54th EAAP Annual Meeting - Bled, Slovenia, 5-8 September, 2004

Session code: C3.7
Abstract No. 364

Influence of work routine elements of milking on milking parlour performance

Bernadette O'Brien[1], Kevin O'Donovan[1, 2] and David Gleeson[1]
[1]*Teagasc, Dairy Production Department,*
Moorepark Research Centre, Fermoy, Co.Cork, Ireland.
E-mail: bobrien@moorepark.teagasc.ie
[2]*Department of Agribusiness, Extension and Rural Development, Agriculture and Food Building, National University of Ireland, Dublin, Belfield, Dublin 4, Ireland.*

Abstract

This study measured work routine times (WRTs) for different work routine elements of milking and established the factors affecting milking parlour performance. Measurements were conducted in a research milking facility. The time taken to carry out each element of the milking routine was recorded for 50 rows of cows (5 rows x 10 milkings) over a five-day period. Measurements were conducted in a 14-unit parallel, mid-level parlour, with swing-over arms, automatic feeding and sequential bailing. Measurements were taken with one operator when average milk yield/cow was 27.4 litres/day. A psion personal organiser was used for data recording. The maximum predicted number of cows milked/operator-hour was 79 and 88 with a routine incorporating a complete teat preparation technique (washing, pre-milking, drying of teats) and a 3 s time interval/cow for miscellaneous tasks, in the absence and presence of automatic cluster removers (ACRs), respectively. Comparable numbers for a 5 s time interval/cow for miscellaneous tasks were 76 and 85, respectively. Predicted milking performance was increased to 87, 96, 110 and 116 cows/operator-hour when the pre-milking (drawing foremilk); drying; pre-milking, washing and drying; and washing, drying and dry wiping elements were eliminated, respectively, in the presence of ACRs. Predicted optimum unit number for these routines was 15, 16, 19 and 20, respectively. The ability to accurately predict parlour performance associated with changes in milking parlour size/design and milking routine will be necessary for future herd-size expansion.

Introduction

Milking performance is a most important determinant within the dairy farming system and will become an issue of increasing concern, particularly in the light of increasing herd size. In addition, milking performance must be addressed in the context of good milk quality and cost-effective production. The overall objective is to harvest the maximum volume of milk with the least amount of labour, under the least stressful conditions for the person and cow. The number of cows milked per operator-hour is the best measure of performance of both the operator and the milking facility. A focus on milking performance requires consideration of the following issues.

Current labour input associated with milking: The Moorepark labour study has highlighted the very high labour requirement associated with milking. The complete milking process defined as herding time+milking time [in parlour]+washing time accounted for approximately 33 % of dairy labour input over a 12 month period (O'Brien *et al*. 2003). Thus, improvements in milking performance may have a greater influence than any other aspect of the dairy farmers work, on overall farm labour requirements. So it is appropriate to investigate existing obstacles and limitations to efficient milking and to investigate the role of technology in reducing the time associated with milking.
Factors affecting milking performance: Milking performance is influenced by factors including adequate milking units with minimum vacuum losses, an efficient work routine time (WRT), fast cow flow at entry and exit, a reliable drafting system and stall work that gives good cow control. It is extremely important that the operator does not have to leave the pit during milking time. Upgrading of many parlours in respect to these characteristics is required.
Work routine time (WRT): There are three main factors that determine the performance of a milking installation namely; individual cow milking time, the number and arrangement of the milking units and the operator's work routine. WRT represents the average time taken by the operator to complete the series of routines associated with each cow. The operator's WRT depends mainly on the number and duration of the elements in the routine and on the degree of automation (Armstrong and Quick, 1986). A typical work routine includes the following tasks; cow entry, teat preparation, cluster attachment, checking of cow for completion of milking, detachment of cluster, teat disinfection, cow exit and miscellaneous (fixing cup slips, rest, etc). In order to achieve optimum milking performance, the number of milking units, the milking time per cow and the milking work routine have to be co-ordinated. A greater number of milking units will allow potential for a greater number of cows to be milked per hour if the operator has idle time during milking (Hansen, 1999). Reducing WRT would only increase idle time unless sufficient milking units are available. Alternatively, too high a number of milking units would lead to increased milking unit idle time, and consequently either over-milking (in the absence of automatic cluster removers [ACRs]) or idle milking units (in the presence of ACRs), unless WRT is shortened (Whipp, 1992). Both parlour performance and milker performance must be optimized in order to achieve maximum milking performance (Klindworth, 2000).

As herd-sizes continue to increase and the dependence on hired labour is higher, a greater focus on working conditions and ergonomics will also develop. Current information on detailed parlour WRTs, and thus, limitations to optimum performance is scarce. Some anecdotal information exists, but this does not provide dairy operators with information that would allow them to predict accurately, the parlour performance resulting from changes in milking parlour size and design, and changes in milking procedures and routines. The objective of the current study was to measure WRTs for the different work routine elements of milking and thus, establish the main factors affecting milking performance in modern Irish milking parlours.

