SHORTER MILKING TIME

Mel Eden, Fox Eden and Associates, Hamilton
Jenny Jago, DairyNZ

Introduction

Milking is the most labour intensive job on dairy farms. With larger herds and limitations on capital, it is inevitable that the time spent in the dairy is getting longer; milking is harder on people and harder on stock if they have to wait around. This paper gives a number of suggestions on how to improve milking efficiency and make milking a little easier. It focuses on cow flow, milking routines and provides an update on research on setting a maximum cups-on time for milking.

Most of the useful ideas come from the practical experience of dairy farmers and so it is a good idea to find the time to visit other farms and observe a milking. There are probably thousands of farmers thinking of ways to save time, improve productivity, and reduce the effort of milking. Sharing these ideas will help trigger even more ideas for innovation.

Cow flow

Milking is a combined effort from the cows, the people and the machinery – all must do their job effectively, and good teamwork is essential for efficient milking. One of the major causes of frustration during milking is cows that are not flowing well through the system. Good cow flow is important from the time the cows leave the paddock until they leave the dairy and return to the paddock.

From paddock to dairy

- Races. A 200 cow herd needs about 4 metres of clear race width, and larger herds a metre wider for each 50 cows added to the mob up to about 7 metres. The surface should be hard, free of sharp stones and crowned very gently rather like a motorway. Cows hate walking along a slope. Eliminate all sharp turns as these can each add 5 minutes to the time. Avoid uneven climbs. After a steep climb, cows will stop on the flat section so it's better to even it out. Avoid mud holes and changes in width.
- Yard entry: Avoid cows stepping down when entering the yard as this can cause lameness when cows step on stones dragged in from the race. Instead have the entryway leveled and,

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if concerned about stones being dragged in, fit a concrete nib. Entrances should be wide so cows don't slow down entering the yard.

- Yard design: A rectangular yard is always better than a round yard for cow flow. Sometimes it does not suit for other reasons and a compromise is needed. For herringbones the efficiency of a round yard falls away if more than about 10 metres in radius and for rotaries at about 12 metres. Overhead gates work, but add to costs, and are hard to manage well. Cows move better into, and through any yard, if they are not tightly packed. If they have to be seriously forced, there is a design fault in the milking area.

Herringbone dairies

- Yard design is even more critical, especially for long herringbones, with rectangular yards. These are a clear winner but the site often determines the most practical design.
- A backing gate control that is operable from most of the length of the pit avoids interrupting cluster changing and therefore wasting time.
- The lead-in to the bail area is often restricting. To improve, either extend the lead-in from the rump rails out beyond the building, or alternatively, extend the breast rails out further and have a very short rump rail extension. The latter allows for easy cross-over of cows from one side to the other especially for the last row.
- The breast rail height is critical: 760 mm to the top of the pipe for Friesians and 700 for Jerseys. Otherwise the pipe affects the shoulder blades of the cows where there is no protection by muscle, causing pain, and an inevitably hesitant approach down the bail area.
- Zigzag rump rails control the cows' position, giving better cow flow because cows know when they are in the 'right' position. The resulting good alignment with the cluster gives faster, more even milking.
- The first bail space is critical. It needs to be about 200 mm longer with no intrusive pipe work – so the biggest cow in the herd can stand in comfort. Alternatively, leave out the first zig zag as this helps with flexibility.
- Head gates need to be at the correct angle so cows fit in easily. Widely spaced vertical supports avoid cows getting hit on the way out. They need to be operable from well down the pit. The pit-side post supporting the head gate should be in line with the rump rail and not stick out into the cows' pathway.
- Long pits work against short row times, because cows take too long to change over. Long pits require better staff coordination with both milkers changing clusters quickly and both milkers changing clusters together. This gives enough 'free' time for the milked cows to move out and the unmilked cows to move in.

- A system using two pits side by side to make more efficient use of labour is preferred to pits more than about 40 clusters long (the exception being rapid exit herringbones). These can be up to about 40 clusters long each.

