The influence of pulling force in the liner and teat penetration into the liner on basic vacuum parameters of a milking unit

J. Szlachta & K. Aleksander

Institute of Agricultural Engineering, Agricultural University in Wroclaw
Ul. Chelmonskiego 37/41, 51-630 Wroclaw, Poland
e-mail Szlachta@imr.ar.wroc.pl

Summary

The influence of high liquid flow rate Qm=0-8kg/min, teat penetration and pulling force in the liner on vacuum milking parameters for Harmony milking unit was analysed and the empirical formulae were adopted. As has been observed, such milking parameters as average vacuum during the milking phase (pss), average vacuum decrease during a complete pulsation cycle (dp) and the pressure difference between the end of teat and the claw (dp1max1) change its value significantly with the increasing Qm. The best value of vacuum fluctuations parameters and dp1max1 were observed for pulling force in the liner being in the range of 40-70N. This range of pulling force is also suitable for dp1max1, which oscillates between –0.1 and –0.2 kPa.

Key words: *Milking units, liner, measurements, vacuum parameters.*

Introduction

Stable vacuum in the teat cup chamber and elimination of the back flow has the very important requirements influencing the course and conditions of milking of cows with high milk productivity(Szlachta, 1997; Haman & Dück, 1984; Hamann, 1989).

The analysis of vacuum level and teat end pressure during milking shows differences in the milk flow rate (O'Shea J. *et al.*, 1976; Nordegren, 1980; Williams and Mein, 1980; Mayntz, Laidig & De Toro, 1990; Szlachta & Wiercioch, 1994; Szlachta *et. al*., 2000**).** It should be noticed that stabilisation of vacuum under the teat end demands attention from researchers, especially when it comes to cows with high milk productivity (Szlachta & Wiercioch, 1997). The above-mentioned basic aspects of work of a milking unit allow us to notice that vacuum is a factor of a great importance. The conditions of milking also depend on the construction of a milking unit, especially the milk claw volume, liner characteristics and massage pressure

and stimulation. Taking into account what has been said heretofore, it should be noticed that milking units often work improperly, especially when the cows milked, exhibit high milk productivity, i.e. when the intensity of liquid flow > 4-8 kg / min. The aim of the study was to evaluate the influence of pulling force in the teat liner and teat penetration on the change of basic parameters in milking units used for milking of cows with high milk productivity. The basic criteria of assessment were level of pulling