Materials and methods

Work routine times were recorded for different milking activities in a research milking facility. Work routine measurements were carried out on a 70 cow herd. The herd was milked by one operator in a 14-unit, parallel, mid-level parlour, with swing-over arms, automatic feeding and sequential bailing. ACRs were in place and these could be switched on or off as required. WRT measurements were taken for a full range of milking activities over the May / June period (2002) when cows were yielding an average of 27.4 litres per animal per day. The measures recorded were; (i) cow entry, (ii) cow exit, (iii) washing teats, (iv) drying teats, (v) washing and drying teats as one task, (vi) drawing foremilk, (vii) dry wiping teats, (viii) attaching clusters, (ix) detaching clusters, (x) changing clusters, (xi) disinfecting teats and (xii) washing cow standings. Each measurement incorporated the time taken to complete the task for a full row of cows. This time was divided by the number of cows in the row when calculating work routine times per cow. Measurements were taken for 50 rows in total (5 rows for each of 10 milkings). Recordings were taken at subsequent morning and evening milkings for 5 days. Cows were at pasture during the period of measurement. A hand-held data logger was used for data recording by the continuous timing method (Armstrong and Quick, 1986). The duration of each individual activity was calculated by subtracting its starting time from its ending time.

Results

The time associated with different elements of the milking work routine together with the predicted number of cows that could be milked per operator-hour with a range of different work routines and the optimum number of milking units for different milking routines (based on unit times) is shown in Table 1. A unit time of 10 min was used (Klindworth, 2000) which did not allow for idle unit time or over-milking. Consequently unit time was assumed to be equal to milk-out time.

As various elements of the work routine were automated or excluded, WRTs decreased while the number of cows milked per operator-hour increased. A time interval of 3 s or 5 s per cow was allowed for miscellaneous tasks (fixing cup slips, rest, etc.) in each of the work routines. Milking routine A involved cow entry, washing teats and drawing foremilk as a combined task, drying teats, changing clusters, disinfecting teats, washing cow standings, cow exit and miscellaneous (5 s). Milking routine A allowed for a maximum predicted milking performance of 76 cows per operator-hour to be milked. Milking routine B assumed that ACRs were in place, thus eliminating cluster removal and including cluster attachment. Milking routine B allowed a maximum predicted milking performance of 85 cows per operator-hour. Predicted milking performance per operator hour increased to 87 cows per operator-hour when the task of drawing foremilk was excluded from the routine (milking routine C). Predicted milking performance increased to 96 cows per operator-hour when the routine included washing of teats and drawing of foremilk but excluded teat drying (milking routine D). In milking routine E all teat preparation tasks were excluded except for dry wiping of teats. This allowed a predicted milking performance of 110 cows per operator-hour to be achieved. When all teat preparation practices except drawing of foremilk were excluded (milking routine F), the predicted number of cows milked per operator-hour increased to 116. Predicted optimum unit number for milking routines A, B, C, D, E and F was 13, 15, 15, 16, 19 and 20, respectively.

Table 1. Time associated with different elements of milking work routines together with the predicted number of cows that could be milked per operator-hour with a range of different work routines and the optimum number of milking units for different milking routines (based on unit times)

Milking routine	A	B	C	D	E	F
Cow entry (s/cow)	3.4	3.4	3.4	3.4	3.4	3.4
Washing teats + drawing foremilk (s/cow)	11.5	11.5	-	11.5	-	-
Washing teats (s/cow)	-	-	10.0	-	-	-
Drawing foremilk (s/cow)	-	-	-	-	-	5.1
Dry wiping teats (s/cow)	-	-	-	-	6.5	-
Drying teats (s/cow)	5.0	5.0	5.0	-	-	-
Attaching clusters (s/cow)	-	10.1	10.1	10.1	10.1	10.1
Changing clusters (s/cow)	14.8	-	-	-	-	-
Disinfecting teats (s/cow)	1.9	1.9	1.9	1.9	1.9	1.9
Cow exit (s/cow)	1.9	1.9	1.9	1.9	1.9	1.9
Washing cow standings (s/cow)	3.9	3.9	3.9	3.9	3.9	3.9
Miscellaneous (s/cow)	5.0	5.0	5.0	5.0	5.0	5.0
WRT (s)	47.4	42.7	41.2	37.7	32.7	31.3
WRT (min)	0.79	0.71	0.69	0.63	0.55	0.52
Max predicted cows/h	76	85	87	96	110	116
Unit time (min)	10.0	10.0	10.0	10.0	10.0	10.0
Optimum number of units	13	15	15	16	19	20

Discussion

Cow entry and exit times are becoming increasingly important as parlour length increases due to increased unit number. Efficient cow flow in the research farm milking parlour in this study resulted in it being unnecessary for the operator to leave the pit during milking. This may be due to the presence of the indoor feeding system in the parlour. Good cow entry and exit times of 3.4 and 1.9 s/cow respectively, were probably due to wide, bright funnel-shaped entrances, which were free of any obstacles and wide, straight exits. However, unlike many parlours, no overlapping of entry and exit was possible due to the bailing system in place.

