AUTEX 2018

Leading Edge Technologies and Trends in Textiles

18th World Textile Conference

www.autex2018.org

BOOK OF FULL TEXT

20-22 June 2018

Swissotel The Bosphorus

İstanbul, Turkey

Smart and Safe Chemical Protective Clothing (CPC)

E. Strazdiene[1], A. Kozic[2], V. Bytautaite[1] and Inga Dabolina[3]

[1]Vilnius University of Technology, Faculty of Arts and Creative Technologies, Didlaukio str. 82 LT-08303 Vilnius, Lithuania
[2]Vilnius University of Technology, Faculty of Electronics and Informatics, J. Jasinskio str. 15 LT-0111Vilnius, Lithuania
[3] Riga Technical University, Kaļķu iela 1, LV-1658 riga, Latvija

Corresponding author: email address e.strazdiene@mtf.viko.lt

Abstract The object for the investigation is chemical protective clothing (CPC), which totally coves dressed human body together with gear: breathing apparatus, breathing mask and helmet. The end users of such clothing are the members of rescue team – firefighters. The results of 3D scanning with stationary Vitus Smart XXL scanner and portable Artec Eva scanner are presented. The possibilities to export scanned bodies into specialized CAD systems for suit design development are analysed. The necessity to understand and to implement corresponding clothing material properties during 3D visualization of garment on CAD systems are presented. Obtained results showed, that virtual fitting supplemented by scanning procedure significantly contribute for the implementation of mass customization concept not only for traditional garments, but for specialized work wear, as well.

***Keywords*— Safe work wear, 3D scanning, CAD system, Mass customization.**

I. Introduction

Fashion industry is an exceptionally viable area of activity that employs millions of people by creating extremely high profits, and which touches each of us wherever we are and whatever we do. In the second half of the 20th century the concept of clothing as non-processed item started to dominate. Technological progress and rising middle class all over the world have led to the appearance of "fast fashion", which is accompanied by uncontrolled environmental pollution, the excessive use of resources, the phenomenon called "modern slavery". Still land resources are limited, and rapid global warming forces inevitably lead to new added value chains that must ensure long-term sustainability - the circular economy and the waist-less society.

The approach of 4th industrial revolution accelerates the efficiency growth of fashion value chains due to the integration of data analysis, robotics, sensors 3D scanning and printing, internet of things, virtual and augmented reality. Intensive digitization of the majority of design and manufacturing processes leads to mass customization, which still is not widely available option for companies producing fashion and specialized clothing, e.g. personal protective garments. The widespread use of CAD systems in garment industry to design patterns along with database resulting from 3D scanning technology of the human body, are perquisites for virtual modelling of the dimensional correspondence between 2D patterns and concrete human body [1]. All these innovations concern not only traditional garment industry, but specialized protective clothing, as well. Due to the huge number of variables involved, numerous levels and types of chemical protective clothing systems has been technologically developed [2]. It must be noted that such clothing is worn on fully dressed human body and often equipped with specialized gear, what makes comfort fitting of them more complicated. Thus, the aim of this research was to develop the digitized method of chemical protective clothing (CPC) prototype generation, which would comprise 3D scanning with hand-held scanner technology together with virtual fitting, 2D pattern creation and material consumption calculation software by providing maximal comfort of developed clothing. Additional task was to integrate smart communication system into CPC for more efficient and safe work of firefighters' team.

II. Object of the Investigation

The object of the investigation was chemical protective clothing (CPC) for firefighters Trellchem®VPS of encapsulating design (type VP1), size XL. Technical characteristics of the selected type of CPC show that it is resistant to a wide range of chemicals for more than 8 hours. It is also resistant to abrasion and flame due to materials and seams multilayer structure. A visor and standard zipper applied in this CPC are both chemically resistant. Trellchem®VPS CPC suit follows the requirements of standards: EN 943-2/ET; EN 943-1; EN 1073-2; EN 14126 [3].

III. Full Body 3D Scanning Methodology

In circular economy digitization of value chains takes a special place, especially where earlier only physical objects - human models, paper patterns, real textile pre-samples, etc., were used. Virtualization and digitalisation of design and manufacturing processes allow to create products in respect to personalized needs of any customer, who becomes not a passive user, but an active participant in the value chain. Such processes are based on innovative IT technologies: 3D scanning and 3D printing, product virtualisation and animation, new digital e-commerce formats, and co-design development platforms. These technologies provide sustainability by digitizing physical objects, e.g. parametric dummies, scanned human bodies, etc., which may be accessed any time, anywhere.

In global production time is a guarantee of success, which to a large extent depends upon the product development process, which is an intermediary between design and manufacturing and mainly determines brands appeal and customer loyalty in terms of product appearance, comfort and price. Nowadays plenty of software exists for 2D design and 3D try-on of clothing. Such names of CAD companies as Gerber, Lectra, Optitex, Audaces, etc., have already become an integral part of the everyday life of a larger or smaller clothing company, producing traditional, as well as specialized and protective garments.

