

SHORT TERM SCIENTIFIC MISSION (STSM) SCIENTIFIC REPORT

This report is submitted for approval by the STSM applicant to the STSM coordinator

Action number: CA17107

STSM title: Effect of anti bacterial finish on the performance and durability of medical compression socks

STSM start and end date: 24/05/2021 to 31/05/2021

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PURPOSE OF THE STSM:

Venous disease at lower part of leg is very common disease nowadays and affect 50% of general population and women getting more affected than men. Chronic venous insufficiency (CVI) occurrence ranges from 2% to 9% and increases with age. Patients admitted for long-term-care are nearly 2.5%. Treatment of leg ulcers is greatly improved by proper use of compression therapy. Compression socks are highly recommended textile garment for pressure exertion on lower part of leg. An inappropriate value of pressure exertion by compression socks will affect the energy, work efficiency and health of the wearer. Insufficient pressure will limit efficiency, and perhaps reduce the aesthetic appeal of the garment, while too much pressure will result in reducing heart and lung functions, and perhaps cause serious damage to health.

Factors like anti-bacterial (any kind) finish can have a significant effect on the breathability of the socks and secondly the durability and functionality of these medical socks after finishing needs more research and analysis.

DESCRIPTION OF WORK CARRIED OUT DURING THE STSMS

The STSM at Jordan University of Science and Technology was very helpful to learn from the expertise of the researchers. Prof. Fahmi is specialized in the field of the Chemistry where as Dr. Mazari is more focused on the physiological properties. The STSM helped to discuss and analyse the samples of Medical compression socks for the possible chemical treatments related to the antibacterial finishes and methodology of application for better durability and without significant effect on the comfort. Many articles and research articles were discussed. The samples are provided to the research team and further results related to washing, compression and physical properties are mentioned in the next section.

The samples socks are selected according to pressure classes, following is the detail of the standard pressure class of medical compression socks.

Table 1: Compression classes according RAL GZ 387

Compression class	Compression intensity	Compression in kPa
I	Low	2.5
II	Moderate	3.7
III	High	5.1

Fabric thickness is measured as the perpendicular distance between the two fabric surfaces under a specified applied pressure. Further properties of the socks are listed in table 2 & 3.

The details of socks are mentioned in Table 2.

Table 2: Specifications of MCS samples

Sample identification	Structure	Composition	Circumference [cm]
I	Plain/Single Jersey	60% Tactel/Polyamide, 40% Lycra/Elastane	23 - 26
II			23 - 26
III			23 - 26

Table 3: List of stitch density and thickness of socks

Sample identification	Wale density [Loops/cm]	Course density [Loops/cm]	Stitch density [Loops/cm ²]	Thickness [mm]
I	27	22	598	0.93
II	24	21	510	0.72
III	26	21	550	0.61

DESCRIPTION OF THE MAIN RESULTS OBTAINED

The standard wooden leg with circumference of 24 cm from the Swiss company is selected for the experiment all the measurements of pressure are done on the ankle position.



Figure 1: Placement of the pressure sensor on leg.

Table 4. Compression pressure of socks after long term usage

Sample identification	Pressure at cB [mmHg]					Total of pressure drop [mmHg]
	After wearing	After 4 hours	After 24 hours	After 28 hours	After 48 hours	
I	27	23	18	17	13	13
II	41	38.5	31.7	30	26	14
III	54	48.5	37.5	36	29	24.3

1.1.1. DIMENSIONAL CHANGE

The exact original dimensions in a square form were indicated by textile marker pen on each sample of socks at the location of ankle level. The size of marked square was 50x50 millimetres. After the samples were washed and air-dried, the dimensions of the marked square were measured again to determine the change in dimensions. Table 5 shows the dimensions in course and wale directions before and after the M samples were washed, where D_{NW} are dimensions of marked square before washing, D_{AHW} are dimensions after HW. Measurements were taken to the nearest 0.5 millimetre of the lines that were marked off.

Table 5: Dimensional change after different types of laundering

Sample identification	D_{NW}		D_{AHW}	
	course x wale [mm]		course x wale [mm]	
AI	50	x 50	50	x 48.45
BII	50	x 50	49	x 50
CIII	50	x 50	49.1	x 49.45

Dimensional changes expressed in [%], were calculated according to this formula:

$$s = \frac{l_1 - l_2}{l_1} \cdot 100$$

Where: s = shrinkage [%]

l_1 = is the initial dimension of the sample [mm]

l_2 = is the dimension of the sample after washing [mm]

Change in dimensions is indicated (+) if shrinkage occurs or (-) when fabric is extended. The higher the dimensional change value, the more shrinkage or extension occurred. Table 6 shows the total dimensional change for course and wale in [%] for the marked square at ankle level of each MCS after being hand washed.

Table 6: Dimensional change in percent after hand washing

Sample identification	D_{AHW}		
	course x wale [%]		
AI	0	x	3
BII	2	x	0
CIII	2	x	1

From the results of percentage dimensional changes is obvious that no fabric extension happened, but shrinkage occurs for all types of MCS. Wale direction can be labelled as a less stable direction due to the higher values for shrinkage. The results demonstrate that shrinkage occurs during washing, but the amount of dimensional changes after washing does not occur with the same trend. Also, MCS samples with the same or similar stitch density or composition do not behave in laundering with the same trend, so influence of those factors on overall performance of MCS cannot be confirmed.

It is concluded from the research that the compression socks loses pressure insertion with respect to time. After just 4 hours of wearing there is minimum decrease of 10% whereas after 48hours of wearing the compression pressure is decreased by 23%. For medical patients the precise pressure management is very important for health. From the washing test it was concluded that the socks have insignificant change in the compression pressure after hand washing. The slight increase in the mean value was observed which is due to the shrinkage of the knitted structure. It is recommended from the research to change the medical socks after 6 hours to have precise pressure rating.

FUTURE COLLABORATIONS (if applicable)

The STSM was very useful to know the research capabilities of both institutes and find oportunities to apply for mutual projects.

The research work performed can also be used for a conference proceedings