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Efficient milking systems

Key external stakeholders:
Dairy farmers, dairy industry, milking machine companies

Practical implications for stakeholders:
As the number of milking units increased, row time and duration of over-milking were increased and the operator idle time was reduced

- The type of routine practiced largely dictates the number of milking units one operator can handle and the overall efficiency of the milking operation
- When minimal teat preparation prior to milking is used, the milking operator can manage more milking units
- The use of automation in the form of automatic cluster removers (ACR)s may be used to eliminate over-milking

Main results:
The full pre-milking routine reduced time to milk let-down and milking time, increased average flow-rate but did not affect milk yield. As milking unit number increased, the duration of over-milking (defined as time at milk flow-rate <0.2 kg/min) increased more with a full compared to minimal routine. As parlour size increased, milking row times, as well as the proportion of cows that were over-milked also increased, thereby reducing overall efficiency.

Opportunity / Benefit:
These results have implications for milking management and sizing of single-operator swing-over parlours with seasonally calved herds.

Collaborating Institutions:
DairyNZ, Hamilton, New Zealand.

Contact Bernadette O'Brien Email: bernadette.obrien@teagasc.ie.

Teagasc project team: Dr. Bernadette O'Brien (PI)
Dr. David Gleeson
External collaborators: Dr. Jenny Jago, DairyNZ, Hamilton, New Zealand

1. Project background:

A milk quota policy change coming into effect in 2015 is expected to lead to rapid expansion of dairy herds in Ireland. Efficient milking systems, in terms of labour demand, capital investment and cow udder health are critical to successful expansion. Some Irish farmers managing larger herds that have undergone expansion are reporting issues with milking management, in particular optimizing udder health (minimizing somatic cell count and clinical mastitis) and the length of time it takes to milk the herd (efficiency). Optimum milking efficiency may be defined as when the number of milking units are appropriate for the operator work routine and the cow milk production level such that both over-milking and idle time (operator waiting time between when cows are ready for cluster attachment and when the cluster becomes available) are minimised. The criteria of operator idle time and overmilking are critical issues in relation to labour efficiency/ requirement and udder health. Overmilking is one consequence of milking management that contributes to mastitis risk. Overmilking is defined as the period when teatcups remain attached to teats after the milk flow rate from an individual cow has fallen below an arbitrary 'end-point' of milking e.g. a milk flow rate of 200 mL/minute. The operator work routine (including cow preparation for milking) is a significant influencing factor, as is cow milk production. Milking time is longer when cows are at peak lactation compared to the later stages of lactation. This is a particularly relevant scenario in both Ireland and New Zealand dairies due to the seasonal calving pattern in both countries resulting in the complete herd being at a similar stage of lactation at any particular time point. In Ireland most parlours are swingover herringbone or side-by-side without automatic cup removers (ACR).

2. Question addressed by the project:

Could the effect of parlour size (number of milking units), pre-milking routine (full and minimal) and stage of lactation on milking efficiency (milking characteristics, row time, over-milking duration and operator idle time) of spring-calved cows, in a single-operator side-by-side, swing-over milking parlour be established?

3. The experimental studies:

A 5x2 factorial design was used to study the effects of parlour size and pre-milking routine on milking performance. Over-milking duration, operator idle time and milking time were the main variables. Five combinations of parlour size (14, 18, 22, 26 and 30 milking units) were examined, each with two different pre-milking routines. With minimal pre-milking routine, clusters were normally attached directly to cows in sequence starting at cluster 1. With full pre-milking routine, the cows were sprayed with disinfectant, fore-stripped and wiped with individual paper towels in that order. The full row of cows was sprayed first to ensure adequate contact time for the disinfectant product to be effective. Then foremilk was drawn, teats were wiped and clusters attached in groups of 6-7, starting at cluster 1. This experiment was conducted when cows were at 221 (late lactation, 2009) and repeated at 50 (peak lactation, 2010) DIM (days in milk). Four rows of cows were milked at each session, giving three data points from each milking session. Each combination of routine and parlour size was tested at four milking sessions (two AM, two PM) giving a total of 12 values for each combination. Automatic cluster removers (ACRs) were used to prevent any teat damage due to over-milking and over-milking duration was calculated as the time difference between ACR activation and swing-over of a milking unit (to the next cow).

4. Main results:

Cow milking duration, milk let-down time, maximum and average milk flow-rate as well as milk yield were not affected (P>0.05) by milking unit number or parlour size at either peak or late lactation. Total cow entry time, pre-spray time and time taken for cows to exit all increased (P<0.001) in duration as parlour size increased from 14 to 30 milking units in peak lactation (ranges: 0.7-1.4 min, 0.7-1.6 min and 0.8-1.6 min, respectively). This trend was also observed in late lactation (ranges: 0.9-2.0 min, 0.8-1.9 min and 0.6-1.4 min, respectively). Milking row time increased from 9.2 to 12.9 min as cluster numbers increased from 14 to 30, when minimal pre-milking routine was applied. The corresponding row times were 11.1 to 21.1 min when full routine was applied. Shorter row times were observed in late lactation with similar trends regarding cluster number and pre-milking routine. Over-milking time increased with more milking units (P< 0.001) and was longer with full compared with minimal pre-milking routine (P< 0.001) at both peak and late lactation. There was also an interaction between cluster number and over-milking time (P< 0.001). Using the minimal pre-milking routine, over-milking duration increased from 0.8 to 2.9 min as milking unit numbers increased from 14 to 30 at peak lactation. Using a full routine the corresponding over-milking times were 2.1 to 9.3 min. The

Contact Bernadette O'Brien Email: bernadette.obrien@teagasc.ie.

duration of over-milking was extended in late lactation with increases of 0.9 to 4.7 min and 3.3 to 10.4 observed with minimal and full pre-milking routines, respectively. A reduced operator idle time per row was observed with the minimal pre-milking routine in both peak and late lactation; operator idle time ranged from 2:11 to 0:19 (min:sec) and from 0:51 to 0:06, respectively, generally decreasing as milking unit number (row size) increased from 14 to 30.

