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Studying The Strength of Seams in Special Field Clothing Made from Secondary Fiber Materials

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Abstract: This article presents research findings on the seam strength of specialized field clothing made from secondary fiber materials. The study evaluated the strength of joining seams in special garments sewn from both untreated secondary fabric and hydrophobically treated secondary fabric.

Keywords: Secondary fiber, specialized clothing, seam, strength, breaking force.

INTRODUCTION:

During the use of special clothing, maintaining its appearance and reliability is of great importance. The appearance and durability of clothing and other items depend to a certain extent on the strength of the seams [1]. The strength of connecting seams is one of the important indicators determining the quality of clothing, which includes the main structural seams and allows for determining their durability and resistance to mechanical influences.

Various factors affect the strength of special clothing components. As a result of periodic loads acting on the item, dust causes abrasive action, leading to the deterioration of the means connecting the parts (clause 3.2). Under the influence of high temperatures, materials connecting parts of special clothing - polymer of sewing thread, adhesive in adhesive joints, or polymer of the main material in welded joints - undergo aging, weakening, and structural changes. Chemical substances such as acids, alkalis, organic solvents, and others also affect the strength of the joining of parts, partially dissolving them and increasing their degree of deterioration. All of this leads to a decrease in the joint strength of the product parts. Therefore, when designing special clothing and choosing the method of fastening its parts, it is important to consider operating conditions [2].

Various factors influence the quality of special clothing seams, including seam structure, fabric weave type, properties of fabric and thread, seam parameters, and technological modes [3]. Fabric thickness affects the amount of structural allowances and seam structure. The criterion for seam reliability under tension is its resistance to breaking.

This stage of the dissertation investigates the strength of seams in special field clothing made from fabric woven from secondary raw materials. Cotton fabric samples made from secondary raw materials and fabric treated with hydrophobic emulsion were selected as the research objects. Analysis of existing special field clothing seam structures revealed the directions of various influences and loads on garment parts and components during use, as well as the stress vectors affecting the seams (Figure 1). Accordingly, when selecting seam structures and technological processing allowances, stress-bearing seams, technological properties of the fabric (slippage resistance, tensile strength), and the direction of warp threads in garment parts were taken into account [3].

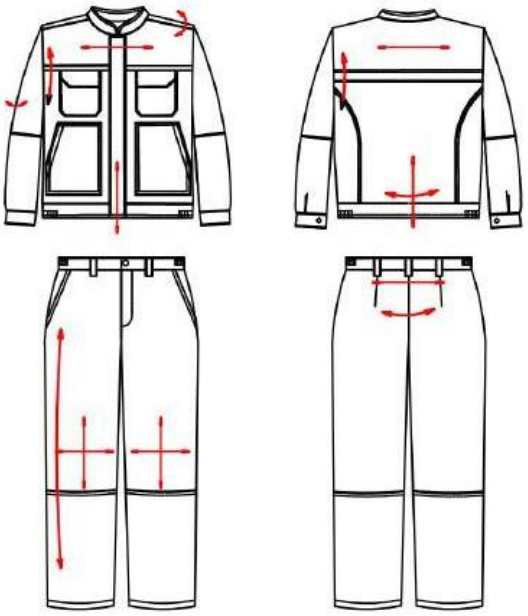


Figure 1 - Stress distribution in specialized clothing: jacket and trousers

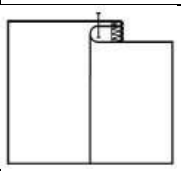
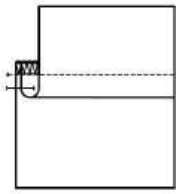
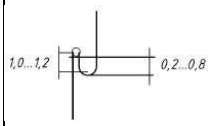
All seams were sewn with the same thread (cotton-polyester №40LX). Research was conducted on 16 binding and edge-stitched seam structures using 4 fabric samples. To test the tensile strength of joining seams, samples were cut at different angles relative to the fabric's longitudinal direction: along the warp threads (longitudinal seam) and at 90° to the warp threads (transverse seam) [4]. Seams were sewn using two methods: joining and topstitching, with stitch densities of 4, 3, and 2,5 stitches per 10 mm. The breaking strength of threaded connections was studied on five experimental samples of special clothing until rupture, after which the average value of the obtained results was determined.

