ASPECTS REGARDING THE OPERATING PRESSURE INSIDE THE MILKING TEATCUP LINER

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Abstract

The paper presents some preliminary results regarding the pressure variations inside the teatcup liner, during the milking process. The analysis was performed on the upper part of the liner, which has contact with the teat during milking.

A proprietary test rig was used for the experiments; the system was equipped with a proprietary electro-magnetic pulsator, which can provide two milking ratios (1:1 and 3:1, respectively).

Milk flow through the teatcup was simulated using water stored in an open tank of the test rig; water was chosen because its density is close to milk density.

The tests results are presented within tables, for the two milking ratios used during the experiments.

The tests showed that only small pressure variations were recorded in the liner-teat contact area. The small differences among the average values suggest that pressure inside the liner may be considered to be constant during milking.

Key words: milking equipment; teat cup

INTRODUCTION

Obtaining high quality milk during milking is an important issue for every farmer, no matter of the farm size or number of animals.

The number of animals dictates the type of milking system, starting with the mobile ones (for small cow farms) and ending with the milking parlors and automated milking machines (for big farms).

No matter what type of milking system is used, a series of basic requirements must be fulfilled in order to ensure a successful milking; these requirements take into account the vacuum level inside the liner, the milking rate and the milking ratio.

A mean liner vacuum within the range 32... 42 kPa ensures that most cows will be milked quickly, gently and completely, with no stress for the animal [2]. There should be no large variations of the vacuum level inside the liner.

In this context the paper presents some preliminary results regarding the pressure variations inside the upper part of the teatcup liner, during the milking process.

MATERIAL AND METHOD

A proprietary test rig was used for the experiments. The test rig (fig. 1) contains a bucket type milking unit. This type of milking unit was chosen due to its simplicity and easy replacement of its parts.

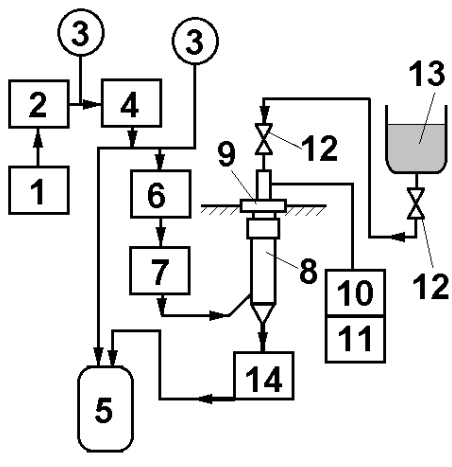

Fig. 1 Schematics of the test rig
1- vacuum pump; 2 - vacuum regulator; 3-vacuum meter; 4-intercepto; 5-milk bucket; 6-pulsator; 7-vacuum distributor; 8-teatcup; 9-teatcup support; 10-recorder; 11-chronometer; 12-valvet; 13-water tank; 14-claw

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Vacuum meters are used in order to measure vacuum level at the vacuum pump intake and on the air line.

The teatcups used during the tests had the following features:

- volume of the chamber between the liner and the shell: 90 ml;
- liner barrel volume: 125 ml;
- diameter at liner exit: 25 mm.

The rig was equipped with a proprietary pulsator [1], which can provide two pulsation ratios (1:1 and 3:1, respectively). The pulsation rate was 60 cycles/min.

A water tank connected to the teatcups was used in order to simulate milk flow through the system. Water temperature during the tests was 11°C; its density was 999.7 kg/m^3. Due to the small difference between water and milk density (1030 kg/m^3), no significant errors were introduced by using water as a test liquid. The water flows through a valve, allowing the adjustment of the flow rate.

The teatcup was mounted on a support, provided with a pressure intake port in order to measure the vacuum level inside the teatcup (fig. 2).

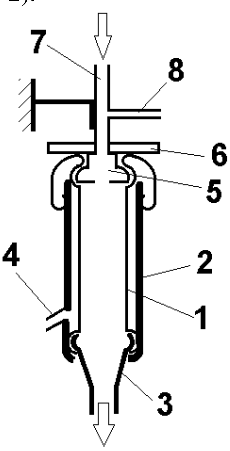

Fig. 2 Placement of the pressure intake port
1-liner; 2-shell; 3-sight glass; 4-pulse tube;
5- teatcup support; 6-limitation plate; 7-water feeding port; 8- pressure intake port

Figure 3 presents a general view of the teatcup support with the pressure intake port.

The vacuum signal from the pressure intake port was directed towards a recorder by the means of a pressure transducer. A chronometer was used in order to measure the recording duration.

The teatcup support was mounted to the system's washing plate, using a clamping device. Thus, all the four teatcups of the unit are connected.

During the tests both the pressure inside the teatcup barrel and the pressure inside the barrel-shell chamber were recorded.

Atmospheric pressure was used as a reference; as a result, the minus sign was used for vacuum. The recorder was calibrated using vacuum levels of 20; -22; -24; -26; -28; -30; -32; -34; -36; -38; -40; -42; -44; -46; -48 and -50 kPa.

Fig. 3 Teatcup support

RESULTS AND DISCUSSION

The pressure charts recorded the vacuum level in the upper part of the liner for the two pulsation ratios taken into account.

The permanent vacuum level was -48 kPa, as this is the usual level in the mechanical milking systems.

The cycle beginning and end points were marked on the pressure-time charts. The maximum and minimum pressure points, for each cycle, were also marked.

