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The effect of the duration of the C-Phase of pulsation on milking performance

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Abstract

Milking performance is dependent on system settings, with pulsator ratio being a major factor in the overall efficiency and speed of the milking process. The objective of this study was to monitor milking performance as a result of C-Phase pulsation changes. This information can help identify areas of the milking system and process that have often been overlooked, but can make significant contributions to the effectiveness of the milking system. Increasing the C-Phase above 90 ms resulted in an increase in milking performance.

Introduction

Pulsation is defined as the cyclic opening and closing of a liner by ISO 3918-2007. Pulsator rate and ratio are typically the main focus when it comes to characterizing the pulsation system. The pulsation cycle is divided into four phases as: The A-Phase or liner opening, the B-Phase or the liner open or milking phase, the C-Phase or liner closing, and D-Phase or liner closed. The objective of this study was to isolate the affects the duration of the C-Phase has on milking performance. The C-Phase is defined as the period when the vacuum in the pulsation chamber decreases from the maximum pulsation chamber vacuum minus 4 kPa to 4 kPa in ISO 39182007. Studies by Billion et al. (2001) and field observations have shown notable variations in milking performance with differences in the chamber vacuum C-Phase. This study shows that in addition to the pulsator rate and ratio, the C-Phase needs to be closely monitored when setting a milking system for optimum performance.

Objective

The objective of this study was to monitor milking performance as a result of C-Phase pulsation changes. This information can help identify areas of the milking system and process that have often been overlooked, but can make significant contributions to the effectiveness of the milking system.

Material and Methods

A trial using 300 Holsteins milked three times daily was carried out at Lauren Dairy, Millersburg, OH. The experiment used a silicone liner with a circular barrel in the open phase and triangular barrel in the closed D-Phase (Lauren Tri-Circle® Silicone Liner). Three C-Phase durations of 90, 120, 150 milliseconds (ms) and vacuum levels of 13, 14 and 15 inHg were used over an 18 day period. Yield (Y), Machine on Time (MOT), Peak Flow (PFR), Average Flow (AFR), and Milk in the first 2 Minutes (M2M) were the parameters used to determine milking performance.

Analysis

Usable data for 121 cows with complete observations were used in the analysis. Data was collected using Afikim® milk meters and data management program. A malfunctioning Afikim® control board at one station in the parlor resulted in over 100 cows being deleted from the study due to lack of identification. Pulsator rate (60cpm) and ratio (65:35) were kept constant throughout the study. The C-Phase was altered by restricting the flow at thefresh air intake on each pulsator. This provided a constant A-and B-Phase which allowed milking performance variables to be evaluated for comparative analysis at each of the C-Phase settings. A laser was utilized to measure liner wall movement under laboratory conditions.

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Results

Increasing the C-Phase above 90 ms resulted in an increase in milking performance. The experiment showed that the duration of C-Phase has a significant effect (P ≤0.05) on MOT, PFR, AFR, and M2M, while having no effect on Y, (Table 1). The results show a clear difference in performance between 90 and 120 ms C-Phase. At 120 ms, MOT decreased 5.7%, while PFR (6.2%), AFR (4.9%), and M2M (6.0%) all increased. There were slight differences in performance from 120 to 150 ms in MOT and M2M; however, PFR and AFR were not significantly different. No interactions were found between the vacuum settings and the duration of C-Phases.

Discussion

Milking performance is dependent on pulsation parameters (Spencer 2007). This study shows that in addition to the pulsator rate and ratio, the C-Phase needs to be closely monitored when setting a milking system for optimum performance. When the C-Phase was set at 90 ms, the lowest flow rates and longest milking times prevailed. The difference between a C-Phase of 90 ms and 120 ms affects the rate at which the liner closes. A liner closing faster will apply pressure faster to the teat and at higher levels. The increased speed results in an initial spike in pressure causing physical discomfort to the cow which could cause milk to be injected back into the udder (Whittlestone 1964). Both of these scenarios would provide negative results to milking performance and overall discomfort to the cow. In order to better understand this interaction the velocity of the liner wall should be further examined (Spencer 2000).

Table 1:

Least squares means for Y, MOT, PFR, AFR, and M2M for 3 C-Phase intervals for one milking of 121 Holsteins during the trial period of 18 days.

c Phase, ms	Yield, lb	Time, min	Avg Flow, lb	Peak Flow, lb	In2min, lb
90	26.46	4.60[a]	9.05[a]	5.83[a]	12.42[a]
120	26.34	4.34[b]	9.64[b]	6.11[b]	13.16[b]
150	26.47	4.40[c]	9.69[b]	6.12[b]	13.31[c]

**Statistics provided by G. Rogers and J. Cooper, University of Tennessee*

Table 2:

Duration of C-Phase vacuum and liner wall movement during C-Phase.

Chamber vacuum (ms) c phase	Liner Wall Movement (ms)
91	43
124	58
153	70

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