

# Health-Promoting Properties of Blankets Made with the Bioactive Fibre 'Rhovyl AS' in the Pile

## Abstract

Bioactive fibres are more and more widely used in textile production. Presented in the paper are the results of research aimed at determining the proportions of the antibacterial polyvinyl chloride fibre Rhovyl AS in woven blankets to ensure their antibacterial and non-flammable properties. The results of the research on the properties of blankets made with Rhovyl AS in the pile made it possible to determine in which areas of social life the blankets made with various proportions of Rhovyl AS could be used.

**Key words:** polyvinyl-chloride fibres, antibacterial fibre Rhovyl AS, antibacterial blankets, non-flammable blankets.

ry. Bioactive fibres, such as those with antibacterial properties, can if used in a textile product stabilise or even reduce the growth of the bacteria which inhabit it. Among fibres known to have antibacterial activity are the polyester, polyamide, polyvinyl-chloride, and polyacrylonitrile fibres [1-4]. In the first years of their production, the new generation of bioactive fibres was used in the manufacture of textiles for personal use. A limitation to wider use of these fibres was their price, which was rather high compared to their standard types. However increasing awareness of the advantages of disease prevention, enhanced by the marketing activities of the manufacturers, resulted in an increasing demand for textiles made with various proportions of these fibres. In the last two years, a target project was realised jointly by the Institute of Natural Fibres and the Zwoltex company, which among other things resulted in the development of a product range of non-flammable, antibacterial blankets made with the fibre Rhovyl AS in the pile. The general objective of the project was to determine the optimum percentage of Rhovyl AS in the blanket fabric which would guarantee the production of fire-resistant blankets with antibacterial properties which show resistance to catching fire. As a result of the project and the performance tests on the produced blankets, the

therapeutic properties and the range of possible applications of blankets made with Rhovyl AS in the pile were determined.

## Object and Scope of Study

### Materials

The polyvinyl-chloride fibre Rhovyl AS was selected as the object of tests, as it displays antibacterial activity owing to the antibacterial preparation Triclosan introduced directly into the polymer melt of this fibre [3,5]. Furthermore, Rhovyl AS, similar to other polyvinyl-chloride fibres, does not sustain fire, and when rubbed against human skin it is electrified negatively. This negative ionisation, in turn, causes expansion of the blood vessels on the surface of the body, thus improving the circulation of blood and having a positive effect on body temperature [6]. The end-use properties of Rhovyl AS are supplemented by its physical and mechanical characteristics; the breaking strength of the fibre is 13-16 cN/tex. Rhovyl AS is manufactured in a range of linear density from 2.4 to 5.6 dtex and staple length from 26/32 mm to 70/110 mm, which enables the fibre to be processed by various spinning techniques.

### Scope of tests

Tests were carried out to determine the effect of the presence of Rhovyl-AS in

## Introduction

The advances in the development of civilisation have had both positive and negative effects on man and his environment. The high mobility of modern man, manifesting itself as a massive traffic of people between continents and countries and within individual countries, favours the dissemination of various diseases. Potential dangers to human health may be hidden in bed-clothes, including the blankets and plaids used in hotels, holiday facilities, sanatoriums, and even hospitals where they are the source of in-hospital infections. Recently prophylactic measures have been taken, including the use of textile products with therapeutic properties. This is possible owing to the introduction onto the market of a new generation of the bioactive synthetic fibres whose most intensive development took place in the last decade of the twentieth centu-

Table 1. Proportion of Rhovyl AS in blanket fabric pile.

Type of fibre in blanket fabric pile	Variant I - 530 g/m <sup>2</sup>		Variant II - 400 g/m <sup>2</sup>		
	Trial I/1	Trial I/2	Trial II/1	Trial II/2	Trial II/3
Rhovyl AS [%]	100	50	100	70	50
Dralon [%]	-	50	-	30	50

Table 2. Antibacterial activity of fabrics made with different proportions of Rhovyl AS

Variant	Weft of the fabric	Time	Count of bacteria on sample	Bacteriostatic activity	Bactericidal activity
		h	cfu	log (B/C)	log (A/C)
I - 530 g/m <sup>2</sup>	Standard Dralon control sample /A/	0	1.1x10 <sup>6</sup>	-	-
	Standard Dralon control sample /B/	24	4.7x10 <sup>8</sup>	-	-
	100% Rhovyl AS test sample I/1 /C/	24	3.0x10	7.2	4.6
	50% Rhovyl AS test sample II/2 /C /	24	6.0x10	6.9	4.3
II - 400 g/m <sup>2</sup>	Standard Dralon control sample /A/	0	2.3x10 <sup>4</sup>	-	-
	Standard Dralon control sample /B/	24	2.9x10 <sup>8</sup>	-	-
	100% Rhovyl AS test sample II/1 /C/	24	<20	7.2	3.1
	70% Rhovyl AS test sample II/2 /C/	24	<20	7.2	3.1
	50% Rhovyl AS test sample II/3 /C/	24	<20	7.2	3.1

