Initial pressure application to the teat by various C-Phases

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Abstract

During the C- and D-Phases of pulsation, pressure is applied to the teat by the walls of the liner. The initial pressure applied to the teat by liner closure differs from the pressure applied by a closed liner. The objective of this study was to examine how the spikes of pressure exerted on the teat affect milking performance differences between liner types. The pressure exerted initially on a teat at the beginning of the C-Phase will change dramatically based on the duration of C-Phase, which may also explain the difference in milking performance based on the variability of C-Phases (Kochman 2008).

Introduction

Pressure is applied to the teat by the liner during the C and D-Phases of the pulsation cycle. During these phases, pressure is applied to the teat by the walls of the liner. The C-Phase is related to the rate at which the liner closes and can be used as a reference to characterize the velocity of the liner while closing (Spencer 2000). The initial pressure applied to the teat by liner closure differs from the pressure applied by a closed liner. Spikes in pressure exerted on the teat can be observed based on the velocity of the liner while closing.

Objective

The objective of this study was to examine the spikes of pressure exerted on the teat to make inferences as to the reasons for milking performance differences between liner types.

Material and Methods

Vacuum sensors with a resolution of .1 in Hg and a response time of 2.5 ms (Keyence, AP-44, Beachwood, OH) were used to measure the vacuum levels in the shell chamber and the milk tube. A laser sensor with a sampling cycle of 1024 µs, and a resolution of 3 µm (Keyence, LK086/RD-50RW, Beachwood, Ohio) was mounted in a fixture and aligned with a modified shell that had the middle section replaced with clear plastic.

An artificial teat was molded from a plastic teat dimensioned to ISO 6690-2007 and filled with glycerin. The teat was mounted to a pressure sensor with an accuracy of <+/-.5% and a response time of 50 ms (Turck, PS001R-503LIUP8X-H1141, Plymouth, Minnesota) and was used to measure the pressure during the pulsation cycle.

Analysis

Liner position was calculated as a percentage from open to close. Recordings of liner position, teat pressure, and chamber vacuum were taken each ms for 9 s duration for analysis. A DeLaval WC-01 liner was used in this trial. Vacuum was set at 13 inHg.

Results

The pressure applied to the teat through pulsation is depicted in Figure 1. This graph displays the pressure exerted on the teat by the liner based on the percent the liner is open. The maximum pressure is observed during the D-Phase and the minimum during the B-Phase. The increase of pressure is evident through the C-Phase and the decrease through the A-Phase.

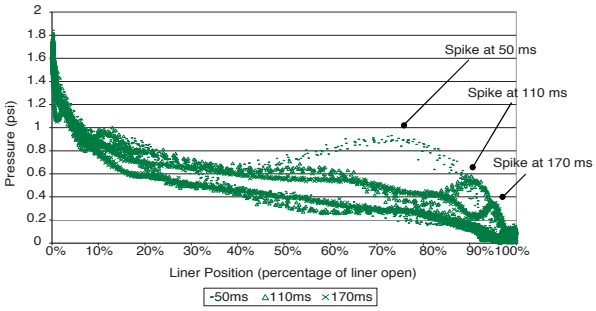
The pressure profiles are displayed in Figure 2 with varying C-Phases. Each profile depicts a different amount of pressure applied during the initial closing of the liner. The liner produced 0.90 psi with the C-Phase at 50 milliseconds (ms), 0.55 psi with the liner at 110 ms, and 0.33 psi with the liner at 150 ms. The initial spike in pressure is then followed by a decrease in pressure, which is followed by a gradual increase until peak pressure is applied.

Discussion

Creating a pressure profile that an individual liner produces on an artificial teat could be used to explain the differences seen in milking performance from each liner. It is expected that each liner design will produce its own unique profile. The shape (round, square, triangle and Tri-Circle®), thickness, compound and durometer of the liner barrel should contribute to the pressure profile of each liner by the means of which pressure is distributed to the teat. The pressure exerted initially on a teat at the beginning of the C-Phase will change dramatically based on the duration of C-Phase. This may also explain the difference in milking performance based on the variability of C-Phases (Kochman 2008).

Figure 1: Pressure Applied to the Teat with WC01 Liner Throughout Pulsation Cycle

Figure 2: Pressure Applied to the Teat with WC01 Liner at Various C Phases



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