IMPACT OF BOTTLENECK SHAPE ON CORK STOPPERS FUNCTIONAL PARAMETERS

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Abstract. *Bottles of wine are seldomly stoppered with cork closures. This work aims at contributing to the understanding of the impact of bottleneck shape and storage temperature on the stoppers performance parameters. It was observed that natural and microagglomerated corks show different time and temperature dependence on the elastic memory, the wine absorption and the extraction forces. It was also determined that the extraction force of the microagglomerated corks is significantly affected by the bottleneck shape, with up to 15 daN differences. The on-going research intends to address the importance of the bottleneck shape on the performance metrics of the two cork types, natural and micro agglmerated.*

1 INTRODUCTION

Cork stoppers are closure options for glass bottles promoting seal pressure from the inside of the bottleneck (figure 1). Cork stoppers can be made by cutting and processing the natural cork, or by manufacturing as micro agglomerated cork stoppers obtained by agglutinating cork granules within a range of sizes from 0.25 mm to 8 mm, by an extrusion or molding process using binding substances and production aids [1].

Diversely combined factors are involved in the closure insertion into the bottleneck and its further sealing capacity. Bottlenecks are characterized by their manufactured dimensional tolerances. The dimensional relation of the internal bottleneck shape to the cork determines the sealing ability with the interfacial path being fixed by the length of the closure.

Cork shows viscoelastic properties [2], [3] under the deformation (strain) promoted inside a bottleneck. The elastic memory is also affected by the confinement time into a certain volume. Moreover, the mechanical behaviour is dependent of the water content and of the temperature [4], [5]. The advancement of liquid through cork in a bottle of wine has been described as a process consisting of three stages [8].

The use conditions can then impact the performance. The performance of corks can be

assessed by the rebound recovery rate [6], compression and relaxation force [7], [8], extraction force [8], wine absorption and progression [9] and oxygen transfer [10], [11].

In the current work the goal is to bring insight into the impact of temperature and bottleneck profile on the corks performance in bottles stored for over one year.

2 METHODOLOGIES AND RESULTS

Two bottleneck profile typologies, three temperatures (room temperature for shelf storage simulation, 40ºC to account for the travel of wine bottles in long distance hauls, and 8ºC for fridge storage simulation) and two types of cork stopper (natural and micro agglomerated) were considered for the experimental design. The output variables aiming at measuring the performance of the cork closures were wine absorption, wine travel and rebound recovery rate.

A novel methodology adopting computer vision (Figure 2) and thermal images methods was used for evaluating performance, specifically for the wine absorption pattern and the diameter elastic memory after cork extraction.

In previous research it was highlighted that the time and temperature storage affect the cork elastic properties (Figure 3). Therefore, it is possible to postulate that the properties of the corks are determined by time and the temperature the stopper is subjected to in a certain volume. In a parallel experiment, it was confirmed that the extraction force is affected by the bottleneck shape by almost 15 daN when the opening of the bottle differs by less than 1.2 mm (Figure 4).

The ongoing research is designed to confirm the relevance of the bottleneck shape in the cork stoppers performance parameters.

3 FIGURES

Figure 1: representation of the seal pressure inside the bottleneck

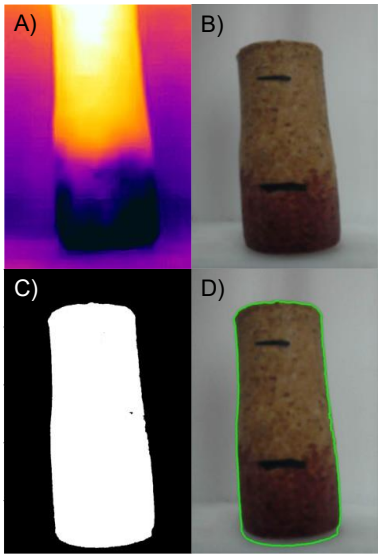

Figure 2: A) Thermal image captured with FLIR ONE PRO for wine absorption analysis, B) optical image, C) black and white image for computer vision process, D) final contour of the cork stopper for rebound recovery rate