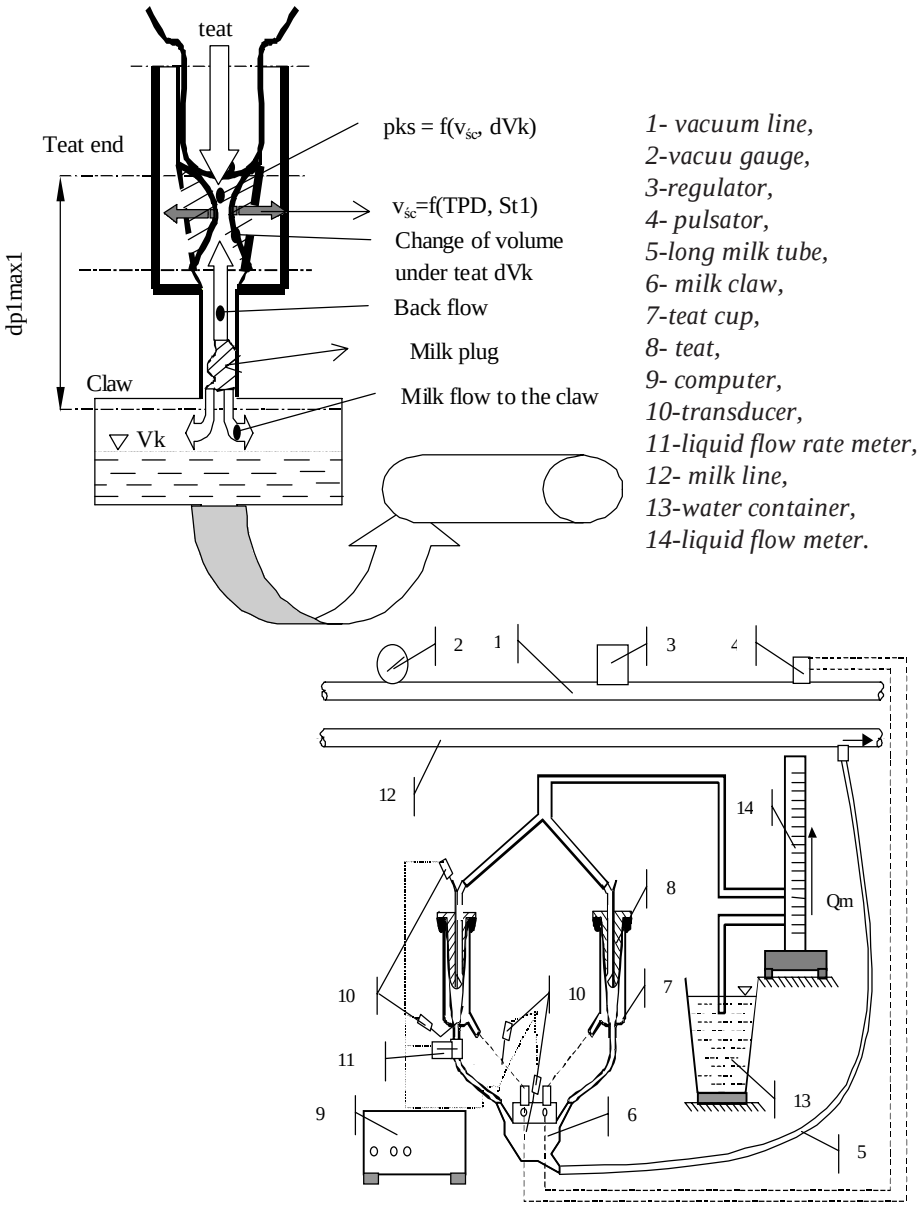


Figure 1. Methods and test procedure: a-problem illustration, b-scheme of test installation.

forces in the liner and vacuum stability at the teat end during laboratory empirical test. Very interesting was the influence of liquid flow rate (Qm) on the average vacuum during milking phase (pss), average vacuum decrease during a complete pulsation cycle (dp) and pressure difference between the end of teat and claw (dp1max1, Figure 1), as factors causing back flow (Szlachta *et. al.* ,2000).

Material and test procedure

The research was carried out using test installation of the Institute of Agricultural Engineering, Agricultural University of Wroclaw (Figure 1). The Harmony milking unit with claw TF450 was examined. The liner Harmony was pulled in teat cup chamber with the force of 30-80N. The vacuum parameters were measured for liquid flow rate Qm=0-8kg / min and for teat penetration 50, 62, 75, 100 mm. The basic technical data of milking units are shown in the table 1. The work of the milking unit was recorded by a system of computer registration and analysed for chosen milking parameters (Wiercioch & Szlachta, 1994).

Table 1. Basic technical data of the milking units tested.

Milk chamber capacity of claw, cm^3	Pulsator type	Diameter of short milk tube, mm	Diameter of long milk tube, mm,	The volume under the teat by the teat penetration into liner:				
				0 mm	50 mm	62 mm	75 mm	100 mm
450	EP-100	14	16	76 cm^3	58.7 cm^3	54.5 cm^3	44.8 cm^3	30.8 cm^3

The influence of liquid flow rate Q_m on changes in average vacuum during the milking phase pss was very similar for all examined teat penetration and pulling forces. With changing Q_m from 0 to 8 kg / min, the drop of the average vacuum during the milking phase pss is less impetuous (Figure 2).

Results and discussion

The influence of liquid flow rate Qm on changes in average vacuum during the milking phase pss was very similar for all examined teat penetration and pulling forces. With changing Qm from 0 to 8 kg / min, the drop of the average vacuum during the milking phase pss is less impetuous (Figure 2).

This parameter decreases for all teat penetrations in the liner. In the case of pulling force in the range of 30-40N and little teat penetration (50-62mm) a high drop of average vacuum during the milking phase (pss) was observed. This situation is a result of big changes of the volume under the teat (dVk, fig.1a). To eliminate the back flow, the difference pressure between the end of teat and claw (dp1max1) should have a negative value or oscillate around zero. For Qm=8kg / min (Figure 3) negative values of

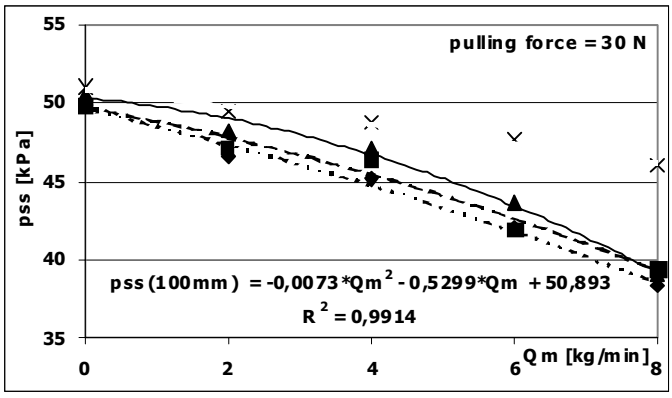
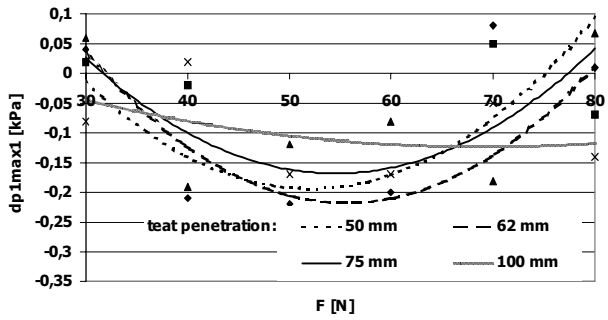