Rotary dairies

- The exit race leading from the platform to the main race should be short – not more than about 10-12 metres long - or else doubled up to avoid the cows jamming up.
- A variable speed drive on the platform saves time if adjusted continually, not simply to speed up the platform to adjust for the shorter afternoon milking times. It too can be automated.
- Put duplicate platform and backing gate controls on the exit side. The person there (if no ACR and auto teat sprayer are installed) usually has a better view of the yard and more flexible demands on their time.

People

Train the milkers to move slower, not dash about aimlessly, to not interrupt the cow flow on to the platform by leaping up into the yard and to not disturb the cows with loud unpleasant noises. Practicing karaoke songs loudly and throwing chains across the entry bridge in front of the cows should be discouraged. Extraneous noise, e.g. from noisy vacuum pumps, may not affect the cows directly but tires the milkers. Site the pump well away and soundproof it. Steel platforms can be fitted with rubber pads under the cows to minimise the sound of crashing clusters.

Things that put cows off

Cows are slow-moving, slow-thinking creatures but they have very good eyes and ears. They do not appreciate being hassled by impatient, inconsiderate people.

- They are wary of lines/shadows which can be difficult to avoid in a steel pipe bail area.
- They dislike fast movement (such as by staff who insist on flitting about wearing a brightly-coloured shirt with a flapping tail and singing loudly out of tune).
- They dislike getting hurt by vertical pipes hitting their hip bones and resent having a piece of steel within 100 mm of their eye. They do not like getting jammed at the entry of a rotary where there is no safety switch, or having to shove past a rigid ‘D’ gate to get into the rotary

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bail. They do not like bumping their unprotected shoulder blades into a herringbone breast rail that is too high.

- They walk hesitantly if unsteady on their feet - as you would on a steep slope of slippery concrete, without the benefit of your hands to break an unexpected fall.
- If they fidget, kick or stamp their feet when you are putting on or taking off the clusters it is possible they are getting hurt by the machinery. They could also have sore teats resulting from dirt, or sand, or inclement weather and incorrect choice or use of teat spray mix.
- Stray voltage makes them hesitate to walk into the bail area but there are plenty of other faults that give the same effect.
- Any action that causes fear has been shown to inhibit milk production.
- Steady mechanical noise from worn vacuum pumps does not appear to annoy cows as much as it does people - even if both prefer the noise not to be there. Cows show their objection to the crash and clatter of noisy gates, banging alkathene and bashing teat clusters – and also Hard Rock music - by giving a little less milk. Turn on the preferred Country and give the workers headphones and a Walkman so they can play military marches to get them to step up the pace. Aim for total cow comfort. Your reward will be more milk, quicker milking and much greater job satisfaction.

Cupping techniques

Cluster changing can be a long, tiring and repetitive job. The aim is to find ways to change clusters quickly without unnecessary physical strain and to avoid the problems of muscle/tendon over-use. Many milkers use dangerous methods that will affect their long-term health.

The 'Round-the-Circle' method is – or should be - taught to all new milkers as the simplest, easy-to-learn, reasonably quick method. Another method, more suited to people with large hands, involves putting on two front teat cups more or less at once then the third, then flicking up the fourth with the other hand. A change in method during milking is recommended - again to relieve muscle strain. Each method works on both rotaries and herringbones, although there are some refinements.

For herringbones, use the right hand to put on the teat cups on the right hand side row of cows (with you facing the exit) because it is easier to reach through the back legs. Pick up the claw with the left hand and reach over the left arm to pick up the left back teat cup at the same time. Put it on then the left front then right front then right back. On the left hand side use the left hand to put on the teat cups.