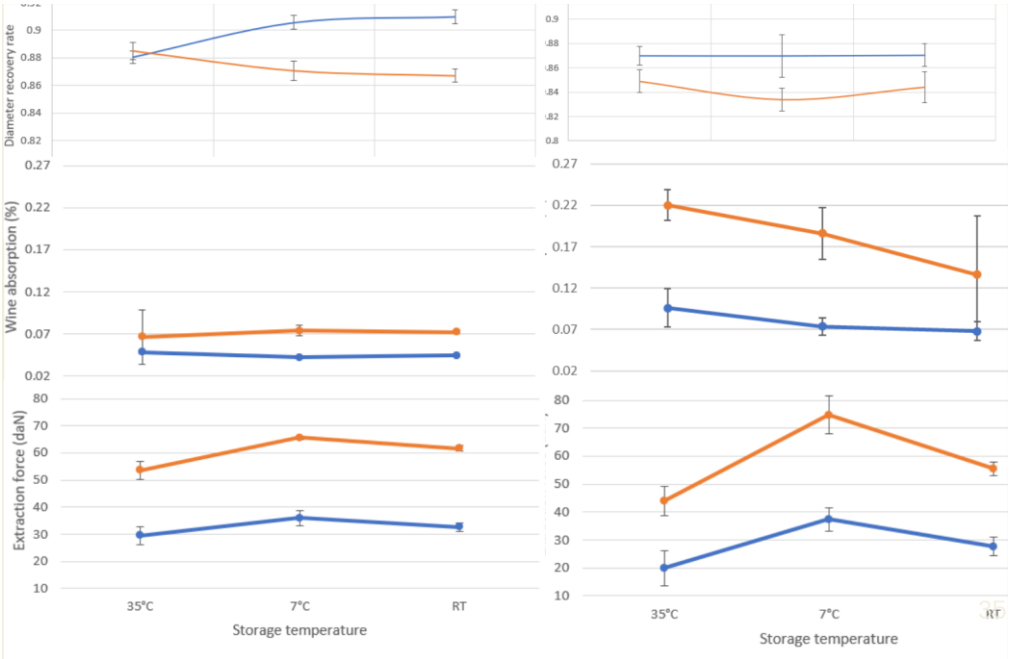

Figure 3: Preliminary results on the effect of temperature on microagglomerated (left) and natural (right) cork stoppers at 10-day and 180-day storage (The dots are the means and the vertical bars are standard deviations) after **10 days** and **180 days** of storage.

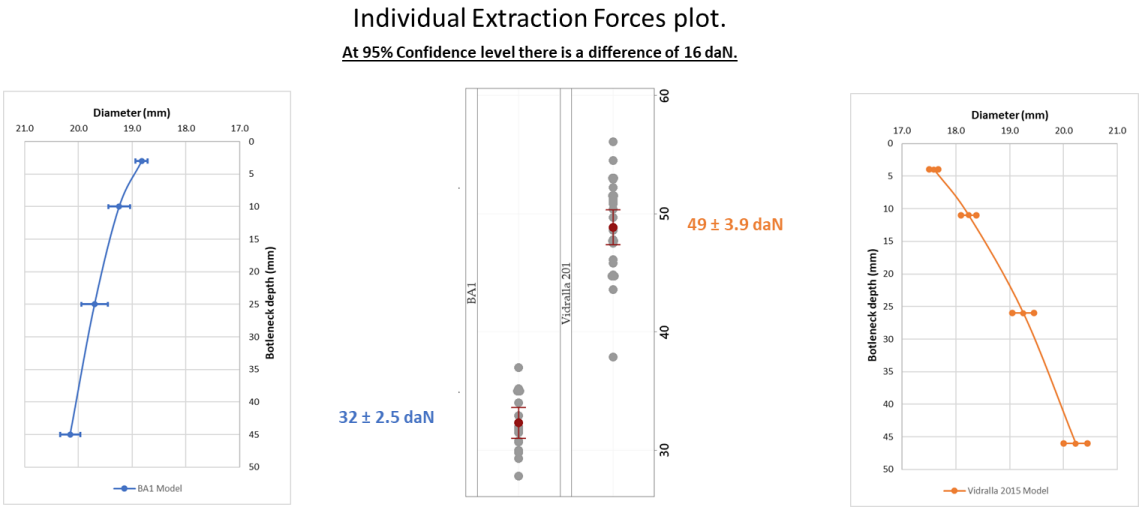

Figure 4: The impact of bottleneck profile on the extraction force of a micro agglomerate cork stopper

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