

CIRCULAR & FUNCTIONAL MATTRESS FOR THE HEALTHCARE SECTOR

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Abstract: Pressure ulcers (bedsores or decubitus) are a serious international healthcare problem affecting between 7.9% and 20.5% of the population in each European country [1]. The Netherlands alone has nearly 180,000 robust, non-recyclable mattresses [2] in the healthcare sector (Figure 1A). Studies [3], expert nurses, and surgeon from partner hospital indicate that these mattresses are highly uncomfortable to caretakers because of poor microclimatic management (air and moisture permeability, temperature, friction, and pressure regulation) across the mattress, causing pressure ulcers (often in a day), leading to extra costs. Therefore, the aim is to develop and valorise a category 2 decubitus preventive, standard, functional, and circular mattresses for the healthcare sector (Figure 1B). The aim is to extend the reach of this caretaker-centric technology to different hospitals and nursing homes in the Netherlands/Europe.

Keywords: Mono-material circular and functional mattress, APTI Category 2 decubitus preventive mattress.

The ATPI (Assistive Products for Tissue Integrity) standard mattress will be re-designed to satisfy key EU requirements and Medical Device Regulations (MDR) guidelines. This will be a passive standard mattress without any electrical pumps.



Figure 1 Proposed circular (mono-material) and functional mattress (B) and its comparison with standard mattress (A).

A detailed list of requirements for such a mattress system has been generated by following a suitable V-shape verification and validation methodology. MDR guidelines, expert interviews, and thematic analysis into

five areas; a) General mattress systems for healthcare, b) Usability and hygiene, c) Functionality, d) Circularity, and e) Logistics & others.

The entire mattress value chain (the 'systemic approach') is involved, including producers, caretakers (users), caregivers (nurses), and recyclers. The mono-material solution has been envisioned. This approach ensures that all components including the core, cover, zipper, and labels, contribute to a seamless recycling process of the entire mattress. The design and development have been successfully progressed in the following phases. The detailed evaluation and testing results will be presented in the full paper.

- 1. Mattress cover:** We have been working on at least 10 different alternatives that offer functionality and circularity. We have identified commercially available polyester-based monolithic membranes that support gradient diffusion of vapour (sweat) and body heat. Such membranes have been used to produce robust multilayer mono-material sandwich structures.
- 2. Mattress core:** 3D spacer fabrics (Figure 1B) are made of lightweight thermoplastic polymers. We have tested 15 cm thick 3D spacer for its pressure distribution, resilience, heat distribution, etc.
- 3. Design and mattress assembly:** Here design plays an important role. The key challenge is to impart a polymeric zipper (no metal zipper) to the mattress cover. Different welding techniques (attaching zippers to the cover without stitching e.g., ultrasonic welding, have been explored. This is important from a production, usability, and recycling perspective.

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REFERENCES

- [1] Fact sheet, European Pressure Ulcer Advisory Panel, (www.epuap.org), 2019.
- [2] Agrawal, P.B., et. al., Mechanical & Chemical Recycling of post-consumer mattress components, AUTEX 2021, 20th World Textile Conference, 2021.
- [3] Zhong, et.al. Textiles and Human Skin, Microclimate, Cutaneous Reactions: An Overview. Cutaneous and Ocular Toxicology 25 (1): 23–39, 2006.