Figure 4 presents a generic pressure-time record.

Fig. 4 Pressure-time chart, recorded at the upper part of the milking liner

The experimental results are shown as follows: in Table 1 for 1:1 pulsation ratio; in Table 2 for 3:1 pulsation ratio.

Table 1 Pressure variation in the upper part of the milking liner, for 1:1 pulsation ratio

No.	Pressure at the beginning of the cycle [kPa]	Pressure at the end of the cycle [kPa]	Minimum pressure [kPa]	Maximum pressure [kPa]
1	- 34.0	- 34.0	- 37.0	- 33.0
2	- 34.0	- 35.0	- 36.0	- 34.0
3	- 35.0	- 34.0	- 38.0	- 33.0
4	- 34.0	- 34.0	- 36.0	- 32.5
5	- 34.0	- 35.0	- 37.0	- 33.0
6	- 34.0	- 35.0	- 35.5	- 33.0
7	- 35.0	- 33.5	- 36.0	- 31.0
8	- 33.5	- 33.5	- 36.0	- 31.0
9	- 33.5	- 34.0	- 35.0	- 33.0
10	- 34.0	- 34.0	- 35.0	- 33.0
11	- 33.5	- 35.5	- 36.0	- 33.0
12	- 35.5	- 34.5	- 37.0	- 32.5
13	- 34.5	- 35.0	- 36.5	- 33.0
14	- 35.0	- 34.0	- 36.0	- 33.0
15	- 34.0	- 34.0	- 36.0	- 33.0
16	- 34.0	- 35.0	- 36.5	- 33.5
17	- 35.0	- 35.0	- 36.0	- 33.5
18	- 35.0	- 38.0	- 38.5	- 35.0
19	- 38.0	- 35.0	- 38.5	- 34.0
20	- 35.0	- 33.5	- 36.0	- 33.0
21	- 35.0	- 35.5	- 37.0	- 34.5
22	- 35.5	- 35.5	- 38.0	- 34.0
23	- 35.5	- 34.0	- 37.5	- 33.0
24	- 35.5	- 34.5	- 37.0	- 33.0
25	- 34.5	- 34.0	- 36.0	- 33.0
AVERAGE	**- 34.66**	**- 34.60**	**- 36.56**	**- 33.10**

Table 2 Pressure variation in the upper part of the milking liner, for 3:1 pulsation ratio

No.	Pressure at the beginning of the cycle [kPa]	Pressure at the end of the cycle [kPa]	Minimum pressure [kPa]	Maximum pressure [kPa]
1	- 32.0	- 32.0	- 36.0	- 31.0
2	- 32.0	- 32.5	- 35.5	- 32.0
3	- 32.5	- 33.0	- 36.0	- 32.5
4	- 33.0	- 32.5	- 36.0	- 32.0
5	- 32.5	- 32.5	- 36.0	- 32.0
6	- 32.5	- 32.5	- 36.0	- 31.0
7	- 32.5	- 33.0	- 36.5	- 32.0
8	- 33.0	- 33.0	- 37.0	- 32.5
9	- 33.0	- 32.5	- 36.0	- 32.0
10	- 33.0	- 33.0	- 36.0	- 32.0
11	- 32.5	- 36.5	- 37.5	- 32.5
12	- 36.5	- 28.5	- 38.5	- 28.0
13	- 28.5	- 37.5	- 38.5	- 28.5
14	- 37.5	- 33.0	- 40.0	- 30.0
15	- 33.0	- 33.5	- 38.0	- 30.0
16	- 32.5	- 32.5	- 36.5	- 32.0
17	- 32.5	- 32.5	- 36.0	- 32.0
18	- 32.5	- 32.5	- 36.0	- 31.0
19	- 32.5	- 32.5	- 36.0	- 31.0
20	- 32.5	- 33.0	- 36.0	- 32.5
21	- 32.5	- 34.0	- 38.0	- 33.0
22	- 34.0	- 33.5	- 36.5	- 33.0
23	- 33.5	- 34.5	- 37.0	- 34.0
24	- 34.5	- 34.0	- 38.0	- 34.0
25	- 34.0	- 33.0	- 38.5	- 32.0
AVERAGE	**- 33.0**	**- 33.1**	**- 36.88**	**- 31.70**

The data presented in these tables show that there are only minor differences among the average values of pressure at the beginning and at the end of the milking cycles. Thus, for the pulsation ratio of 1:1 the difference is 0.06 kPa; for 3:1 the pulsation ratio the difference is 0.1 kPa. Therefore we may conclude that the average pressure at the cycle beginning and end was constant.

The average pressure was around -34.6 kPa in the first case and around – 33 kPa in the second case.

The difference between the minimum pressure and the one recorded at the beginning or the end of the cycle was 1.96 kPa for the 1:1 pulsation ratio and 3.78 kPa for the 3:1 pulsation ratio.

The difference between the maximum pressure value and the one recorded at the beginning or the end of the cycle was 1.5 kPa for the 1:1 pulsation ratio and 1.4 kPa for the 3:1 pulsation ratio.

CONCLUSIONS

The experimental tests proved that only small variations of the pressure inside the liner were recorded for the two pulsation ratios taken into account; therefore it was conclude that the pressure is constant during the operation of the milking system.

In order to obtain the bigger picture the test should be repeated with different types of teatcups, at different vacuum levels and different flow rates.

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