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*Published in:*

Book of Abstracts. DTU's Sustain Conference 2015

*Publication date:*

2015

*Document Version*

Publisher's PDF, also known as Version of record

[Link back to DTU Orbit](#)

*Citation (APA):*

Brilhuis-Meijer, E., & Saxena, P. (2015). The sustainable future of packaging: A biodegradable paper beer bottle. In Book of Abstracts. DTU's Sustain Conference 2015 [M-5] Lyngby: Technical University of Denmark (DTU).

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## The sustainable future of packaging: A biodegradable paper beer bottle

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The vision of the Green Fiber Bottle (GFB) project is to develop the world's first paper beer bottle, which will be both recyclable and biodegradable. It is intended to be an environmentally sustainable alternative to the existing glass and plastic beer bottles. To achieve this, both the bottle and the production process that is required to shape the cellulose fibers into the bottle need to be developed. This is done in a collaboration between Carlsberg, EcoXpac, Innovation Fund Denmark and DTU.



To ensure that the GFB will offer an environmentally friendly solution, sustainability will be integrated in the development process. Ecodesign approaches will be selected and applied each step of the way for both the bottle itself and the required technologies. One of these approaches will be the use of Life Cycle Assessment (LCA). Early on, the LCA will be based on predictions and assumptions, which will be replaced with more precise data whenever it becomes available. The resulting calculation of the potential environmental impact provides insight into the areas that may require specific attention, such as energy consumption during the production process, transportation and recycling. With the availability of more precise data will come more detailed insight, allowing more precise assessment of materials and emissions that may be of concern. Other sustainability considerations include the sourcing of bio-based materials, biodegradability and prevention of waste.

Besides the sustainability considerations, there are many other challenges for developing the GFB. These include production challenges, such as the required throughput for Fast Moving Consumer Goods (FMCG) and functional challenges, such as maintaining a pressure of up to 6 bar inside the bottle, limiting oxygen ingress and achieving a shelf-life of at least 6 months.

To enable the production of the GFB, a new mass production process based on integrating fiber molding and in-mold impulse drying technology will be developed, able to cope with the required production rate and volume. Impulse drying is a technique to enhance the removal of water from paper pulp using a tool heated to a temperature in the order of 250 °C. It exploits the partial vaporization of the liquid phase and the consequently generated overpressure to quickly push the water out of the pulp which thus dries and hardens.

The impulse drying will reduce both the need for energy and the production time for each bottle, thereby reducing the production cost significantly. In this way the price of a GFB is intended to be competitive with existing market solutions, thus making it attractive for companies to use.