

## THE INFLUENCE OF UP- AND DOWNRIGHT BOTTLE STORAGE ON OXYGEN PERMEATION THROUGH CROW CORKS

Hofmann, R.<sup>1</sup>, Mugume, F.<sup>2</sup>, Dobrick, S.<sup>1</sup>, Weber, I.<sup>1</sup>, Pahl, R.<sup>1</sup>

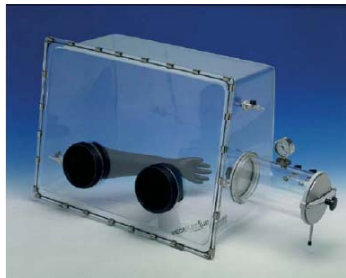
<sup>1</sup> Versuchs- und Lehranstalt für Brauerei in Berlin (VLB) e.V., Berlin, Germany

<sup>2</sup> Business Academy Aarhus, Aarhus, Denmark

### Introduction:

Oxygen permeation is an essential quality issue for the shelf-life of a bottled product. In the case of the product beer even small quantities of oxygen ingress may lead to a faster loss of flavor and chemical stability. At the World Brewing Congress 2012 in Portland, Oregon, a presentation by Eric Samp, Miller Coors Brewing Company, revealed the possibility of storing glass bottles upside down to reduce the measured oxygen content in beer to 0 within a short time frame. By storing the bottles upright after two weeks the oxygen ingress may be measured within the following days using a destructive measurement method. The results of the research also suggested that the permeation rate is reduced when bottles are stored upside down and the oxygen transfer passes a solid-liquid barrier instead of the solid-gas barrier when stored upright. The presented research shall further investigate the kinetics of the oxygen ingress when bottles are stored in both ways and the results are compared.

Fig. 1: Glove box system that was used to prepare sample bottles with water medium and beer at controlled low oxygen levels



### Materials and Methods:

Table 1: Groups of samples for the research project

	Storage	
	Upright	Downright
Daily shaking	Group 1 (UD)	Group 3 (DD)
No shaking	Group 2 (UN)	Group 4 (DN)

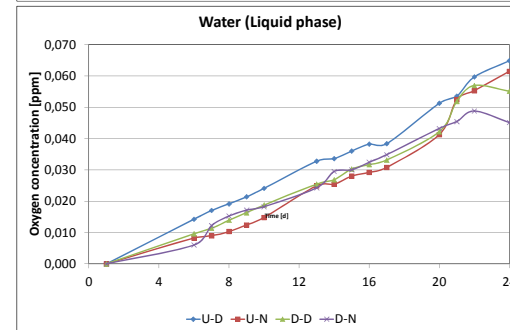
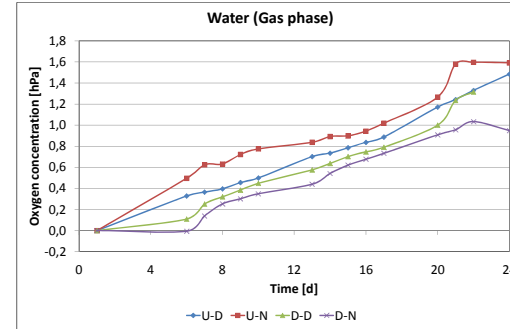
Oxygen measurement was done using a non-destructive optical measurement method (Fibox 3; PreSens, Regensburg/Germany).

Beer, as an oxygen consuming medium, and an inert water based medium were filled into test bottles to monitor the influence of the liquid itself. During the filling the oxygen atmosphere in the Glove box system was monitored to ensure starting oxygen values of < 0.02 mg/L in the liquid phase.

Initially all bottles were shaken into equilibrium and the starting values registered. The oxygen level was evaluated dissolved in the liquid (in mg/L) as well as in the gaseous head space (in hPa). Half of the bottles (Groups 1 and 3) were shaken into equilibrium between both phases before each new measurement. The aim was to investigate if the oxygen is well preserved in the head space or directly consumed by the liquid within the given storage period. The timeframe for each test run was three weeks.

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### Results and Discussion:



The results showed that the oxygen is permeating a little faster into the bottle when the closure compound is not permanently moisturized (upright without shaking).

When the medium is beer, all samples where the oxygen gets transferred into the liquid do not show increasing oxygen levels. But for upright storage and no shaking it is obvious that the oxygen is fairly stable in the head space.

