for specific settings [3].

II.ANALYSIS OF EXISTING FILTERING MATERIALS AND RESEARCH RESULTS

In conditions of economical growth, a demand for filtering textile materials had been sharply increased. Though, annual production of filtering fabrics is approximately 8 million meters, which is less than 20% of their consumption. Insufficient production of filtering fabrics and their limited assortment constrains industrial companies to use for filtering purposes such fabrics as coarse calico, batiste, chiffon, gauze cloth, belting, silk and linen fabrics, i.e. fabrics designed for public and other technical usage. That causes overrun of fabrics, irrational use of their particular settings, decreasing of filter efficiency and high costs.

Textile filtering materials by definition already point on their main purpose and usage. Same requirements as for apparel, shoes or transporting belts cannot be applied to textile filters.

The main requirement for filtering fabrics is fine cleaning ability at high-speed filtering process, low hydraulic resistance and pressure drop of liquid, gas and steam.

That is necessary to mention that the problems of structure, design and production of filtering fabrics and other textile materials still not totally solved.

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The results of previous researches show that cleaning systems with application of sleeve structures with textile elements are more efficient. Usually sleeve structure are formed by laying out and sewing of textile fabrics. Though, in this way a sleeve will have a side linking seam, which is the main disadvantage of it.

Sleeve can be produced on circular woven looms, as in production of seamless bags from polymer belts or fire hose. Moreover, there are modern machines producing nonwoven sleeves by linking of continual spiral scrim.

Study results identified that in first and further cases of sleeve production, technological capabilities of machines are limited. In service terms, woven filtering fabrics have a high hydraulic resistance, nonwovens have low physical and mechanical configurations. Both cases make it impossible to put additional bulk fibrous or disperse filling into their structure.

Collected particles in textile filters, particularly in woven filters are gathered in pores or make a dust layer on the surface of septum, so become a part of filtering process for upcoming particles. As dust is gathered, the porosity of textile filter is decreasing and resistance is increasing. Therefore, it is necessary to regenerate the filter which requires certain strength and strain configurations.

Comparing to previous woven filters, the ability of sleeve production does exist in all circular knitting machines, which allows to develop different structures and technologies for poly functional sleeve production [3-7], including knitted filled filters with technological parameters for different sectors.

Table 1

Technological parameters of knitted filled fabrics

Variant	Raw material ratio, %		Density in 100 mm, loops		A, mm	B, mm	Thread length in loop, mm			Q, gr/m^2
	warp	filling CO 200 t	$P_г$	$P_в$			$L_л$	$L_и$	$L_с$	
1	CO 18,5 t - 26,6 Semi-WO 31 t - 17,2 Elasthic yarn 20 t - 9,8	46,6	50	100	2,1	1,2	5,52	6,13	3,49	730
2	CO 18,5 t - 24,1 Textured dyed PL 16,7 t - 35,2	40,7	50	90	2,0	1,15	4,91	5,54	5,02	513
3	CO 18,5 t - 57,5	42,5	50	100	1,95	1,0	5,11	5,71	5,31	419
4	CO 18,5 t - 52,36	47,64	50	100	2,1	1,1	5,35	6,11	5,51	510
5	CO 18,5 t - 15,5 Textured dyed PL 16,7 t - 26,9 Fansy yarn 27 t -11,2	46,4	60	90	1,65	1,12	9,25	5,62	5,14	632
6	CO 18,5 t - 17,9 Textured dyed PL 16,7 t - 22,8 Fansy yarn 27 t - 13	46,3	50	110-70	1,85	0,9-1,4	5,58	7,43	5,06	600

In order to create high efficient textile filtering sleeves, researches on development of new structure of filled knitted fabric and techniques of its production are done within the frames of Uzbekistan-China joint research project “M/UZB-KNR – 16/2015”. The technique is tested at the enterprise “Gani Rakhimov Ishonch” (Samarkand city) and pilot batch of new samples in two variants from cotton and polyacrilic raw material, by modernization of two-bar circular knitting machine is obtained.

