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Wet and Dynamic Tests in Conventional and Single Tube Milking Clusters

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Abstract The objective of this study was to determine the effects of milk flow on the cyclic vacuum fluctuation in con-ventional and single tube clusters by using wet and dynamic test method in laboratory and practical conditions. The combination of both methods will greatly contribute to get the real-life conditions at the teat end.
Different milking systems such as conventional clusters (3 types), AMS (2 types), Multilactor (single tube sys-tem with periodic air inlet) and conventional systems with periodic air inlet (2 types) were tested with wet method in laboratory and at different farms. The equipment used for measurements was named "Bovi Press", A&R Trading GmbH. The registration from the vacuum at ten different points is possible. The properties during milking were determined and the milk flow curve was recorded with LactoCorder.
The calculations of the mean values and the vacuum fluctuations were achieved according to the guidelines from ISO 6690 Annex A. The systems with periodic air inlet had stabile vacuum conditions to get higher milk flow. Resulting consideration is, it can be useful to introduce the periodic air inlet teat cups in single tube sys-tems. The Multilactor system has this combination (single tube and periodic air inlet).
It is possible to use wet and dynamic test for evaluating different milking clusters. For AMS and single tube systems it is necessary to introduce new methods. The results show that it is useful to find other constructions for single tube systems as compared to the standard systems. In the future, the Multilactor System will be tested deeply.
Key words: Wet test, dynamic test, single tube milking clusters

INTRODUCTION

The target of the developments in the field of milking technique is to obtain the whole milk from the teat of the animal in a shortest time without causing any detrimental effect on udder health. The most direct measure of the milking system effect on the cow is the vacuum in the claw of the milking unit (Reinemann et. al, 2007). According to NMC guidelines, accurate recordings of vacuum levels at various locations during milking provide the best means of demonstrating the adequacy of the vacuum production and regulation function of any milk-ing system

The measurements stated above can be either made under dry, wet or dynamic (milking time tests) conditions but the most realistic measurement is the dynamic ones since it resembles the real situation.

On the other hand, wet tests carried out at constant flow rate using flow simulator are of importance at present since milk flow from one animal to another during dynamic tests may change and this affects the vacuum measurements and evaluations of the system performance. Due to the above mentioned reason, the ISO in-cludes the wet test. But current standards for performance and test of milking machines do not include AMS but ISO-work is now initiated on this matter (Bjerring and Rasmussen, 2002).

The widespread use of AMS lately requires the wet tests be defined in details in ISO. Additionally, there is no standard method developed for the dynamic measurements.

On the other hand, a new milking system called “Multilactor” was developed in order to eliminate the detrimen-tal effects on udder health and this system uses the single tube system like AMS. But these systems include periodic air inlet in pulse chamber (like Biomilker) and can be adapted for the use at milking parlor. It has a sequential pulsation and cluster is adapted by milking person.

As a result, it can be stated that the use of both, wet and dynamic tests for conventional and single tube sys-tems (AMS and Multilactor) will help the development of these test methods and for the evaluation and the comparison of the milking systems.

The objective of this study was to determine the effects of milk flow on the cyclic vacuum fluctuation in con-ventional and single tube clusters by using wet and dynamic test methods in laboratory and practical condi-tions. Determining the effects involves modifying existing test setup and/or developing new test methods. The second phase is to introduce the wet test method and the dynamic method to the ISO Standard test program for modern milking systems. The combination of both methods will greatly contribute to get the real-life condi-tions at the teat end. For this reason mean claw vacuum level was used one of the important evaluation pa-rameter to compare the systems.

MATERIALS and METHODS

Different milking systems such as conventional clusters (3 types), AMS (2 types), Multilactor (single tube sys-tem with periodic air inlet) and conventional systems with periodic air inlet –Biomilker- (2 types) were tested with wet method in laboratory and at different farms. For analysing the dynamic behaviour of milking machine vacuum systems of pulse and periodic disturbances, wet and dynamic test method were used (ISO 5707 and 6690, 1996). The milking characteristics of the systems tested for the study and the methods applied in each system are shown in Table 1.

The equipment used for measurements was named "Bovi Press", A&R Trading GmbH. The registration of the vacuum at ten different points was achieved with this equipment. The sensors was located at different points.

For the wet-test it was necessary to develop a new method since the use of only salted water was not possible due to the sensors in the systems. So, calf powder was added to the test water during the measurements in AMS. As the second part of tests, dynamic measurements were made in Multilactor (Rose et. al, 2007) and another system with periodic air inlet.

The flow rate during the experiments was set to six different values ranging from 0.8 to 8 lt min-1.

