ABSTRACT

This dissertation was prepared as part of the "Implementation Doctorate" programme in cooperation between the Institute of Material Science of Textiles and Polymer Composites at the Technical University of Łódź and the Tricomed SA company operating as a joint-stock company within the TZMO SA Capital Group. This dissertation presents the results of research into the development of a technology for the production of an innovative garment with presumed parameters to ensure optimal physiological comfort for use in newborns classified as premature infants.

In the first chapter, the problem which concerns premature babies related to thermoregulation and in particular to excessive loss of heat and water from their bodies is introduced. Furthermore, a literature and market analysis of current material solutions with special applications for premature babies is provided. In addition, raw material and constructional solutions for clothing for preterm infants as well as textoronic solutions containing sensors in their structure to measure children's vital functions are presented. Criteria for protective garments for babies are defined, as well as the scope of tests to be conducted in order to obtain a quality certificate for a medical device such as a garment for premature babies under development.

The second chapter summarizes the current state of knowledge on solutions for children and the criteria for garments for babies and especially for preterm infants. It is presented that there is an urgent need to work on the development of garments for preterm infants which at simultaneously maintain the thermal and liquid balance in the body of preterm infants in a state of physiological equilibrium and which are safe and comfortable to wear. A solution currently used in neonatology units, i.e. foil bags, which do not provide thermal comfort but only ensure reduced water loss from the body, is presented.

Section three includes the aim, scope and thesis of the study. The aim of the study was to develop a garment that protects the physiological comfort and safety of the preterm baby, based on layering systems that protect against heat and moisture loss with integrated electronic systems that monitor the functional parameters of preterm babies.

The fourth chapter presents the research methodology that was used to characterize the tested materials and to verify that the design objectives that were assumed at the introduction were achieved.

The fifth section contains the results of research to characterize the tested materials, which enabled the best variant of the three-layer system for garments for premature babies to be selected. The study of the raw materials of the developed layering system is presented, followed by physical, chemical and biophysical comfort tests, on the basis of which 2 variants of the layering system were selected for further testing. Tests of the three-layer systems both before and after washing, sterilization and accelerated ageing processes are also presented. The results of tests on three-layer systems with embroidered sensors made from electrically conductive yarns are described.

The sixth chapter is focused on the description of technological processes, which included the design and development of technology for the production of innovative three-layer materials and the selection of the equipment necessary for the manufacture of the final products. The selection of the type of sterilization process, washing process and packaging

system is described. In addition, the manufacturing and sterilization validation process and biocompatibility assessment were presented.

The chapter seven presents a summary of the research results obtained, focusing on the selection of the material and the total technology for the production of three-layer systems and baby clothes, which are a medical device of the first class. The total process of achieving the set parameters and the goal of developing a protective garment for premature babies was summarized.

Finally, this dissertation was summarized by presenting the final conclusions.