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Table 2
Technological parameters of new knitted filled fabrics

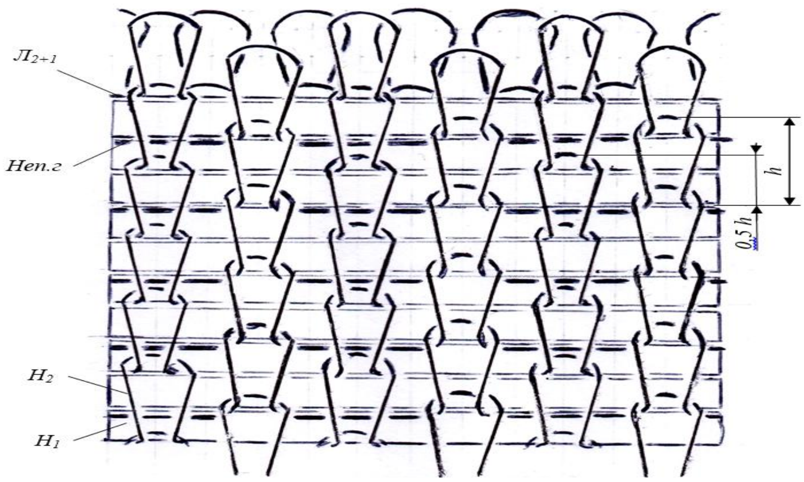
Linear density (number) of raw materials, the basis filler	Density on 100 mm, loop		A, mm	B, mm	Thread of length in loop, L, mm	Q, г/м^2
	$P_г$	$P_в$				
cotton 17,5 (№$_e$34) t x 1 x 2 cotton 21 (№$_e$28) t x 1 x 2	54	88-44	0,92	0,6-1,1	4,5	435
PAN 21 (№$_e$28) t x 2 cotton 21 (№$_e$28) t x 1 x 2	48	76-38	1	0,7-1,3	5,1	534

The essence of modernization lies in the fact that a two-loop circular knitting machine (grades 10-12) operates under conditions of increased inter-distance distance. In the length of the knitting system, an optimum zone for feeding the filler into the interphonic shed has been found.

The entity of new structure formation of filled knitted sleeve filter is that it is made from cells include two layers of single and a number of double linking knit. In this case, the loops of the matching columns of adjacent rows along the least of one side are shifted by half the height due to the formation of the corresponding mating and the proportionality of the loop. In addition, an increase of the filtering ability is achieved by improving the placement of the filler, which may be a dispersibly filled with composite cord or bulky fibrous materials. The mass fraction of the filler in the samples is increased by more than 50% of the total surface density by separate feeding them from at least two serially arranged systems.

It should be noted that in the new method the possibility for each specific application of the final product of the use of various types of raw materials, both warp and filler, is included, taking into account their thermal stability, chemical resistance to acidic and alkaline media, oxidizing agents, solvents, etc.

Features of new structure of the knitted filter sleeve are illustrated in Figure 1. where I - III -



a)

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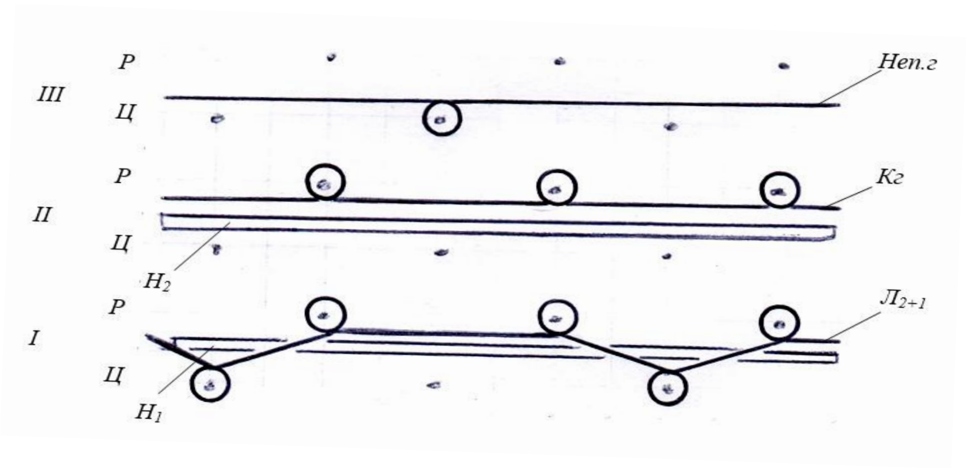
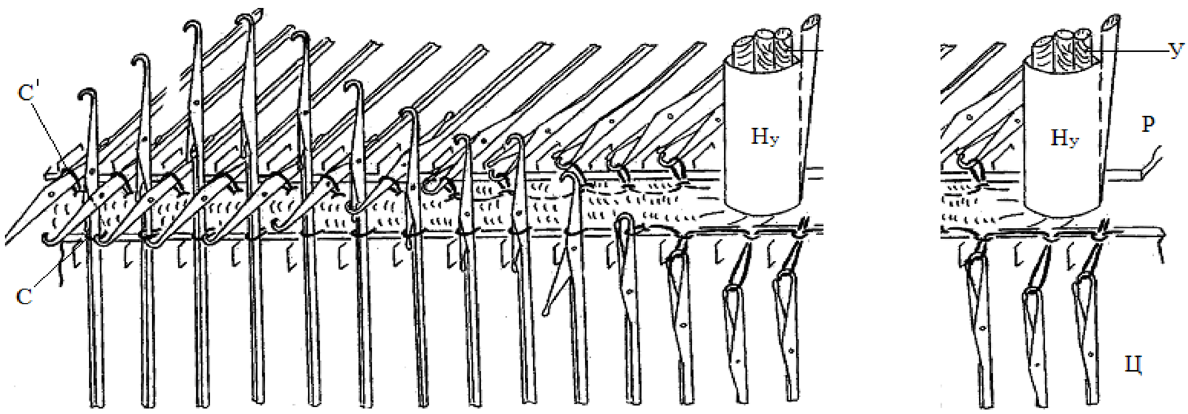