It is known from the previous studies that the vacuum of the milking system affects the mean vacuum and fluctuations. In order to compare the milking systems under the same conditions, the vacuum change in per-cent calculations were made in the data obtained for each system. The vacuum change used here is defined as given below.

$$\text{Vacuum change}\,(\%) = \frac{\text{Mean vacuum} - \text{System vacuum}}{\text{System vacuum}}.100$$

Table 1. Milking systems characteristics and the test methods applied.

Milking system	System vacuum [kPa]	Claw volume [ccm]	Test method applied
Conventional	42	160	Wet
BioMilker	35	milk flow	Wet & Dynamic
Multilactor	35	single tube	Wet & Dynamic
AMS A	46	single tube	Wet
AMS B	42	modul	Wet

RESULTS

The mean values and the vacuum fluctuations were calculated as described in ISO 6690 Annex A. The mean values and vacuum fluctuations are depicted in Figures 1 and 2 for conventional and multilactor.

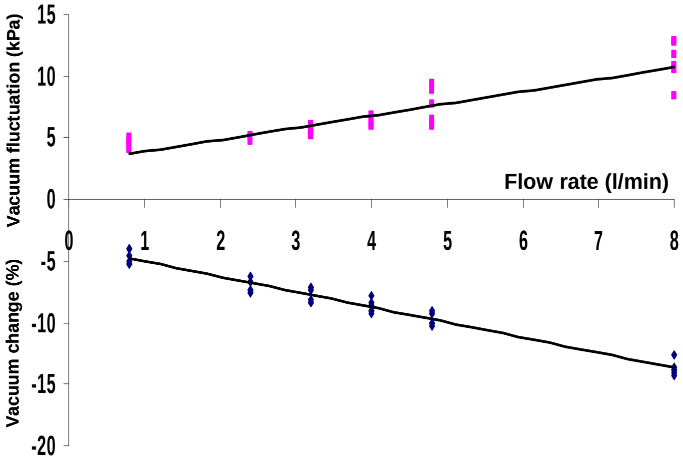

Figure 1. Vacuum fluctuations and vacuum change in percent for conventional milking system

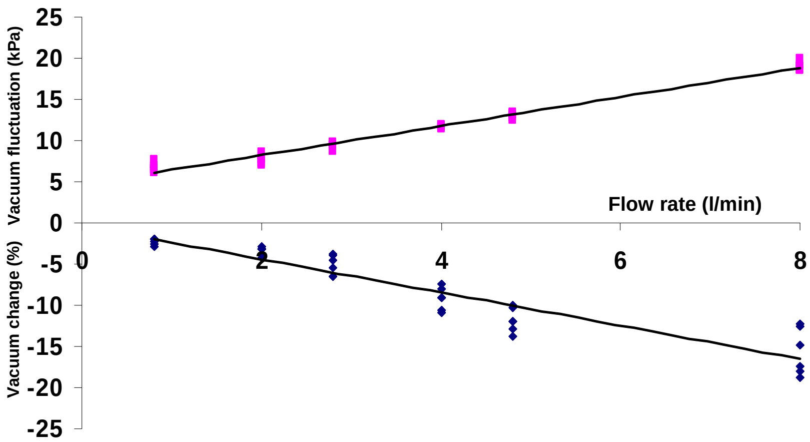

Figure 2. Vacuum fluctuations and vacuum change in percent for Multilactor

As seen from Figure 1 and 2, Vacuum fluctuations and vacuum changes increase as the flow rate increases and this is the same trend for all other milking systems considered in this study. The minimum and maximum values for vacuum fluctuations and vacuum changes along with the range for the calculated mean values as measured are given in Table 2.

The lowest fluctuation range among all milking systems was obtained in conventional milking system. On the other hand, vacuum fluctuations obtained when Biomilker and Multilactor were used are greater than the conventional system but this could be an expected result since air-intake to teatcup is allowed in these systems.

The range for the AMS B in terms of vacuum fluctuations is wider as compared to AMS B and this could be the result of problems encountered during wet test. This indicates the need to improve the wet test method for AMS.

Once the results were examined from the point of mean values range, it is obvious that the range for AMS A is wide and this also could be the result of problems in order to apply wet test to AMS.

Table 2. Minimum, maximum values for the vacuum fluctuations and vacuum changes and the mean vacuum values for each milking system during wet tests.

Milking system	System vacuum [kPa]	Min. and max. vacuum fluctuations [kPa]	Min and max. vacuum changes [%]	Mean values range [kPa]
Conventional	42	4.0 – 12.9	4.0 – 14.3	36.0 -40.3
BioMilker	35	4.7 – 21.1	10.3 – 31.4	24.1 – 31.4
Multilactor	35	6.1 – 20.0	2.0 – 18.9	28.4 – 34.3
AMS A	46	4.1 – 16.2	8.7 – 24.0	26.9 – 42.0
AMS B	42	6.2 – 27.7	0 – 16.2	35.2 – 42.0

Once the results were examined from the point of mean values range, it is obvious that the range for AMS A is wide and this also could be the result of problems in order to apply wet test to AMS.