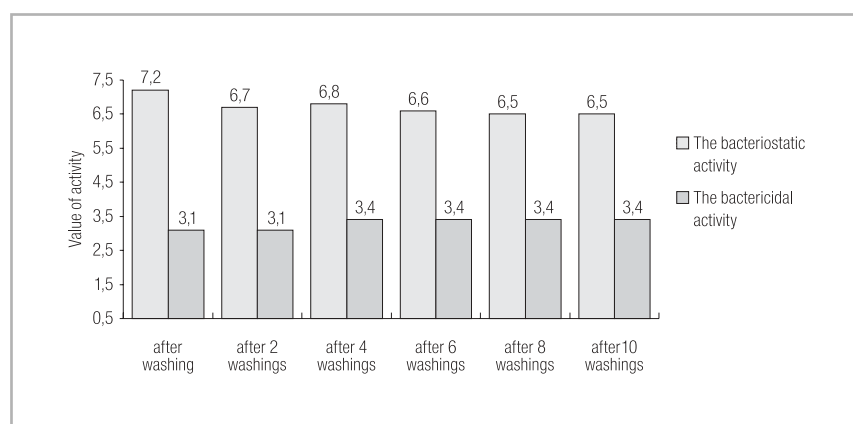


Figure 1. Effect of wet washing on the bacteriostatic and bactericidal activity of blanket fabric made with Rhovyl AS.

the weft which forms the pile of a finished blanket. The following two variants of blanket fabrics were tested: variant I - a woven fabric of an area weight of 530 g/m<sup>2</sup>; and variant II - a woven fabric of an area weight of 400 g/m<sup>2</sup>. The proportions in the blanket pile of Rhovyl AS and the standard PAN fibre, Dralon, are presented in Table 1.

After the weaving process, the grey blanket fabrics were subjected to bacteriological tests comprising tests of bacteriostatic and bactericidal activity directly after weaving and after repeated washing. The tests of the finished blanket fabrics (after the finishing process) comprised:

- establishing their resistance to catching fire from a smouldering cigarette and from a small open flame;
- evaluating their performance in use.

## Test Methods

### Micro-biological tests

The tests of the bacteriostatic and bactericidal activity of the blanket fabrics made with varied proportions of

Rhovyl AS were conducted at the Microbiological Laboratory of the Institute of Chemical Fibres, Łódź. Use was made of a quantitative test based on Japanese Standard JIS L 1902; 1998. The bacteriostatic and bactericidal activity of the fibres was determined against the bacteria of *Escherichia coli* (ATCC 11229) characteristic of the hospital environment. The control sample in these tests was a fabric of which the weft was 100% Dralon.

The effect of wet cleaning (washing) on the bacteriostatic and bactericidal activity of the blanket fabrics made with Rhovyl AS was checked out on the example of trial I/1 (with 100% Rhovyl AS in the weft), the test fabric and the control sample (fabric with 100% Dralon weft). The antibacterial activity was tested after 2, 4, 6, 8 and 10 washings at 40±2°C for 5 minutes in the presence of a mild detergent in an amount of 1 g/l, without any auxiliary agents.

### Tests of resistance to catching fire

The tests of resistance to catching fire from a smouldering cigarette and from a small open flame were made on sam-

ples of finished blanket fabrics containing 100%, 70% and 50% of Rhovyl AS in their pile (trials II/1, II/2, II/3). The comparative reference was a blanket fabric with 100% PAN in its pile. The tests were made by the accredited Laboratory for Flammability Tests (Laboratorium Badań Palności Wytobów) of the Textile Materials Engineering Institute (Instytut Inżynierii Materiałów Włókienniczych), Łódź, using methods complying with the relevant ISO draft standards [7,8,9,10].

### Evaluation of performance in use

The objective of the performance tests in use of the blankets was to determine the effect on health of those properties of their pile that were attributable to Rhovyl AS, i.e. attributable to the negative electrification of this fibre. For the evaluation, blankets with 100% Rhovyl-AS pile were selected (trial I/1). The evaluation was carried out by the Rheumatological Clinic of Łódź Medical University and the Home Ministry's Hospital in Łódź. The blankets were test-used for three to several weeks by the following groups of patients:

- 1) children treated for chronic juvenile arthritis with intensification of pain at night;
- 2) adult patients with pain syndromes due to degenerative changes in the spine and/or joints, and adult patients with post-apoplectic pain syndromes.