b)

Fig. 1. Structure (*a*) and graphical record (*б*) of knitted sleeve filter.

looping systems of knitting equipment; P - dial and Ц - needle cylinder; I system on needles Ц and P forms a ribs fabric 2 + 1 ($Л_{2+1}$); additional filler - H_1; II the system on the needles D forms a jersey ($К_г$); additional filler - H_2; III system on the needles Ц forms an incomplete jersey (*Неп.г.*).

The task of feeding the filler from additional thread guides to each cell before the formation of a binder series of at least two alternating systems in the conditions of the increased size of the interphonic tap was successfully solved with the modernization of the equipment (Figure 2).



Р – dial; Ц – cylinder; $Н_у$ – additional thread guides;
У – filler; C и C' – previous loops of cylinder and dial

Fig 2. Feeding process of filler to cell.

Table 3

Physico-mechanical and operational features of knitted filled fabrics

Thickness, mm	Breaking load, H		Relative extension, %	Resistance to abrasion, cycle	Breathability **, cm^3/cm^2 sec
	by length	in width			
1,35	345	292	9,4	12500	41
1,65	471	201	7,9	28000	101
Note: * power above 6 H; ** P=1atm.					

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According to the results of the research, it is revealed that the proposed new method makes it possible to obtain knitted filter sleeves that can be used as:

- a strong sleeve substrate for mechanical filtration in industrial plants;
- adsorption sleeve that detects harmful toxic substances, toxic impurities of exhaust gases in the presence of adsorbents introduced into the material by impregnation of solutions of functionally active polymers and copolymers, by spraying, applying, onto the surface or injected inwards as a contaminant (fibrous or dispersed form) during formation. It is possible to form the very base of active fibers;
- flexible filter elements of the bag filter for installations of industrial and domestic premises;
- flexible filter element for cleaning solutions containing biologically or chemically active substances and ions, in the presence of sorbents in the structure;
- flexible supporting base for catalysts when forming a base from a special raw material (acid-resistant, alkali-resistant, etc.), and filler from a granular or dispersed substance that acts as a catalyst;
- a dispersed-filled flexible element for the protection of museum exhibits;
- technical linens and sleeves used for sewing special clothes and forming waterproof cover materials and other non-traditional products for various purposes.

III.CONCLUSIONS

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Thus, a new structure and method for obtaining a filled knitted sleeve filter has been developed, the method has been tested in production conditions and an experimental production lot has been obtained. The technological parameters, filtering and other operational properties of previous and subsequent variants of knitted samples are analyzed. It was revealed that their effectiveness mostly depends on the percentage of the filler and this index is increased by more than 50% of the total surface density of the filter cloths on the new variants. It is established that for each application of knitted filter hoses based on the requirements of the field of operation, it is advisable to take into account the type of base and filler raw material, their heat resistance, chemical resistance to acidic and alkaline media, oxidizing agents, solvents, etc.

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