The difficulties encountered during the wet tests of AMS are given as follows.

- Attachment of the teatcup to artificial teat
- Adjustment of the water flow rate to predetermined value precisely in a short measurement time
- System failure due to the use of water and stop milking and not allowing to obtain necessary data

Figure 3 and 4 are drawn to compare the milking systems in terms of vacuum change (%) and fluctuations (kPa) for all systems in, respectively.

Mean values measured as a function of flow rate during the wet tests could be seen in Figure 5. ISO defines the mean values within the range of 32 -40 kPa without considering the system vacuum. This means that whatever the system vacuum is, the mean values should be within the range of 32-40 kPa. But the system vacuum set for the Biomilker and Multilactor was 35 kPa as given in Table 1 and this could be a reason since there is a certain slope for all milking systems and mean flow rate goes down as the flow rate increases in general.

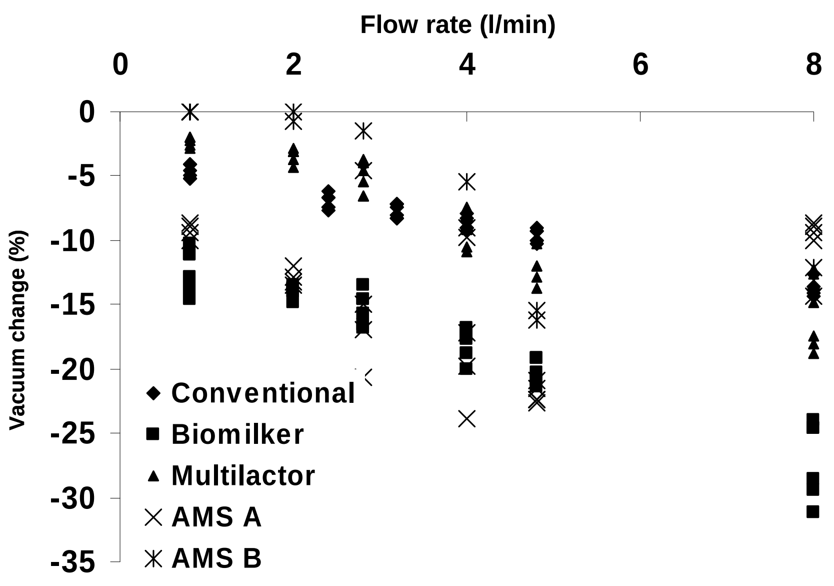

Figure 3. Vacuum changes as a function of flow rate for all milking systems

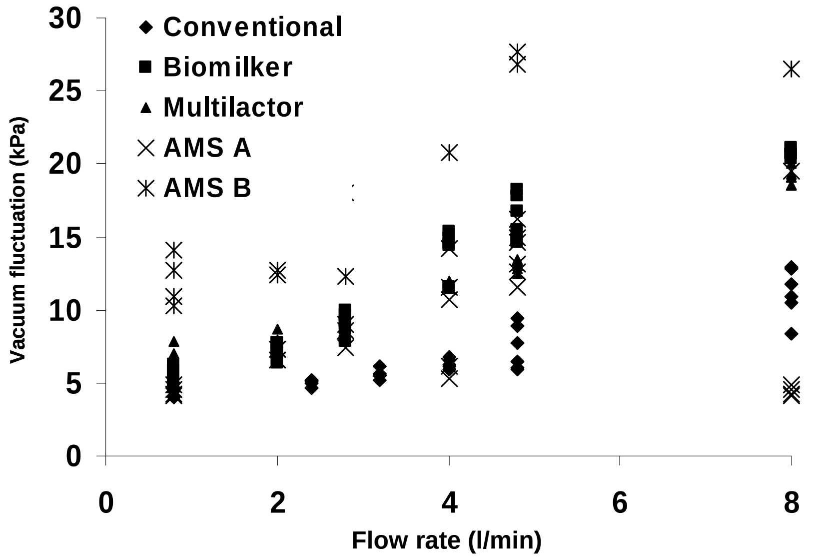

Figure 4. Vacuum fluctuations as a function of flow rate for all milking systems

