TECH NOTE

# Automatic milking

*Addressing industry concerns about automatic milking in a pasture based system*

by Kendra Kerrisk

## AUTOMATIC MILKING IN A PASTURE SYSTEM

An automatic milking system (AMS) on a pasture based dairy farm is vastly different to a conventional system.

Current AMS technology relies on using the milking unit throughout the 24-hour period to reduce the capital requirement and thereby improve the financial viability.

There are two keys to operating an AMS efficiently – voluntary cow movement and distributed milkings.

**Voluntary cow movement:** Cows must move from the paddock to the dairy and back again on their own. We refer to this as 'voluntary movement'. The benefits of an AMS are lost if cows have to be fetched from the paddock regularly. There's no point in replacing the labour needed in the dairy with labour needed to fetch cows.

**Distributed milking:** In a conventional system milking occurs in two or three concentrated 'milking times' – e.g. am and pm).

To operate efficiently, an AMS needs to be used fairly continuously, with a steady trickle of cows visiting the dairy. Milking must be spread or 'distributed' evenly throughout the 24 hour period. We refer to this as 'distributed milking'.

**Incentives:** The need for voluntary cow movement and distributed milkings creates a very different approach to managing the whole farming system with an AMS.

Cows do not respond to udder fill or pressure as a motivation to be milked. They will come to the dairy in the search for feed, water, shade, shelter or herd mates.

A key to the AMS system is the use of incentives to motivate cows to move around the system: from paddock to dairy and back to paddock again, which in turn generates the opportunity for milking.

Retrofitting an AMS on an existing robot is not feasible in the foreseeable future.

**For more information**

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## PASTURE UTILISATION

High levels of pasture utilisation are essential in an Australian automatic milking system (AMS) system, as profitability depends on it.

From our experience at Camden, we believe any farmer who is good at managing pasture in a conventional system can be equally as good at pasture management in an AMS.

Annual pasture utilisation on the Camden AMS farm is has reached 14t DM/ha on irrigated pastures and an average of 10t DM/ha across the farm. This is well above the district average of about 7t DM/ha.

The key difference between an AMS and a conventional system is that pasture allocation is needs to be more accurate in an AMS.

If cows receive much more of their daily allowance than they should have, they will be less willing to move off pasture and therefore through the dairy for milking.

### Incentives

At the Camden AMS, feed is the only incentive used to encourage cows to move to and from the dairy. Cows receive a fresh break of pasture twice a day. Concentrates are fed during milking. When pasture is limiting, a balanced ration is available on the feedpad after milking.

Cows leave the paddock seeking either supplementary feed or a fresh break of pasture. Either way they go through autodrafting gates which are programmed to send to cows to the dairy or pasture depending on certain criteria such as 'time since last milking'.

This system results in cows effectively 'running out' of pasture twice a day. Cows with a big appetite and a high level of motivation will walk out of a break of pasture at a higher residual than another cow.

If for some reason cows don't graze pasture hard enough they are returned to the break or the pasture is slashed to maintain pasture quality. This is no different to a conventional system.

## LABOUR

To better understand the effect of an AMS on labour, FutureDairy is carrying out a series of labour audits combined with social research interviews.

This is being done at the Camden AMS and at the commercial robotic farm in Victoria.

The audits indicate that about 2¼ hours a day are spent carrying out milking associated tasks.

These tasks include all aspects of farm operation that would normally be carried out at milking time or tasks specific to the AMS farm system: herd testing, hosing yards, cleaning exterior surfaces of machines, filling chemical drums for auto plant washes, attending callouts, monitoring daily reports, detecting and treating mastitis cows, setting up new pasture breaks, fetching any cows that don't report for milking, training new cows to the system and changing filter socks.

Social research data indicates that working conditions and staff satisfaction levels are greatly improved in an AMS compared with conventional milking. The working day is extremely flexible.

The average working day for farm staff at Camden is 7:30 am to 4pm. On weekends one staff member works 2-3 hours in two shifts, usually 1-2 hours before 11am and for about 1 hour between 2pm and 8pm.

## ALARMS and CALLOUTS

An AMS dairy uses a system of alarms and 'callouts' to alert staff to problems. At Camden we average 4.2 callouts a week, of which about three occur after hours (5pm-7am), and the rest during working hours.

Most callouts are very simple alarms where the machine simply needs re-starting. For example if the tanker driver didn't push the pickup button or if there is mud or milk on the laser screen.

More than half the alarms can be dealt with from the home by dialling up the robot computer and carrying out a self-test prior to restarting the machine.

Only about 2% of alarms have required the callout of a service technician.

Farm staff involved with the AMS farm say they would far prefer to receive the occasional phone call than to have to collect cows for milking at unfavourable hours every day of the week as in a conventional dairy.

The flexibility of the AMS means staff can start work later the day after a late night call out, or finish work earlier.

## MASTITIS and HEAT DETECTION

FutureDairy is investigating the accuracy of the various alerts given in the form of electronic reports generated from the AMS. The alerts include indicators of mastitis and heat detection.