Figure 2. Influence of liquid rate on the average vacuum level during the milking phase, pss.

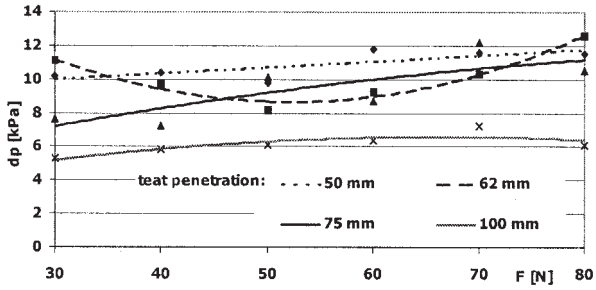


dp1max1(50mm)=0,0004*Qm^2- 0,0383*Qm +0,8059 R^2 =0,5897

dp1max1(62mm) =0,0004*Qm^2- 0,0429*Qm +0,976 R^2 =0,4286

dp1max1(75mm) =0,0003*Qm^2- 0,0352*Qm +0,7925 R^2 =0,603

dp1max1(100mm) =5E-05*Qm^2- 0,0072*Qm +0,1234 R^2 =0,1644



dp(50mm) =0,00001*Qm^2 +0,0342*Qm +8,9495 R^2 =0,5948

dp(62mm) =0,0051*Qm^2 - 0,5325*Qm +22,535 R^2 =0,9614

dp(75mm) =-0,0007*Qm^2 +0,1561*Qm +3,1381 R^2 =0,6275

dp(100mm) =-0,001*Qm^2 +0,1399*Qm +1,9268 R^2 =0,7054

Figure 3. Influence of pulling force in the liner and teat penetration on the pressure difference between the end of teat and claw (dp1max1) and average vacuum decrease during a complete pulsation cycle (dp) for liquid Qm=8kg/min.

pressure difference between the end of teat and claw (dp1max1) were obtained with pulling force ranging from 40 to 70 N. The dp1ma1 had negative value for whole range of pulling force (30-80N).

Conclusion

The best value of parameter pss and dp1max1 was observed for pulling force in the liner ranging from 40 to 70N. This range of pulling force is also suitable for dp1max1, which oscillates between -0,1 and -0,2 kPa. The research showed that the Harmony liner causes back flow in small degree.

References

Hamann J., Dück M., 1984; Modyfikationen von Melksystemen und Mastitisprävention. Milchw. 39. 12.

Hamann J.,1989; Maschineller Milchentzug und mastitis. Stuttgard, 26-45

Mayntz M., Laidig De Toro., 1990; Preliminary results concerning the local stimulation efficiency of linerless milking. Milchwissenschaft, 45, 10-14.

O'Shea J., E. O'Callaghan., Meaney W.J., Crowley C. 1976; Effect of combinations of large and small irregular and cyclic vacuum fluctuations in the milking machine on the rate of new infection in dairy cows. Ir. J. Agric.res. 15, 377-399.

Szlachta J; 1997, Uwarunkowania zmierzajace do zwiekszenia produkcji i poprawy jakosci mleka w Polsce. Ref. Na Miedz. Konf. IBMER-Warszawa, 7-15.

Szlachta J., 2000; Modelling of the effects of vacuum parameters on return flow a short milk tube of the milking unit. Inzynieria Rolnicza 2, 165-173.

Wiercioch M,. Szlachta J., 1994; Komputerowy system wyznaczania i pomiaru parametrów doju mechanicznego w warunkach laboratoryjnych. Zesz. Probl. Post. Nauk Rol. 416; 57-67.

Williams D.M., Mein G.A., 1980; Efects of pulsation failure on the bovine teat canal. Proc. Int. Wkp. Mach. Milk. And Mastitis. Fermony, Ireland, . p. 73-81.

Williams D.M., Mein G.A.., Brown M.R., 1981; Biological responses of the bovine teat to milking; Information from measurements of milk flowrate withing single pulsation cycles. J. Dairy Sci. 48, 251.