SMART FLEXIBLE MATERIALS CLOSE TO THE INDUSTRIAL BREAK-THROUGH

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ABSTRACT

Despite strong development effort inside R&D departments over the last decade smart textiles are still available only on the prototype level. One of the main reasons goes to the technology, which has not been developed or adopted for a serial production yet. Neither the market is ready to accept high prices beside the limited functionality smart textiles still have.
The main objective of the paper is to present the relation "problem/solution fit" and "product/market fit" by the development of the smart textile product, the Textile Heating System which has been successfully transferred from prototype to a scale up level.

Key Words: smart materials, textile heating system, scale up production

1. BACKGROUND AND OBJECTIVES

The overall size of the global smart textile market was estimated to be USD 289.5 million in 2012 and expected to exceed USD 1,500 million by 2020 (PRWEB) and as reported by Global Market Insights today, the smart clothing market is set to exceed US$4bn by 2024 [1].

Stakeholders report that initially, the development of smart textiles domain was driven by technology push. However, this approach often proved to be impractical, not taking into account the actual needs of the market. With the integration of big data analysis into the value chain, more user-driven applications begin to emerge. The profit is reported to come mainly from software selling rather than from the clothing itself[l]. Questions which we are exposed to: Are we finally close to the industrial break-through? Do we understand the relation "product/market fit" and the business roadmap behind it for being able to launch smart flexible products onto the market?

The textile sector related to smart textile products is still at the early stages of development. Rapid advancements in textile technologies, including nanotechnology, biosensors, new materials, and miniaturised electronics are needed for a major change. Beside embedding the sensors to allow sensing and monitoring the wearer's function, another development refers to smart heating that allow maintaining human thermal comfort, by sustaining an optimal body temperature.

The main objective of the given paper is to present the relation "problem/solution fit" and "product/market fit" by use case and the development of one of the first kind of smart textile product, the Textile Heating System (Kufner, Germany) which has been successfully transferred from prototype to a scale up level. The facts, like the solution validation through customer acquisition, market validation through retention and scaling by accelerating growth while increasing the organisational maturity will be discussed.

2. METHODOLOGY and RESULTS

The Textile Heating System (THS) presented on Figure 1 is a patented technology which represents a new generation of flexible heating elements for different applications. It combines conductive elements and a flexible textile structure. Its competitive advantage against conventional heating is in a serial production using special warp knitting technology with weft yarn, which gives uniform heat distribution. Within the robustness is unsensitive against mechanical stresses, while the knitting construction of heating elements assures low energy consumption and the flexibility in the customized size. Based on the testing of the heating function versus energy consumption, the homogeneous heat distribution is achieved for any customized size and end application.

Figure 1 Textile Heating System (THS)

2.1. Textile Heating System with integrated sensors

The patented technology by Kufner [2] enables the integration of the sensor yarn in the same technical procedure as the heating textiles is produced. Such a technological innovation made a huge progress in the serial production of smart textiles.