### Heat detection

Our current heat detection method is visual assessment in the paddock (twice a day) when fresh breaks of pasture are set up. We are assessing the accuracy of the activity meters that come with the AMS as an alternative or addition to visual observation of heat.

The auto-drafting system usually works as the cows in the breeding program are quite early lactation and are moving around the system well. However, there are occasional problems with cows presenting to the dairy and being auto-drafted in a timely manner for AI. In this instance a cow may need to be fetched from the paddock to ensure she is inseminated before staff go home for the day.

### Mastitis

For mastitis detection the AMS has a series of quarter sensors that detect conductivity and blood levels in milk and give an indication of deviations from normal.

This system works well. The dairy was awarded a 'superior milk quality certificate in 2007.

Recent investigations into the effectiveness of the AMS mastitis detection aids indicate that the software tools available are both accurate and easy to manage.

## POWER CONSUMPTION

FutureDairy is auditing power consumption at the AMS dairy at Camden.

Some overseas reports suggest power consumption is no different to a conventional system while others report up to 50% greater consumption.

Our data to date suggests that power consumption at the Camden AMS is considerably greater than that in a conventional system. The Camden AMS energy cost (gas and power) is 1.38 cents/litre milk produced, or

$90/cow/year, which is well above Australian industry averages.

One of the main causes of our high energy costs is that the AMS dairy uses a gas water heating system which operates 24 hours a day, continually circulating the water. This is an expensive set up that is not necessary. We are investigating more efficient options for water heating and milk cooling.

Scale of operation also contributes to energy efficiency. If we doubled the herd size we would be unlikely to double the power consumption and would therefore result in lower consumption per cow or per 1,000 litres milk produced.

## TRAINING COWS

The commissioning period of an AMS dairy is a one-off event but potentially a difficult period.

Technically the AMS dairy must perform effectively and cows need to be trained to use the system.

The farmer and/or staff go through a steep learning process about operating the AMS technology, the farming system, voluntary cow movement and the monitoring systems.

### Commissioning the Camden AMS

In May 2006 FutureDairy commissioned its AMS dairy and trained 110 cows to the system. The entire training procedure went extremely well with cows quickly adapting to the system. Training the cows was much easier than expected, in terms of the level of intervention required and number of man hours involved.

The ease of training was due to the layout of the dairy, the patience and stockhandling skills of the two technicians, the incentives provided for the cows (particularly the feedpad after the milking stations), and the technology itself. Most of these issues are not particular to AMS and would all contribute to the ease of training animals to any new dairy.

By the sixth milking (day 4) all cows were willing to walk from the waiting yard, through the machine to be milked and into the post-milking feedpad with no encouragement or intervention. Some cows were prepared to do this by the second milking which was on day 2.

Within a week all cows were willing to walk from the paddock to the dairy, milk themselves and return to the paddock after the feedpad unassisted. Some cows were completing this process within two days. This speed of learning is similar to training animals to any new dairy facility.

### Training heifers

To date heifers have proven extremely easy to train in the AMS at Camden.

Within two days of being introduced to the system heifers usually volunteer to walk from the paddock and into the milking unit unassisted.

To date heifers have received no pre-calving pre-training and have performed at a level of 75% production of mature cows.

Pre-training the heifers before calving may improve performance up to about 85%. It would help them compete with cows, move around the system without help and be  familiar with the machines and the chino head stalls in the feed pad.

FutureDairy's heifer training trial will determine if training with limited intervention and labour improves heifer performance and makes life easier for farm staff during the calving period.

The trial involves two groups of heifers, both managed with the milking herd for two weeks, starting eight weeks before their due calving date.

One group of heifers is automatically released from the milking units every time they report to the dairy. The other group is held in the machine, given an allocation of feed, teat sprayed and then released from the machine.

Preliminary results indicate that the trained heifers have 10% improvement in production in the first 14 and 30 days of lactation and a 20% improvement in milking frequency.  The labour required to achieve this result has been very minimal.

### Unsuitable cows

Prior the initial training of the herd about 4% of the cows were preselected for 'culling'. The decision was based on udder conformation according to the AMS manufacturer's guidelines. In hindsight, these cows probably would have been suitable for the AMS.

Since the initial set-up period, three cows have been culled from the herd for collapsed udders. They would have been considered a cull in any system as their conformation made them unsuitable for milking in an AMS or conventional dairy.

Seven kickers from the conventional dairy have been sent to the AMS dairy. These cows created occupational health and safety issues in the conventional dairy. They settled well into the AMS without any adverse behaviour.

There have been no cows that haven't adapted to the system in terms of their learning to move voluntarily around the system.

## RETROFITTING A ROBOT TO AN EXISTING DAIRY

Dairy farmers frequently ask the FutureDairy team if it's possible to fit a robot to an existing dairy, especially a rotary. This is not a new concept but it's a very difficult task. It's been considered by dairy equipment companies and researchers over the past 20 years, without any real progress.

