

EFFECT OF THE TEAT CUP SIZE OVER THE PULSATOR RATE

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Abstract

The paper presents the preliminary tests performed on various types of pulsators, aiming to evaluate the influence of the teat cup size over the pulsator rate. Two types of teat cups, with different volumes of the pulsation chamber, were used during the tests. The tests were performed in the "Machinery and animal husbandry equipment" laboratory of the University of Agricultural Sciences and Veterinary Medicine-Iasi, on a rig equipped with high line bucket milking machine; the system was also equipped with the necessary devices for recording the operating diagrams of the pulsator that equipped the milking machine. The same operating pressure was used for all tests; there were no significant changes of the environmental temperature during the tests. The pulsators used during the tests were different with respect to the operating principle. During the tests, the milking machine was equipped with one of each tested pulsators at a time. Each type of pulsator was tested with each of the two types of teat cups and the operating characteristics were recorded. Based on the recorded diagrams the pulsator rate and ratio was evaluated and the different values were then compared with each other. The results were synthetically presented in a table, allowing an easy comparison of the pulsators operating parameters. The results showed that for some of the tested pulsators differences were recorded in the operating parameters, depending on the teat cup size, but the deviations were within the acceptable range.

Key words: milking equipment; teat cup

INTRODUCTION

Proper application of mechanical milking is the key factor for obtaining a high quality milk and a high productivity while preserving the animal health. Therefore the operating process of the milking machine must be correlated with the milk release rate.

A proper operating process of the milking machine is achieved when its functional parameters (the pulsation rate, pulsator ratio, working pressure) have certain well-defined values.

The pulsation rate, pulsator ratio are influenced by the constructive type of pulsator.

The operating cycle of the milking machine includes a suction phase and a massage phase. During milking this cycle is repeated with a specific frequency - 50 ... 60 pulsations/minute [2; 3]

The duration of the suction phase must represent 50...60% of the entire operating

cycle [2; 3]. When this duration increases the supplementary milking (over milking) increases; when the suction phase is shortened, milking becomes uneconomical and may affect the health of the animal.

The duration of the vacuum phase can be determined using the pulsation ratio (ratio between the suction and massage duration). The pulsation ratio may be 1: 1, 3: 2 etc. (50%: 50%; 60%: 40%, respectively).

The duration of the suction phase can be determined theoretically using records of the pulsation chamber vacuum.

For some constructive types of pulsators, the pressure variations in the system may lead to the reduction of the pulsation rate and may also affect the pulsation ratio.

Operation with lower values of pulsation rate leads to slower milking while the changes in the pulsator ratio may negatively affect the efficiency of milking.

Changes in the vacuum in the air line may also affect the deformation process of the teat cup liners.

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Given the importance for respecting the correct values of the pulsation rate and pulsator ratio, the paper presents some preliminary results of the tests regarding the influence of the pulsation chamber size over the operating parameters of the pulsator.

MATERIAL AND METHOD

For this study we used, on a rig equipped with high line bucket milking machine; the system was also equipped with the necessary devices for recording the operating diagrams of the pulsator that equipped the milking machine

The test bed was placed in the laboratory "Machinery and animal husbandry equipment" of the University of Agricultural Sciences and Veterinary Medicine-Iași. The test rig is schematically shown in Figure 1.

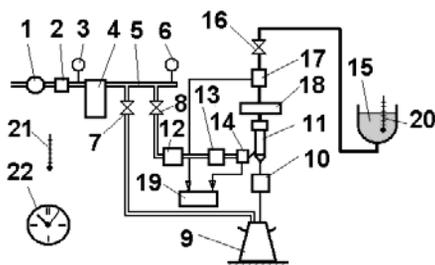


Figure 1 Scheme for the test rig

- 1 – vacuum pump; 2 – vacuum regulator;
- 3; 6 – vacuum gauge; 4 -interceptor;
- 5 – vacuum pipeline; 7; 8; 16 - tap; 9- bucket;
- 10- claw; 11 – teat cup; 12- pulsator;
- 13 – vacuum distributor; 14; 17 – vacuum outlet;
- 15 - water tank; 18- teat cup support; 19 - plotter;
- 20; 21 - thermometer; 22- timer.

We chose to test a bucket milking system because it is simple, the components can be easily replaced and it can be equipped with different types of pulsators.

The vacuum is produced by means of a sliding vane vacuum pump; a vacuum regulator with weights is used in order to maintain a constant value of the permanent vacuum. The interceptor dampens and attenuates the airflow variations that may occur during the milking operation. It also collects any liquid (water or milk) or mechanical impurities, which may inadvertently try to enter inside the vacuum pump.

To simulate the flow of milk during the tests, the rig was equipped with a water tank connected to the teat cups. Water was chosen instead of milk, because these fluids have similar physical properties.

The water used during the tests was collected in the bucket and it was then recirculated into the water tank stand. In order to obtain the operating diagrams of the milking system the vacuum in certain points of the system must be recorded, as shown in Figure 1. The test rig was provided with two vacuum outlets. The plotter transforms the vacuum signal into a displacement signal. The displacement signal is used to drive the chart plotting device. The alternating vacuum outlet should be placed as close as possible to the inlet side of the teat cup.

During the test the value of the permanent vacuum, measured in the vacuum chamber of the teat cup, was - 40 kPa.

In order to evaluate the duration of the recording charts an electronic timer was used; the timer was started and stopped in the same time with the plotter.

The paper used for recording the charts lacks its own grid. In order to read the charts an overlapping template was placed over the recording paper; thus the values of pressure and time can be easily read.