The results of experimental studies on seam strength are presented in Table 1. The investigation of the tensile strength of the seams was conducted using an "Autograph" (Japan) tensile testing machine based on standard methods [5].

Table 1 provides a description and schematic representation of the seams used in specialized clothing.

Description and diagrams of seams used in special clothing

Table 1

Seam code	Seam name	Diagram	Seam description, (cm)	Field of application	Seam parameters
1.01.01	Joining seam			It is used for joining front and rear component parts along the side cut.	PE fiber thread No. 40, needle size 100, seam width 2.5 mm
2.02.01	basting stitch			It is applied when sewing pockets into the upper part of clothing and attaching the yoke to the back piece.	PE fiber thread No. 40, needle size 100, seam width 2.5 mm

The results of studying the strength characteristics of special clothing seams in fabric samples made from secondary raw materials showed that all seam samples are distinguished by high tensile strength

before breaking (420...570 N), elongation at break, and tear resistance (61...51%) (figure 2,3).

During the research, the strength of the joining seams of special clothing made from untreated secondary fabric and hydrophobically treated secondary fabric was evaluated. The experimental results showed that hydrophobic fabric has the best performance properties, making it preferable for sewing special clothing intended for workers in the agro-industrial complex. Based on the results of theoretical and practical research, for special clothing made from new fiber-content fabric with hydrophobic treatment intended for employees of the agro-industrial complex, polyester sewing thread №40 and a stitch width of 2.5-3 mm are recommended to increase seam strength.