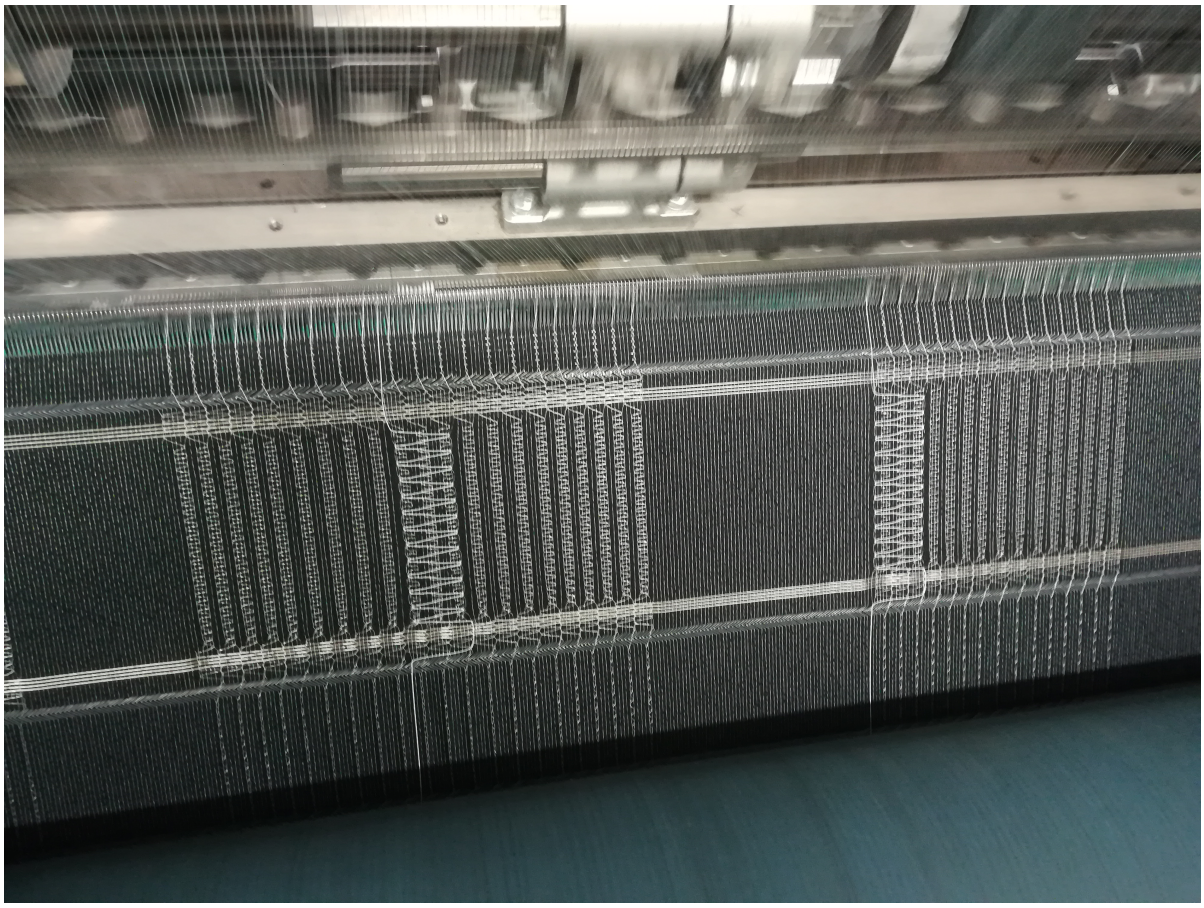

Figure 2 The production of the heating textiles THS with the integrated sensor yarn

3. RESULTS

For the heating textiles is important to reach the homogenic heat distribution. Using the THS Technology, the heat distribution is for 20% better compared to other heating solutions. Figure 3 shows the conventional heating

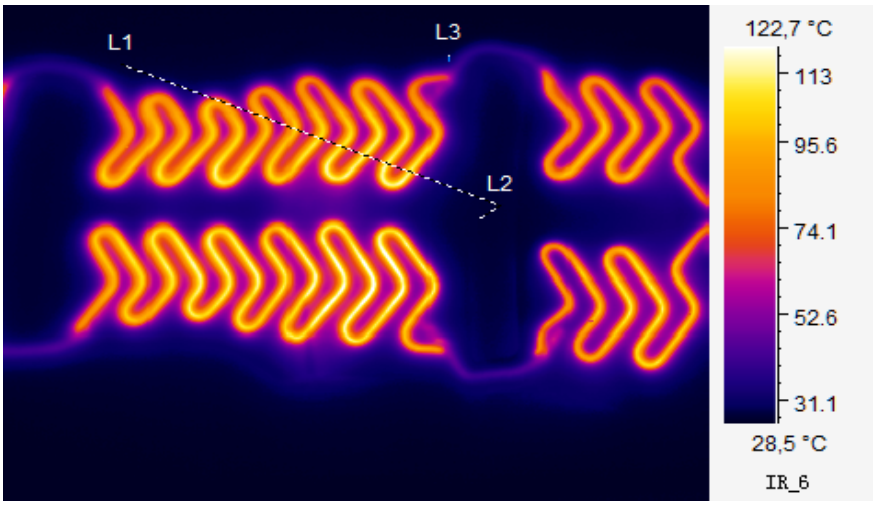

Figure 3 Conventional heating textiles

Figure 4 shows the temperature data obtained over heating surface for the conventional heating textile (presented on the Fig 3).

