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Failure analysis of a filling valve from a Brewery's beer filler

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ABSTRACT

This paper describes a failure analysis carried out to a filling valve of a brewery beer filler. The filling valve under study is one of 120 filling valves belonging to the filler, an equipment dated 1996. This filler integrates a packaging line, in which several equipment compromise it, and the filler leads the production cadence. Hence, any malfunctioning or failure of the filler will affect the entire packaging line.

The failure herein presented prevents the filling valve from performing accurately, requiring production to be stopped and the filling valve to be opened to solve the problem. The failure leads to empty and even over flooding bottles, which are subsequently rejected from the packaging line, causing a monetary waste that could be spared. Since the filler works 64,000 bottles per hour and has 120 filling valves, the failure of one filling valve could lead to 500 bottles being rejected in one hour. The main objective of this analysis is to avoid leakage and product loss.

The failure is due to the existence of a solid residue deposit - identified as solidified beer - inside an area of the filling valve where only compressed air should circulate, preventing the proper movement of a compression helical spring. Until the reason for such deposit was figured out, several trials to eliminate a variety of hypothesis were carried out and, at the end, a modification in one of the parts of the filling valve was performed to avoid failure and keep the filler working accurately.

1. Introduction

Moubray [1] describes a failure as the inability of any asset to do what its users want it to do and a functional failure as the inability of any asset to fulfil a function to a standard of performance which is acceptable to the user. In addition, Collacott [2] cites the BS Maintenance Glossary to define failure as 'The termination of the ability of an item to perform its required function', which can involve catastrophic failure or performance failure, which, in the latter case, is associated with a reducing performance of the equipment [2].

Hence, this paper describes a performance or functional failure regarding a filling valve, showed in Fig. 1a-c, which is an essential component of a filler, Fig. 1d. A filler (Fig. 1d) is an equipment used for packaging vast arrays of liquid products like water, soft drinks, wine and beer [3]; in this particular case, a beer filler is under study.

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a) b) c) d)

Fig. 1. Views of a filling valve. a) Front view; b) Right view; c) Back view; d) Beer filler.

When a malfunction in a filling valve (Fig. 1a-c) is encountered, the filling valve must be opened and a caramelized beer residue is always found embedding a compression helical spring (Fig. 2), in a region where compressed air should be the only fluid circulating through, allowing to conclude the existence of a leakage that should not occur since beer filling valves are not design to have any leakage according to European regulations as referred in TA Luft [4]. The only fluids that circulate in the filling valve are beer and cleaning components. Due to the consistency of beer and its colour it was possible to assume that the residue consists of caramelized beer residues; in fact, cleaning components do not create deposit. This problem has been known since 2013 (Fig. 3), but it was not been taken into consideration before as it did not affect the performance of the packaging line until now.

This malfunction leads to overfilling bottles and even empty bottles that are rejected and go to waste. Once the filler fills 64,000 bottles per hour and has 120 filling valves, a failure in one valve results in 500 rejected bottles after one hour of production, which is equivalent to 165 l when considering that bottles of 0,33 l are being filled.

By assessing the failure records regarding the filling valves, it was possible to conclude that failures have been increasing over the years. Fig. 3, shows the percentage of failures in the filling valve regarding the filler failures, where in 2016, for instance, 48.31% failures of the filler were related with the filling valve. Analysing the graphic, it is possible to confirm that the failures have increased

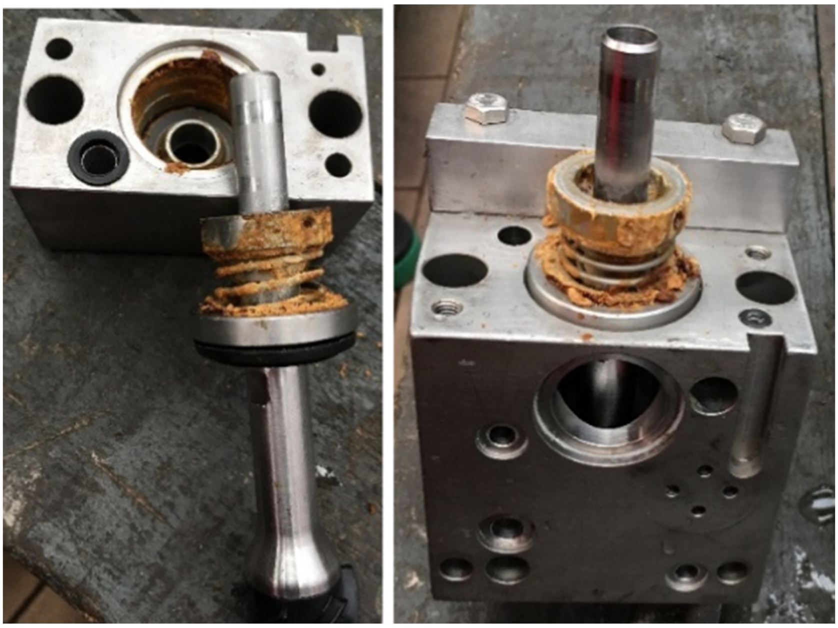

Fig. 2. Caramelized beer residue embedding the helicoidal spring.