The time associated with teat preparation varied considerably, depending on the methods used. Milking parlour performance or output is very much influenced by cow preparation practices. Milking routines with full cow preparation and minimal cow preparation had predicted milking performances of 85 and 116 cows/h, respectively. Meanwhile Smith *et al.* (1998) indicated that, minimal pre-milking teat preparation (pre-dip) and cluster attachment took 14 s/cow compared to 25 s/cow for full pre-milking teat preparation (pre-dip or spray, strip and wipe) and cluster attachment. That study also showed that modifying the milking procedure from cluster attachment (9 s/cow) to a full pre-milking teat preparation and cluster attachment (25 s/cow) reduced predicted milking performance from 102 to 56 cows/operator-hour. Armstrong *et al.* (1994) found that the use of a wash-pen increased cow throughput by 8-20% by reducing preparation times. Minimal cow preparation may not have as significant effect on TBC and milk sediment levels when cows are at pasture compared to indoors. However, from consumer perception and health and safety viewpoints, the issue of preparation of cows for milking has to be addressed. Automation of preparation procedures would speed up milking and cow throughput significantly. Automated teat disinfection is not common in Irish parlours with most operators using hand-held teat dips or sprays or drop-down sprayers. Fox and Smith (1986) found that teat disinfection took 2 s/cow in rotary parlours and between 2 and 3 s/cow in herringbone parlours. Teat disinfection in this study took on average 1.9 s/cow. Ginajlo (1985) stated that spraying was faster than dipping, however the spraying system if installed would require additional capital investment.

In this study, attaching clusters and changing clusters (no ACRs) took 10.1 and 14.8 s/cow, respectively. Therefore the introduction of ACRs reduced work routine time by 4.7 s/cow. While the time taken to remove clusters manually may not be significant, the time spent by operators in making decisions as to when to remove clusters is significant (Klein and Hakim, 1994). Other benefits of ACRs include potential reduction in instances of over-milking and a reduction in the risk of sediment problems in the milk (due to cluster fall-off) (Klindworth, 2000).

The particular requirements of the individual dairying enterprise and the opportunity cost of labour must dictate the level of automation decided on. If a high level of automation is installed, then it must be ensured that it is reliable and dependable and can be operated by a person of reasonable skill. The cost of automation will depend on the degree of automation.

As herd-sizes are expected to increase in the near future, redesign or construction of new parlours will be necessary. The choice of milking parlour should be directly related to the number of cows being milked currently as well as the herd-size envisaged for the future. Larger herd sizes will lead to a greater focus on time, working conditions and ergonomics associated with milking. In an environment where labour is scarce, limitations due to both time input and ergonomics must be minimized. Thus, it is important that maximum potential milking performance be achieved from new milking installations and from changes in existing milking parlour size and design. Herd owners should focus on a unit number adequate for current efficient milking, while allowing sufficient scope for future expansion and automation.

References

Armstrong, D.V. and Quick, A.J. 1986. Time and motion to measure milking parlour performance. *Journal of Dairy Science* **69:** 1169-1177.

Armstrong, D.V., Smith, J.F. and Gamroth, M.J. 1994. Milking parlour performance in the United States. *Proceedings of the 3rd International Dairy Housing Conference, Orlando, 2-5 February 1994,* pages 59 – 69.

Fox, J. and Smith, P. 1986. More efficient milking. *Proceedings of the 38th Ruakura Farmers Conference,* pages 1 –3.

Ginajlo, M. 1985. Time study of milking and cleaning routines in the Maffra district during spring. *Proceedings of the Dairy Production Conference, 1985. Australian Society of Animal Production. (Ed. T.I. Phillips)* pages 529 – 32.

Hansen, M.N. 1999. Optimal number of clusters per milker. *Journal of Agricultural Engineering Research* **72:** 341 – 346.

Klein, J. and Hakim, G. 1994. "A review of labour productivity in milk harvesting in Australia". National Milk Harvesting Centre, Agriculture Victoria, Ellinbank, Victoria, Australia.

Klindworth, D. 2000. Working Smarter Not Harder – benchmarking your labour use in the milk harvesting process. Agriculture Victoria Ellinbank, RMB 2469, Hazeldean Road, Ellinbank, Victoria, 3821, Australia

O'Brien, B., O'Donovan, K., Kinsella, J., Ruane, D. and Gleeson, D. 2003. Factors affecting labour efficiency of milking. Book of abstracts of the *54th Annual Meeting of the European Association for Animal Production*. Page 284.(A8)

Smith, J.F., Armstrong, D.V., Gamroth, M.J. and Harner, J. 1998. Factors affecting milking parlour efficiency and operator walking distance. *Applied Engineering in Agriculture* **14:** 643 – 647.

Whipp, J.I. 1992. Design and performance of milking parlours. In: "Machine Milking and Lactation". (ed. A.J. Bramley, F.H. Dodd, G.A. Mein and J.A. Bramley) pages 285 – 310, Newbury, Bershire, UK, Insight Books.