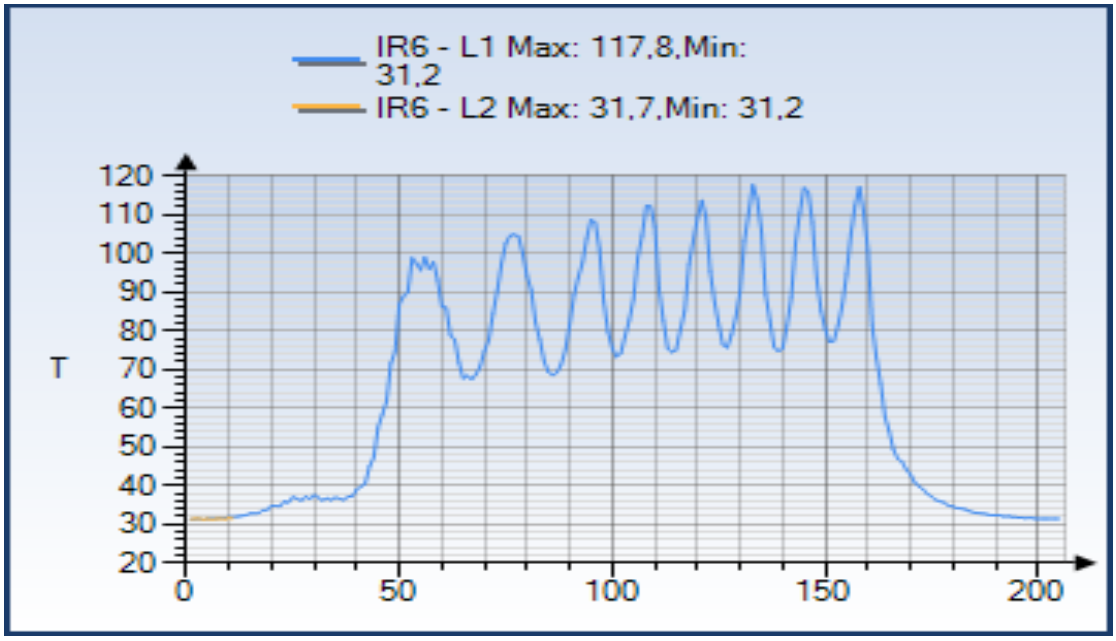

Figure 4 Temperature data obtained over heating surface of the conventional heating

THS enables homogeny heat distribution as shown on the Figure 5. The temperature data obtained over the heating surface are presented on the Figure 6.

