Silicone liner performance as a function of material

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Published at the 2005 National Mastitis Council, 44th Annual Meeting, Orlando, FL.

Abstract
Silicone milk liners have been on the market for a number of years, yet have often been slow milking and detrimental to teat end health. This study focused on the performance of a silicone milk liner in early development. The liner's milking performance as a function of flow and yield was measured over 3,000 milkings and then compared against competing brands. When used on a system with settings tailored to the liner, results of this study are contradictory to previous findings. The silicone liner performs as well as most liners on the market and outperforms other silicone liners in terms of milk speed, yield and teat end health. Following 3,000 milkings, the silicone liner had less surface degradation than other liners, indicating that satisfactory milking performance can be achieved with a liner made of material that is longer lasting than other liners currently on the market.

Introduction
The use of silicone in milking machine liners is becoming more prevalent in the dairy industry. Silicone is a food grade material often chosen due to its resistance to surface fissures that can house bacteria and because it absorbs substantially less butterfat than other materials. Some types of silicone are 3-A approved, a designation reserved for products with manufacturing processes and materials that meet exacting cleanability standards. In addition to the sanitary benefits, silicone blends absorb energy differently than organic liners, which helps combat performance changes as a result of age. Studying the performance of silicone liners will help determine how the physical benefits of silicone relate to diary production.

Objective
The objective of this study was to determine the performance characteristics of a silicone liner in the process of being developed. The liner is characterized by newer silicone or silicone–like compounds using FDA approved ingredients for food contact. The liner shape is different than previous offerings, being round with external ribs in the normal open milking position and triangular in shape as it collapses on the teat. The liner is equipped with a patent pending non-clogging vent located in the short milk tube of the liner.

Materials and Methods
Tests were conducted on two breeds of dairy cows (Holsteins and Jerseys) at the Lauren AgriSystems research facility near Berlin, Ohio. There was an average of 338 Holstein cows in the trial and 240 Jerseys. Milking was done in a double 12 Germaina® parlor equipped with S.A.E. Afikim® electronic meters. The operating vacuum at the pump was maintained at 13.9 inHg (inches of mercury) or 47.1 kPa at a pulsator rate of 60 pulses per minute and a pulsator ratio of 65:35, milk to rest.

Analysis
Data on machine-on-time, yield, average flow and peak flow rate was collected daily for over 3,000 milkings with the silicone liner. Surfaces of the liner were observed under a scanning electron microscope (Hitachi® Model 2600 N) for roughness or cracks, at intervals of 500 milkings. The liners were measured for their Critical Collapsing Pressure Difference (CCPD) and their Touch Point Pressure Difference (TPPD) in a new and used condition with a Dwyer® mercury column. The data was analyzed using standard statistical analysis methods.

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Results

Performance characteristics are presented in Tables 1 and 2. The silicone liner is able to be used 2.5 times longer than a conventional liner. This results in lower cost per milking and fewer liner changes, which saves labor. Based on scanning electron micrograph data, the interior barrel surface of the liner remained smooth after 3,000 milkings. The CCPD of four liners averaged 2.0 inHg (6.77 kPa) when new and 1.4 inHg (4.74kPa) after being used for 3,000 milkings. The TPPD of four new liners averaged 9.9 inHg (33.52 kPa) and 7.6 inHg (25.73kPa) after being used for 3,000 milkings.

Discussion

This silicone liner performed as well or better than a typical conventional liner in contrast to some other silicone liners, which often milk slower. The silicone liner maintained a much smoother interior surface than a conventional liner. Teat condition remained the same or improved while using the silicone liner and the cows were reported by the milkers to be more comfortable with the silicone liners than with a conventional liner.

Table 1

Milking performance of a silicone liner after 1,000 milkings with two breeds.

	Holsteins (N= 337)				Jerseys (N= 230)			
	Avg.[1] Flow	Peak[1] Flow	Yield[2]	Milking Time[3]	Avg.[1] Flow	Peak[1] Flow	Yield[2]	Milking Time[3]
Lb	5.88	9.56	28.07	4.71	5.07	8.24	21.78	4.27
Kg	2.67	4.34	12.73	4.71	2.30	3.74	9.88	4.27
SE	0.111	0.185	0.665	0.085	0.107	0.233	0.576	0.089

[1]Per minute [2]Yield per milking [3]Minutes per milking

Table 2

Milking performance of a silicone liner after 3,000 milkings with two breeds.

	Holsteins (N= 339)				Jerseys (N= 249)			
	Avg.[1] Flow	Peak[1] Flow	Yield[2]	Milking Time[3]	Avg.[1] Flow	Peak[1] Flow	Yield[2]	Milking Time[3]
Lb	6.14	9.86	29.697	4.87	4.97	7.68	21.19	4.26
Kg	2.79	4.47	13.47	4.87	2.25	3.48	9.61	4.26
SE	0.103	0.198	0.603	0.078	0.099	0.167	0.527	0.777

[1]Per minute [2]Yield per milking [3]Minutes per milking

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