The plotter also traces a straight (witness) line, which is used for in order to position the template while reading data.

The measurements were preceded by a calibration of the recorder.

The evaluation of the duration of an operating cycle and of its phases of its composition was made according to the duration of the paper record travel. The duration was evaluated for each diagram drawn on the recording paper.

An example of a diagram recorded during the tests is shown in Figure 2.

Two glass thermometers were used for measuring the temperature of the water used during the test and of the atmospheric air.

The tests were performed with the milking machine equipped with two types of teat cups (Figure 3), namely:

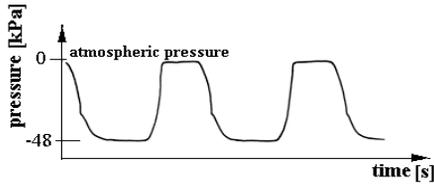


Fig. 2 An example of a diagram recorded during the test

- Type I – with a volume of the pulsation chamber volume of 30 ml, the volume of teat chamber of 70 ml, a mouthpiece diameter of the liner of 25 mm;

- Type II - with a volume of the pulsation chamber volume of 90 ml, the volume of teat chamber of 125 ml, a mouthpiece diameter of the liner of 25 mm.

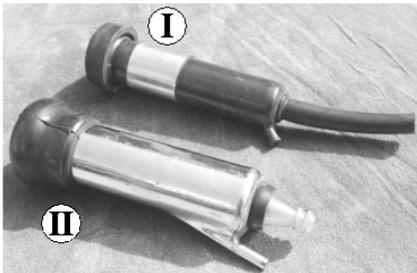


Fig. 3 Types of teat cups used during tests

The claw volume is 25 ml, and the long pulse tube has a length of 2 m.

For this study we have used three different types of pulse, as follows:

- A pulsator with valves and pneumatic control of the valves – the pulsation rate depends on the cross-section value of an orifice, which is controlled by the means of an adjustable screw; the set value of the pulsator ratio was 1: 1

- A sliding valve type pulsator, with pneumatic control, produced by Tarimak in Turkey, with a pulsation rate adjustable between 40 and 60 pulsations/minute and a pulsator rate of 3: 2.

An electromagnetic pulsator - (Pulsator designed by the authors [1]), with electromagnetic control of the sliding valve. The pulsation rate was 60 pulsations/minute; two pulsator ratios may be achieved with this

pulsator (1: 1 to 3: 1), depending on the milk flow rate passing through the claw.

Pulsators studied were tested at working pressure of -48 kPa. Working pressure values were reported at atmospheric pressure, which was considered zero.

RESULTS AND DISCUSSIONS

For each tested pulsator (at an operating pressure of -48 kPa) five diagrams were drawn, each containing a certain number of cycles.

For an easy interpretation of the results averaged values of the pulsation rate and pulsator ratio were calculated, for each type of pulsator and teat cups.

The experimental results are shown in Table 1.

For the valve pulsator, with pneumatic control, when type II teat cups were used, there was a decrease of the value of the pulsation rate by 1.8 pulsation/minute and an increase with 0.275 of pulsator ratio, compared to the case when the type I teat cups were used.

For the sliding valve pulsator with drawer, with pneumatic control, the use of type II teat cups led to the decrease of the pulsation rate by 2.04 pulsations/minute (higher than one recorded for the previous pulsator), while the pulsator ratio increased with 0.086 (compared to the case when the type I teat cups were used).

As far as the electromagnetic pulsator is concerned, the tests showed that for the both operating regimes and for the both types of teat cups only small changes of the pulsation rate were recorded (0.005 ... 0.017), changes that can be considered as not significant. For the pulsator ratio of 1: 1 the use of the two different types of teat cups did not lead to any significant (the difference between pulsator ratios was 0.025); for the pulsator ratio of 3: 1, the use of type II teat cup led to is a slight decrease of the pulsation ratio (by 0.112), compared to the one achieved when the type I teat cup was used.

Standards, stating a tolerance of up ± 3 pulsations/minute [53].

Table 1 Frequency of pulsation rate and pulsator ratio obtained during tests

No Crt.	Pulsator type	Teat cup type	Pulsation rate [pulsations/minute]	Pulsator ratio
1	with valves and pneumatic control of the valves	I	55.756	0.853
		II	53.889	1.128
2	with sliding valve and pneumatic control	I	61.576	1.454
		II	59.536	1.540
3	electromagnetic. with pulsator ratio 1: 1	I	60.258	0.988
		II	60.263	0.963
4	electromagnetic. with pulsator ratio 3: 1	I	60.286	2.539
		II	60.303	2.427

The values of the operating parameters of the analyzed pulsators were within the range of values accepted by the European

The tests proved that pulsators behaved normally, within the acceptable limits.

A problem might appear when using the pneumatic control pulsators to certain types of mobile milking machines, with two milking clusters, for which the interceptor is small or is represented by the milk bucket itself. In this case changes in the air the flow-rate through the vacuum pipeline may occur, leading to the decrease of the pulsation rate when type II teat cups are used.

CONCLUSIONS

After analyzing these results, it was found that the electromagnetic pulsator preserved the imposed pulsation rate of 60 pulsations/minute, when compared to the pneumatic control pulsators, for the both types of teat cups used during the tests.

The results obtained in the laboratory show that the three types of pulsators can operate normally irrespective of the size of the pulsation chamber.

To complete the preliminary results presented in the paper, further test are required, using mobile milking units, equipped with two milking clusters.

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