The aim of this investigation was the adjustment of CPC patterns in respect to the optimal comfort between the dressed firefighter's body with full gear (breathing apparatus, helmet and breathing mask) and the surface of CPC, which nowadays is performed with contemporary pattern making and virtual fitting CAD systems (Fig 1). For this reason, firefighters' full bodies were scanned with hand-held scanner Artec Eva and stationary full body scanner. Modaris 3D Fit (Lectra) CAD system was chosen for CPC suit virtual fitting and its comfort assessment, because this software provides control early on in the product lifecycle, i.e. shortens garment development cycle by reducing the need for time-consuming physical samples, manual grading and physical fit sessions. After the generation of firefighter's virtual body, it was imported into this software for CPC suits visualization and simulation on scanned model. Scanned data was processed with Artec Studio 11, which is industry-acclaimed software for advanced 3D scanning and data processing (Fig. 2 and 3).

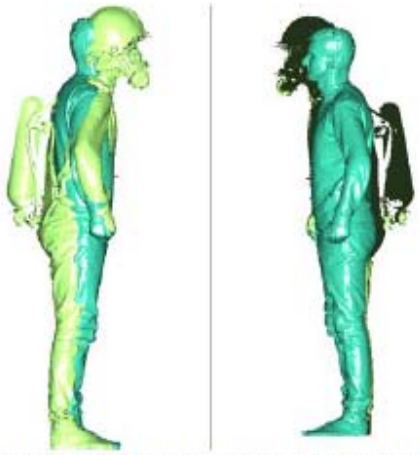

Fig. 1. The change of firefighters body position with gear and without it.

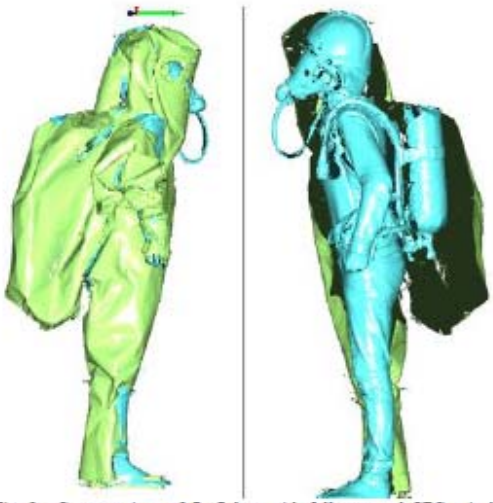

Fig. 2. Cross-sections of firefighter with full gear and CPC suit during fitting investigation at straight standing position.

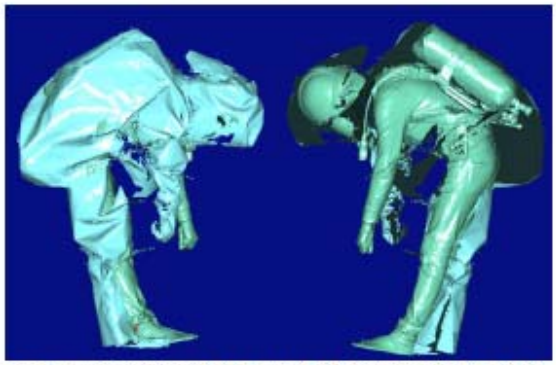

Fig. 3. Cross-sections of firefighter with full gear and CPC suit during fitting investigation at bent body position.

Virtual fittings of CPC on parameterized mannequin from Lectra database and on scanned firefighter with full gear justifies the possibility to assess the comfort level of specialized clothing, but it depends on the construction of the garment. In Modaris 3D Fit software three types of slip-on points neck, hands and legs are used for garment draping simulation. It means that draping of hood, front visor and the bag for breathing gear on the back must be draped manually using pull fabric by point or line function, because no slip-on point is provided for such parts of clothing. It is also important that scanning of workers with different types of equipment allows to customize clothing taking into account not only workers body shape and measurements, but the size of worn equipment. Even more that the gear, which is worn for different jobs differs in size and shape.

IV. Internal and External Communication System of CPC

The second task of this investigation was to develop close-fitting holsters that would integrate radio transmitters, headsets, remote speaker microphones and other devices, which are necessary for firefighters and rescue team members to ensure better internal and external communication between them during different type of accidents. Such vests will be universal. i.e. could be worn under the CPC, which covers the whole body of firefighter together with gear (breathing apparatus, breathing mask and helmet). Also it would be adjustable for lighter types of clothing, e.g. when gear is worn on the top of protective clothing. Sewing and embroidering technologies will be applied to incorporate electronic components into garment.

V. Conclusion

Customer needs and behavior in the future will become more complex, more focused on new technologies and more difficult to predict. The market will be less favourable to those brands that traditionally relied on loyal customers, as they will have plenty of information about different brands and will possess wide choice for options even for specialized and protective clothing. New online technologies such as virtual fashion shows, mobile payment infrastructures, etc. will help to personalize customer communication adding the value of sustainability, which is inseparable from waste and pollution reduction and product life-cycle extension.

Acknowledgment

This research work was partially financed by the European Union's European Regional Development Fund, through the INTERREG BSR Programme, which awarded a grant to the SWW project (#R006). The authors gratefully acknowledge the received financial support.

References

[1] Rahman M, Rayyaan R, Nur G, Saaqib N and Shibly M H 2015 An Exploratory Study on Modern 3D Computerised Body Scanning System and Various Types of Pattern Making Software's with their Constructive Implementation in Apparel Industry (European Scientific Journal vol.11) no. 15, p 1-15

[2] Khalil E 2015 A Technical Overview on Protective Clothing against Chemical Hazards (AASCIT Journal of Chemistry vol. 2) no. 3, p 67-76

[3] Ansell. Chemical products. http://www.ansell.com/en/Industries/Chemical/All-chemical-products.aspx