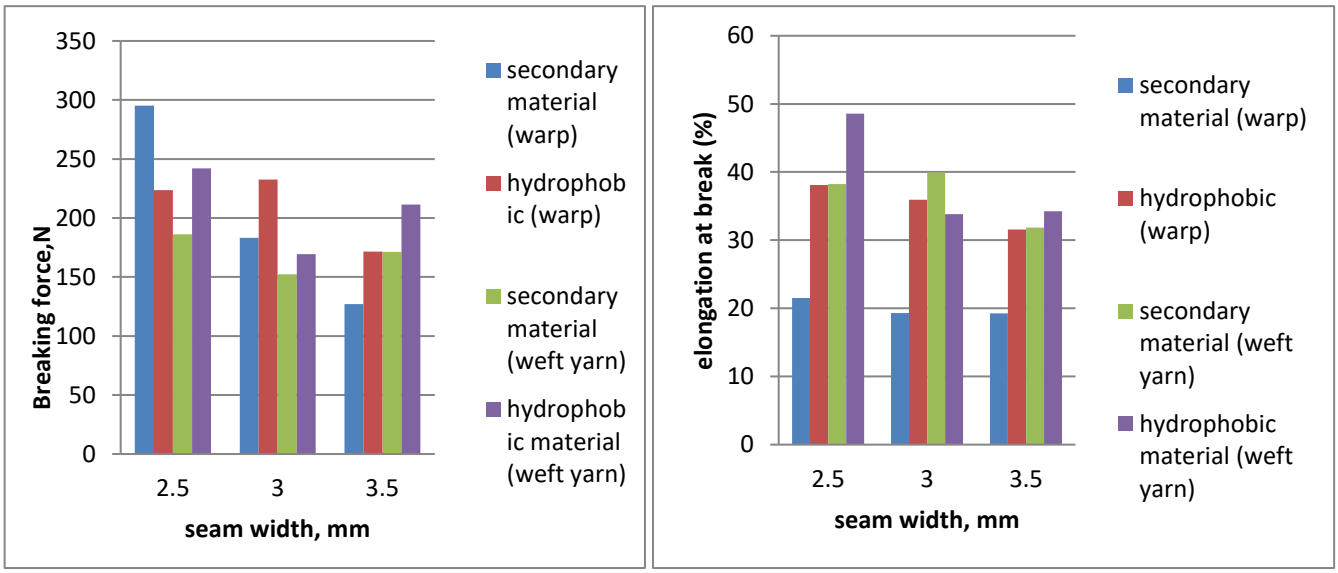


Figure 2. Breaking strength and elongation at break of connecting seam samples

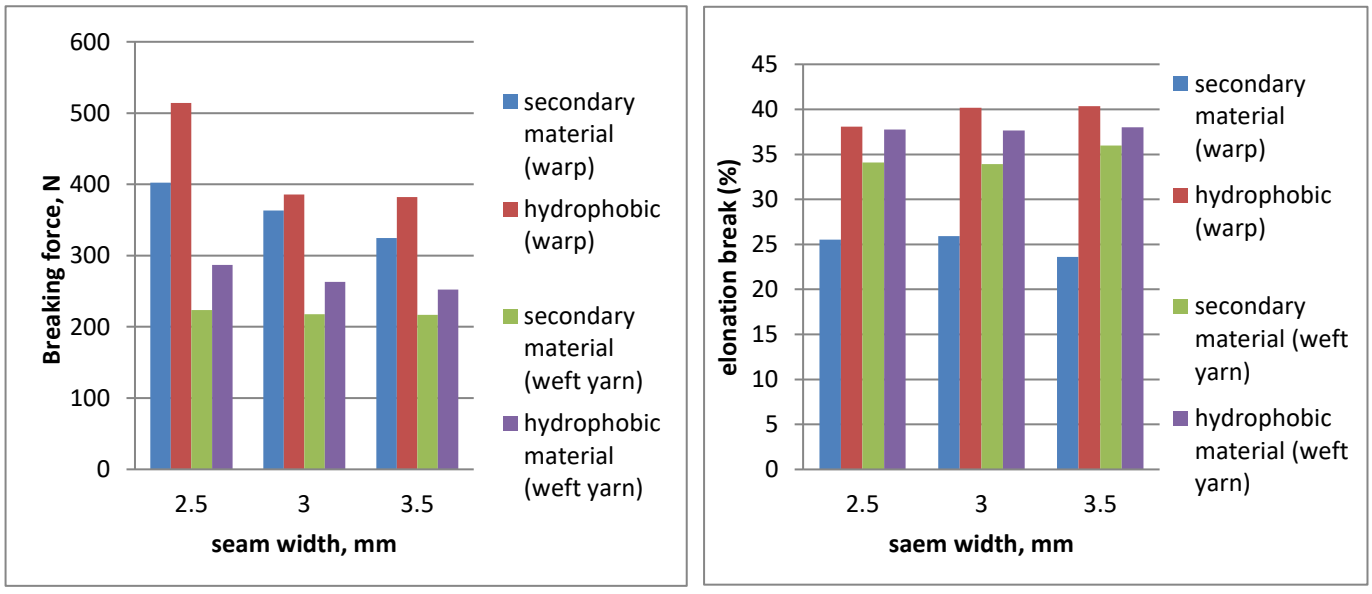


Figure 3. Breaking strength and elongation at break of lap-seam specimens

Secondary fabric is an excellent resource that can be used on par with primary fabric. It allows for the creation of new products without compromising quality, while maintaining durability and comfort.

When working with secondary fabric, additional elements can be incorporated, such as elbow and knee pads, a second layer to increase strength, as well as decorative and protective additions. This not only extends the lifespan of products but also makes them

more convenient to use.

The use of secondary fabric is a rational and environmentally friendly approach that helps conserve resources while enabling the creation of high-quality and long-lasting items.

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