Opinions on the test-used blankets were obtained from 65 patients belonging to each group. On the basis of these opinions and their own observations of their patients' health conditions, the therapists presented a report on the results of the test-use of the blankets with 100% Rhovyl-AS pile.

## Results of the Tests

### Microbiological tests

The results of the bacteriostatic and bactericidal activity tests for all samples of grey blanket fabrics of variants I and II with different proportions of Rhovyl AS are listed in Table 2. The count of bacteria on a sample is given in cfu (colony forming units). The results of the antibacterial activity tests of the blanket fabrics show that the fabrics are characterised by high bacteriostatic and bactericidal activity regardless of the percentage and amount of Rhovyl AS in the weft.

The values of antibacterial activity of the grey blanket fabrics with Rhovyl AS in their weft after 2, 4, 6, 8, and 10 washings are presented in Figure 1. It can be seen that the bacteriostatic activity was slightly lower after 2

washings, but the level of activity remained unchanged after further washings. The bactericidal activity, however, can be regarded as retaining the same level, since the values 3.1 and 3.4 are within the interval of confidence for values describing the amount of bacteria on the sample. All in all, the above results indicate permanent biological activity of the Rhovyl AS fibres imparted to them by Triclosan added to the polymer melt.

#### Tests of resistance to catching fire

An evaluation of the test results for resistance to catching fire from a smouldering cigarette and from a small open flame are presented in Table 3. All of the blankets tested showed resistance to catching fire from a smouldering cigarette. However, resistance to catching fire from a small open flame was shown only by the blankets whose pile was made of 100% and 70% Rhovyl AS.

#### Evaluation of performance in use

All patients expressed favourable opinions regarding the blankets, underlining the following merits: quick warming of the body, contribution to falling asleep, comfort of night rest, alleviation of the nocturnal pain in joints, reduction of morning stiffness; improved general feeling; ability to relax and rapid return to health; reduced suffering from spinal and articulate pain [11,12]. The blankets were also praised for their lightness, softness, and cosiness.

The doctors of the patients said that the reduction of so-called morning stiffness facilitated the rehabilitation treatment. Furthermore, using the Rhovyl-pile blankets in parallel with pharmacological treatment and rehabilitation led to a reduction in suffering for patients with pain syndromes due to degenerative changes in the spine and/or joints [12]. The general opinion of both medical teams was that the blankets made with Rhovyl AS in the pile could be classified in the group of therapeutic products which facilitate the rehabilitation treatment as so-called 'anti-rheumatic' blankets.

#### Summary

1. The effect of the presence of the Rhovyl AS fibre in the weft of a blanket fabric on the properties of a blanket made from such a fabric is the following:

- the blankets made with 100% Rhovyl AS in the pile have antibacterial properties, are resistant to catching fire from a smouldering cigarette or a small open flame, and are proved to assist the treatment of rheumatic and

**Table 3.** Evaluation the test results for fire-resistance of blankets made with Rhovyl AS and with 100% PAN in the blanket pile; psm - progressing smouldering, bwf - burning with flame, - catching fire not recorded, + catching fire recorded, \* sample required extinguishing.

Type of fibre in blanket pile	Criteria	Resistance to catching fire from:	
		smouldering cigarette	small open flame
100% PAN	psm	-	+
	bwf	-	+*
100% Rhovyl AS	psm	-	-
	bwf	-	-
70% Rhovyl AS30% PAN	psm	-	-
	bwf	-	-
50% Rhovyl AS50% PAN	psm	-	+
	bwf	-	+

other diseases causing movement dysfunction;

- the blankets made with 70% Rhovyl AS in the pile have antibacterial properties and are resistant to catching fire from a smouldering cigarette or a small open flame;
- the blankets made with 50% Rhovyl AS in the pile are superior to the standard blankets now available in the market in that they have antibacterial properties.

2. The areas of social life where the developed product-groups of blankets may have an application depend on the expectations of the users regarding the properties of the individual product groups:

- the blankets made with 100% Rhovyl AS in the pile can be used in hospitals and sanatoriums, hotels, holiday hostels, care houses for handicapped and aged persons, in home-care for persons with rheumatic problems, and in the army;
- the blankets made with 70% Rhovyl AS in the pile can be used in hospitals and sanatoriums, holiday hostels, shelters, guest rooms, railway facilities, the army, etc., i.e. in public facilities which are required to meet not only health-safety but also fire-safety requirements;
- the blankets made with 50% Rhovyl AS in the pile can be used in hospitals and sanatoriums and can in the individual-buyer market gradually replace the conventional PAN blanket, i.e. in areas where meeting fire-safety requirements is less important, but the antibacterial property of the blanket is of major importance. □

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