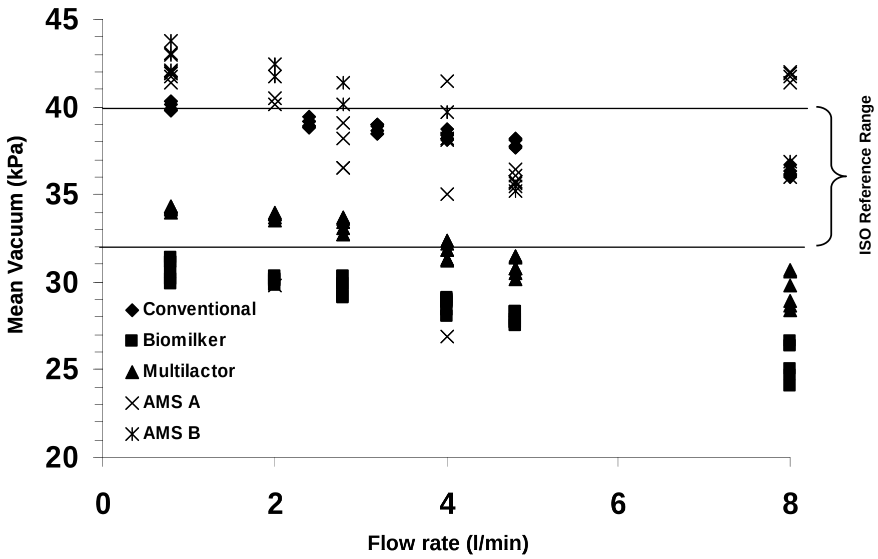

Figure 5. Mean vacuum values as a function of flow rate for all systems

During the dynamic tests of Biomilker and Multilactor, the results depicted in Figure 6 and 7 were obtained. The limited number of data during the dynamic tests indicates the difficulties of obtaining the data in these types of tests and the behaviour of Biomilker and Multilactor systems under different flow rates is different. But this behaviour needs to be confirmed by additional tests and new methods should be improved and apply to these systems in the future studies.

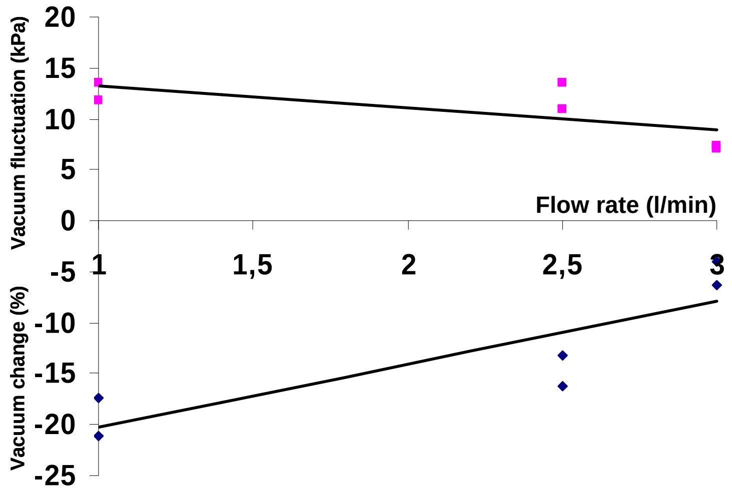

Figure 6. Vacuum fluctuations and vacuum change in percent for Biomilker during dynamic tests

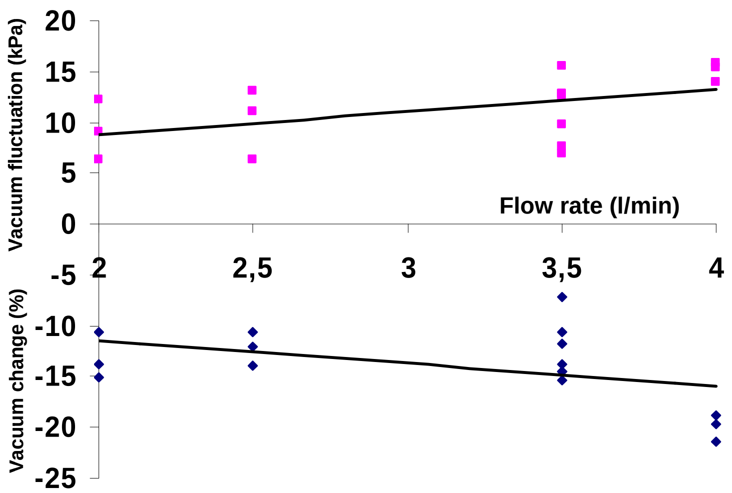

Figure 7. Vacuum fluctuations and vacuum change in percent for Multilactor during dynamic tests

CONCLUSIONS

It is possible to use wet and dynamic test for evaluating different milking clusters. For AMS and single tube systems it is necessary to introduce new methods. The results show that it is useful to find other constructions for single tube systems as compared to the standard systems. In the future, the Multilactor System will be tested deeply.

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