An alternative method is useful, but here there is already a change in muscle usage depending on whether the clusters are being placed on the right or left side of the herringbone. On rotaries, the Round-the-Circle method depends on which way the platform is rotating. For

clockwise rotation, pick up the claw with the right hand, then reach over the arm with the left hand, pick up the right hand back teat cup and place it on the right hand back teat - the first seen as the cow approaches. Then the right front, next the left front leaving the back left till last as the cow goes past. For a 'rest', pick up the claw in the left hand and the two front teat cups in the right hand. Place them on the cow then the right back. As this happens, slip the left hand off the claw and use it to put on the left back teat cup. The Round-the-Circle method is not the fastest method but it is reliable and easier on the milker because there is much less chance of getting kicked.

Cluster removal is important too. Turn off the vacuum, grab the claw, wait a second or so, then twist it so all four teat cups come off the teats more or less together. Do not drag the claw squarely backwards – this upsets the cow. Pulling one teat cup off while the others are still attached, and before the vacuum falls, risks more new infections.

Milking routines

It is here where real savings in time are often possible. The longer the herringbone, the longer the time it takes for the cows to walk in and out. If you reduce the time actually changing clusters, more time is available for the milked row to leave and the unmilked row to line up properly.

Teach people to change clusters in less than 10 seconds – relatively easy to do.

Make sure the two milkers are changing clusters on the cows at the same time - not one of them skiving off to do other, less important tasks. Both working together allows more time for row changing, the key to speeding up the routine. Both people start changing more or less at the exit end and skip past any slow cows. Teat spraying is normally done three or four cows at a time as the people work down the pit – or an automatic system set up at the head gate. As they reach the end, one person goes up to drench (if being done) and the other works their way back towards the exit end to change the slow cows. As soon as possible, the head gate is opened to start the cows exiting. The backing gate is used to tighten up the cows when working about half way down the pit. Use it little and often, but do not get the cows so tight that their heads are all up in the air. In a dairy observed recently, 90 seconds were lost on every row by not opening the head gate early enough, and another 90 seconds by the 2nd milker starting changing part-way down the pit.

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Speed versus rhythm

As a summary, speed in the individual actions in a dairy does not necessarily lead to fast milking. Consider all the processes from getting the cows to the dairy to the clean-up. Consistent progress without exhausting the milkers is the aim.

Machinery

- Cluster alignment is important to get even milking-out; otherwise the milker is waiting longer for the slow teat to finish.
- Teat damage upsets cows and causes mastitis.
- Keep the vacuum level low, especially for early season and if there are no automatic cluster removers. With a high milk line, and during milking, the vacuum level in the claw falls below the milk line vacuum because of the static lift of milk. The faster the cow milks, the more milk in the long milk tube and the lower the claw vacuum.
- During any over-milking the cows' teats will be subjected to the full plant vacuum and, if weather conditions and other factors are adverse, damage is almost inevitable.
- The guidelines in Table 1 are not prescribed by any regulation as such, but result from practical experience. They are generalizations, open to minor adjustment and somewhat dependent on the design of the milking system but are reasonably 'safe'.

Table 1. Vacuum level v milk line height, based on recommendations by the NZ Milking and Pumping Trade Association

Milk line height (m) above the cow platform	**Vacuum (kPa)**
1.8	48
1.6	46-48
1.4	44-46
1.2	42-44
Low line	40-42

- Use the lower vacuum levels listed with large-bore long milk tubes, or in wet, windy weather, e.g., at the start of spring calving.
- With automatic cluster removers (ACR), depending on their internal head loss, and after spring, the higher level is acceptable. In practice, it is wise to start the season off with the vacuum level low rather than high, i.e., never start spring calving with a vacuum higher than 46 kPa regardless of the milk line height.

- Increase to around 48 kPa for herd testing to compensate for the head losses in current milk meters.

Liners

- Change every 2500 cow milkings.
- Use fast milking liners on back quarters and ones that hang on without slipping on front quarters (seek advice from specialist milking equipment advisors).

Pulsation

- Pulsation systems in general have only a small effect on output although there is a theoretical gain in speed of about 15 seconds/average cow by increasing the ratio from 60% to 65%. Increasing the rate has only a tiny effect. Recommended ratios are 60% to 65% and rates 55-60 pulses/min.
- Claws should be easy to use.

