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Publication date:
2016

Document Version
Publisher's PDF, also known as Version of record

Citation (APA):
Didone, M., & Tosello, G. (2016). Green Fiber Bottle: the fully biodegradable packaging. Abstract from Sustain-ATV Conference 2016, Kgs. Lyngby, Denmark.

Green Fiber Bottle: the fully biodegradable packaging

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The ambition of the Green Fiber Bottle (GFB) project is to manufacture a fully biodegradable bottle. Carlsberg is the intended end user, and they aim to package their beer in the new bottle. The new product is intended to replace the existing plastic and glass bottles, and thus reducing their impact on the environment, especially the oceans. For example, the life span of a plastic bottle in the ocean is 500 years, and during its degradation, the plastic is reduced to micro pieces, which causes the starvation of several marine animals.

The new bottle is completely made from molded paper pulp, which is a renewable resource. Nevertheless, due to food and drugs limitations, only virgin paper fibers must be employed in the production. The bottle could then be left to biodegrade in nature or enter a recycle system, along with other paper-based product. In order to contain the liquid, the bottle has to have an inner coating barrier. The most reliable solution proposed is to coat the inner walls with silicon dioxide, which is not biodegradable but rather environmentally inert.

To enhance the environmental footprint and sustainability of the bottle, and to be competitive with the existing technologies, the manufacturing technology for the production of the bottle has to offer the possibility of significant energy savings. Molded pulp products are made from wood fibers dispersed in water, and then they are formed, drained and dried. A relatively large quantity of resources (i.e. energy and time) is consumed during the drying process. It is in this process stage that an innovative way of drying the products can be exploited by using the concept of impulse drying. Impulse drying is an advance drying technique in which water is removed from a wet paper pulp by the combination of mechanical pressure and intense heat. In this process, the wet pulp is exposed to pressures ranging from 30 bar to 50 bar and temperatures typically between 200 °C and 400 °C. At these intense conditions, the wet pulp is dried in the order of seconds.

Many challenges must be dealt with to enable the use of such improvement in the production of the GFB. One of the research topics currently under investigation is the understanding and modelling of the impulse drying effect. Experimental evidence proves that a part of the liquid content in the paper pulp transforms into steam, and the correlated expansion eases the movement of the water out of the product. This secondary effect should be at the base of the reason why the drying takes place in a considerable short time. Nevertheless, a complete understanding of the phenomena has not been achieved, and thus a complete control of the drying mechanism is yet to be realized. The need of a physical model is thus clear in order to enable the use of impulse drying in a production environment.