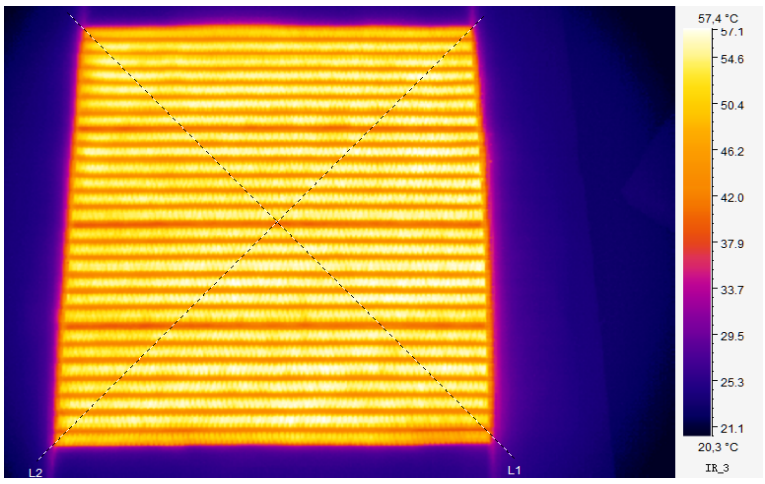

Figure 5 Heat distribution over THS

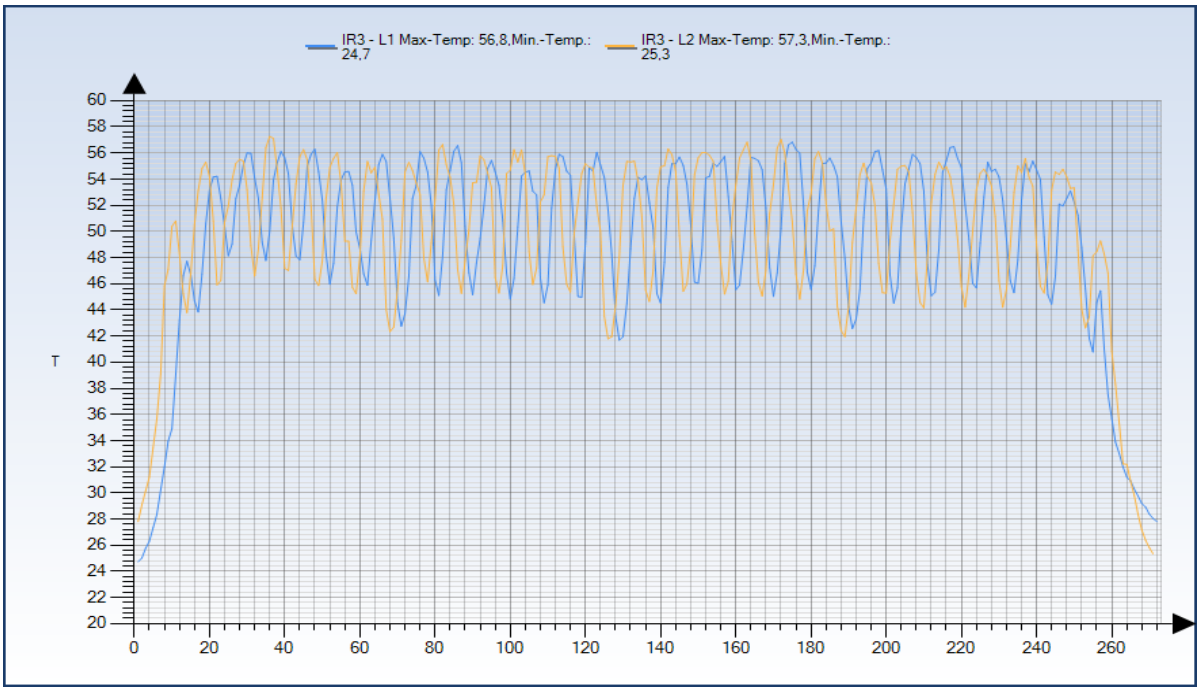

Figure 7 Temperature data obtained over heating surface of the THS

The temperature of the heating textile can be measured using the IR camera in the development laboratory (Figure 3 and Figure 5). However, the real need in the industry and on the side of end users is to measure the temperature over the heating surface in real time. For this purpose, the temperature sensor yarn has been integrated into the THS. The relation between the resistance and the temperature sensor yarn is presented on the Figure 8.

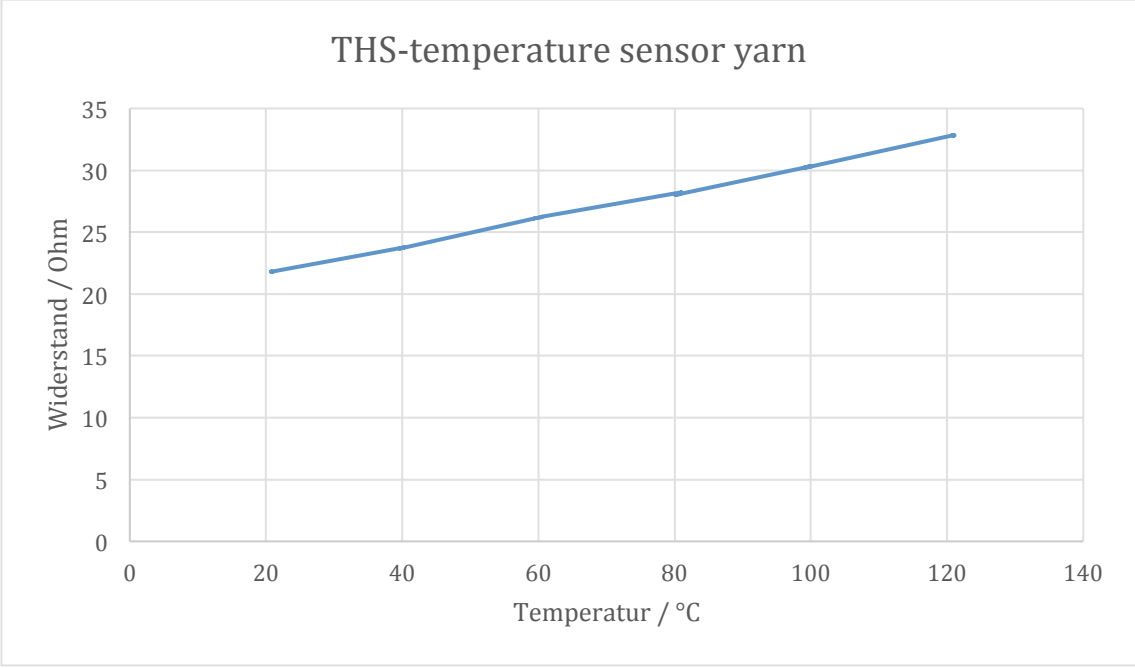

Figure 8 Relation between the resistance and temperature of the temperature sensor yarn

4. CONCLUSIONS

The heating textile THS is today available on a roll in maximum width of 4.4m or in the customized size (Figure 1) and it is applicable on any textile support. It is about the flexible and stretchable textile with an extraordinary uniform heat distribution. While integrated into the clothing, it brings the higher thermal comfort and maintain the constant temperature. With an integrated temperature sensor yarn the overheating can be avoided.

5. REFERENCES

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