Research update: Setting a maximum cups-on time for milking

Most farmers accept that waiting for slow-milking cows limits milking efficiency. Taking clusters off after a fixed time, or position on the rotary platform, or not waiting for the slowest of milkers to milk out in herringbone dairies is becoming a more common practice. However, many farmers have concerns as to the effect of this on milk production, SCC and the likelihood of the cow developing clinical mastitis. These concerns are supported, in part, by some earlier research that reported that under-milking induced higher SCC in infected quarters, but not in uninfected quarters (Napper and Williamson, 1982/83). However, other studies found that small quantities of milk left in the udder did not increase new infection rate or clinical mastitis rates (see O'Shea, 1987). Rasmussen (1993) reported a lower incidence of clinical mastitis when the ACR threshold was raised from 200 to 400 ml/min. A series of recent Australian studies found that by imposing a maximum cups-on time limit, and therefore leaving a small amount of milk behind in some udders, had little or no significant effect on clinical mastitis, and minimal effect on production (Clarke et al., 2004; 2006). A further study by this group found that leaving on average an extra 0.3 l of milk in the udder did not increase quarter SCC in either infected or uninfected udder quarters (Clarke et al., 2008).

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To further explore milking routines that may lead to reduced milking time, a study has been carried out at DairyNZ that aimed to evaluate the impact of setting a maximum milk-out time for cows on overall milking efficiency, production and udder health, commencing when the cows were in peak lactation.

Approach

Twenty sets of identical twin cows were assigned to two treatments that differed according to when clusters were removed: Control = Clusters removed at a milk flow rate threshold of 350 ml/min; MaxT: = Clusters removed at a milk flow rate threshold of 350ml/min or at a maximum milking time, whichever comes first.

The cows were milked through a 30 bail rotary with ACR that operated on flow rate threshold and/or time. The treatment period began when the cows were 68 days in milk (DIM) and at peak lactation. Prior to this, all cows were milked according to the same milking routine (clusters removed at a 350 ml/min milk flow rate). The AM milking began at approximately 07:00 h and the PM milking at 15:15 h. A herd test was carried out weekly and milk yield, milk flow rate, milking duration data were recorded automatically at each milking.

Setting the maximum milk out time

The maximum milk-out time was set according to the milking time of the 70% percentile of the control herd (i.e. the milking time of the 14th cow, when ranked from fastest to slowest, clusters removed at flow rate of 350 ml/minute). Initially this was 9 min 20 s in the AM and 6 min 11 s in the PM, decreasing to 7 min 58 s and 5 min 58 s after two weeks for AM and PM milkings, respectively. The maximum milking duration was reviewed periodically and adjusted to allow approximately 70% of the cows to reach the milk flow rate threshold for cluster removal.

Effect on production and udder health

On average, 30% of cows reached the maximum time and had their clusters removed before the milk flow rate threshold was reached. At times, up to 56% of cows had clusters removed at the maximum milk-out time, and at other times, the proportion was as low as 14%. The production data for the Control and MaxT groups are shown in Table 2. The Control cows produced 262 kg MS and the MaxT cows 261 kg MS. The MaxT treatment had no effect on the incidence of clinical mastitis (number of clinical cases: Control = 2, MaxT = 2), or the proportion of quarters infected with major (Control = 1.3%, MaxT = 1.3%) or minor (Control = 28.8%, MaxT = 31.3%) pathogens. There was a tendency for the number of cows with sub-clinical infections to be higher for the MaxT group than the Control group (Control = 12, MaxT = 17, P = 0.07).