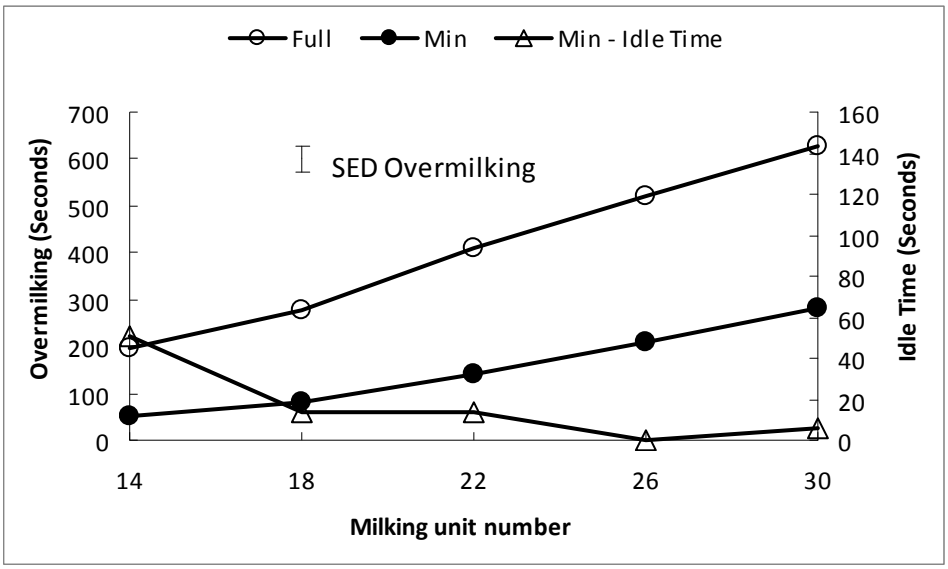

Figure 1. Over-milking time (the time between ACR detachment and attachment of that cluster to the next row) and operator idle time for cows milked in a parlour with 14, 18, 22, 26 or 30 milking units, and two different pre-milking routines, (Full: spray, strip, wipe, milking cluster attachment and Minimal [Min]: milking cluster attachment), when cows were an average of 221 (late lactation) days in milk.

5. Opportunity/Benefit:

When a minimal pre-milking routine is applied throughout lactation, 22 milking clusters may be operated without over-milking of longer than ~2 min, in the absence of ACRs, The use of ACRs would allow up to 26 clusters to be managed due to the ACR effect in eliminating over-milking in late lactation. Alternatively, when a full pre-milking routine is applied throughout lactation, milking cluster numbers of 14 (peak lactation) or less (late lactation) may be operated without experiencing over-milking of longer than ~2 min in the absence of ACR. While ACR prevent over-milking when using more milking clusters, such additional units in this scenario will not allow significantly more cows to be milked within a specified time e.g. 2 h, as the pre-milking routine is the limiting factor. The full pre-milking routine resulted in a shorter milking duration, shorter time to milk flow and higher average milk flow-rate compared with the minimal pre-milking routine at both peak and late lactation stages. However, this was not reflected in overall milking efficiency since milking row time was increased with the full pre-milking routine. Increasing milking unit number can reduce overall milking time but is limited by the increase in row time, which is influenced by both pre-milking routine and stage of lactation and which, in turn, influences cow over-milking.

6. Dissemination:

Main publications:

O'Brien, B., Jago, J., Edwards, P., Lopez-Villalobos, N. and McCoy, F. (2012). Milking parlour size, pre-milking routine and stage of lactation affect efficiency of milking in single-operator herringbone parlours. *Journal of Dairy Research*, In press.

O'Brien, B., Jago, J., McCoy, F. and Edwards, P. (2011). Cow over-milking in a side-by-side parlour as influenced by parlour size and pre-milking routine. In*: Agricultural Research Forum*, The Tullamore Court Hotel, 15-Mar-2011, p. 136.

Popular publications:

O'Brien, B. and Gleeson, D. (2011). The role of Labour Studies in Ireland in leading change in the Dairy Industry**.** Irish Meeting 2011 on Agricultural Occupational Health and Safety 22nd - 24th August, 2011.

Contact Bernadette O'Brien Email: bernadette.obrien@teagasc.ie.

Castleknock Hotel, Dublin, Ireland. http://www.teagasc.ie/publications/2011/1026/IrishOHSproceedings.pdf

O'Brien, B. (2011). Milking process efficiency. Teagasc Greenfield Dairy Programme. Kilkenny Greenfield Open Day 4/5/11. Teagasc IE p. 80-92

O'Brien, B. and Upton, J. (2011). Increase milking efficiency - Irish Dairying Planning for 2015, Moorepark'11 Open Day (29/6/11). Teagasc IE p. 110 - 111

7. Compiled by: Bernadette O'Brien

Contact Bernadette O'Brien Email: bernadette.obrien@teagasc.ie.