Table 2. Mean milk yield, fat, protein, milksolids, somatic cell count for Control (clusters removed at threshold milk flow of 350 ml/min) and MaxT (clusters removed after a maximum milk out time, or 350 ml/min whichever comes first) groups for the experimental period that started when the cows were, on average, 68 ± 7 days in milk

	Control	**MaxT**	**sed**	**P-value**
Total milk yield (L)	3116	3099	68	0.807
Total fat (kg)	146	147	3	0.714
Total protein (kg)	115	116	3	0.776
Milksolids (kg)	262	261	5	0.779
Log_{10} SCC	2.01	1.98	0.05	0.585
SCC (cells/ml)	193,000	213,000	-	-

Effect of setting maximum milk-out times on overall milking time

The impact of adopting the maximum milking time procedure on overall milking time will depend upon the current operational procedures of a dairy. The mean milking duration is not the major factor controlling the time to milk a herd in a given dairy. In a rotary the number of cows going around a second rotation, and the platform speed, are the two main factors, along with the proportion of missed or empty bails. In a herringbone dairy the time that a person waits to remove the cluster from a slow-milking cow will have a major influence on row time.

Scenario 1: A herd of 540 cows producing 22 l/cow/day, milked through a 50 bail rotary. Average rotation speed is 8 min 36 s, 20% of the herd is completing a second rotation

The recommended MaxT for cows producing 22 l/d at a 10:14 h milking interval is 7 min 32s (AM milking) which is equivalent to about 8.5 min rotation time. In this situation the time savings will be achieved through reducing the number of cows that "go-around-again" to zero. For a 540 cow herd this would mean that 108 cows would normally complete two rotations of the rotary. i.e. an additional 2.1 rotations required to milk these cows. At 8:36 min per rotation that equates to 18 minutes per AM milking.

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Scenario 2: A herd of 540 cows producing 23 l/cow/day, milked through a 50 bail rotary. Platform speed is currently 10.4 minutes and 8% of cows are being allowed to complete a second rotation; milking interval is 10:14 h.

In this situation time savings could be achieved by speeding up the platform and not allowing cows to complete a second rotation. Based on Australian guidelines the recommended maximum milk-out time is 7 min 32 s and 6 min 15 s for the AM and PM milking, respectively. Focusing on the AM milking, and allowing a further 54 sec. rotation time between the clusters-off and clusters-on positions, the platform could be set to rotate at approximately 8.4 min, saving 2 minutes per rotation. Not allowing cows to complete a second rotation would reduce the number of rotations required to milk the herd from 11.7 (540 cows + 43 go-around-again cows = 583/50 = 11.7) to 10.8 (540 cows + 0 go-around-again cows/50 = 10.8). Total time savings would be 30 minutes ([old milking time: 11.7 x 10.4 = 121 minutes] – [new milking time: 10.8 x 8.4 = 91 minutes]).

Scenario 3: A herd of 250 cows milked through a 20 aside herringbone dairy, producing 23 l/cow/day. Average row time is 9 minutes and milking interval is 10:14 h.

For a herringbone dairy time savings will be achieved by not waiting for slower-milking cows. The impact on the total milking time is, however, complicated by its size, number of operators, operator routine and load and unloading row times. Assuming the operator is not limited by the time it takes to cluster up one side and then release the other side, clusters should be able to be removed after cows have had clusters attached as soon as the maximum milk-out time has been reached (i.e. 7 min 32 s for the AM milking for this average herd yield and milking interval), saving an average of 1 min 28 s per row or 18 minutes per AM milking.

The key to implementing this approach to milking cows is to determine the correct maximum milk-out time. Australian researchers have established guideline maximum milk-out times for a given herd yield and milking interval (targeting the 80% percentile ranked by milking speed) which are available on the internet (www.cowtime.com.au). The guidelines are based on average herd yield and milking and are slightly more conservative than the maximum milk-out times used in the DairyNZ study.

The results from this study and others raise important questions, and opportunities, regarding the optimal time to remove clusters from cows such that milk quality, udder health and production goals are met alongside the need for improvements in milking efficiency. Further studies will be undertaken by DairyNZ to investigate the effects of implementing MaxT milking from the start of lactation, as well as comparing different ACR threshold settings under New Zealand milking conditions.

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