The concept appeals to those with a relatively new dairy which is still very functional. Automation already available in conventional dairies includes in-shed feeding, automatic cup removal (ACR), teat spraying and drafting. So is automatic cup attachment (ACA) the next development for conventional dairies in Australia? The answer is no, it is not feasible in the foreseeable future. The NZ industry has come to the same conclusion[1].

There are four reasons why there is limited potential for retrofitting a robot to an existing dairy in Australia:

- Technically, it's not feasible;
- Most labour and lifestyle benefits of an AMS would not be achieved with a robot on a rotary;
- Costs are prohibitive; and
- Limited market size in Australia.

### Technical issues

Technical issues with putting a robot on an existing rotary include speed of cup attachment, access to the udder, variation in existing dairy dimensions and milk quality concerns.

Current automatic cup attachment technology is too slow to be retrofitted to an existing dairy. It takes about 30 seconds for a robot to attach a set of cups, which is much slower than a human working in a conventional dairy (3-10 seconds). The speed of robotic attachment is improving, but it may be many years before a robot is as fast as a human.

Either a number of robots would be needed, depending on the size of the platform, or cows would need to be fetched in smaller batches to minimise the amount of time cows spend waiting for milking.

A system that involved fetching small batches of cows would simply replace one tedious task (putting cups on cows) with another (fetching many groups of cows).

Conventional dairies are not uniform in dimensions which also poses technical challenges for retrofitting.

Another technical challenge is providing the robot with access to the udder. Currently all robotic automatic cup attachment technology approaches the udder from the side of a cow.

A robot on a conventional system would have to be developed to access the udder between the cows' back legs. The only other option would be to use every second bail on a rotary as a dummy bail allowing the robot to access the cow from the side.

The conformation of the udder is less suited to automatic cup attachment from between the back legs than the side. Automatic attachment uses lasers and a camera to detect the position of teats. In most cows, the back quarters are bigger and lower than the front quarters. This means the lobes of the back quarters obscure front teats from the lasers and cameras, making automatic cup attachment very difficult.

Added to that, cows' legs are relatively close together providing limited room for the robot to access the udder from between the back legs. A robot has much more room to access the udder from the side of a cow.

A robot accessing the udder through the back legs would have increased risk of soiling and contamination of milking apparatus, resulting in milk quality risks.

One manufacturer has attempted to attach cups by having automatic cup attachment coming up through the floor (potentially rotary platform) however, this attempt was unsuccessful and has been abandoned for now.

### Labour and lifestyle issues

Using a robot for automatic cup attachment in a conventional dairy does not carry the same labour and lifestyle benefits as an automatic milking system where cows move voluntarily to and from the dairy and milking occurs throughout the day and night.

A conventional dairy fitted with automatic cup attachment technology would still involve twice daily milkings. Cows would need to be fetched and it is likely that someone would need to oversee the operation, detect mastitic cows, divert colostrum and antibiotic milk and reattach cups that are kicked off (or send individual cows around the platform for a second rotation).

So this system may reduce the total amount of labour units required, but does not remove the need for someone to work the unappealing hours of a conventional system.

## Costs

The cost of this type of automatic cup attachment technology on top of other automation and the conventional dairy itself would limit the uptake on farm.

## Australian potential market

Rotaries account for 11% of all shed types in Australia[2]. The proportion of new installations being rotaries is likely to be quite high. We estimate that 25-35% of the Australian herd is currently milked by rotaries (no hard data is available).

The use of automation in Australian dairies is still fairly low. Of the Australian dairy farms surveyed**:

- 13% had electronic animal identification (EID);
- 8% had automatic drafting;
- 4% had activity monitors;
- 9% had computer assisted feeding; and
- 28% had automatic cup removers (ACR).

Even if it was technically possible to retrofit automatic cup attachment technology to a conventional dairy, it would only be relevant to a very small number of Australian dairies in the coming 10 years.

## New concept

FutureDairy is developing a farm management system to support the use of current AMS technology on a pasture-based operation.

We will also test a 'new concept' AMS which is being developed by DeLaval, specially designed for Australian conditions. It will be a 'higher throughput' system with a single robot being capable of milking about 240 cows.

This higher throughput would make an AMS more suited and cost-effective for Australian dairy farms.

[1] The development of automatic cup attachment technology for New Zealand dairy farms – a feasibility study, Ohnstad and Jago, 2006

[2] Australian Dairy Industry Technology and farm management practices survey, (Klindworth and Greenall 2007, based on data from 2004/05)

## About FutureDairy

FutureDairy aims to help Australia's dairy farmers manage the challenges they are likely to face during the next 20 years – the availability and cost of land, water and labour; and the associated lifestyle issues. Our activities are structured around three priority areas – **Forages, Feeding and Innovations**.

FutureDairy's approach is unique in that our work considers Science, Systems and People issues. In addition to conducting trials on research farms (**Science**), we explore how our findings work under commercial conditions to develop robust and relevant management guidelines (**Systems**). We work with Partner Farms and use an innovative integration process to capture the results of technical research and the experience from the Partner Farm and its local support group. Social research helps us understand the social issues (eg labour, lifestyle and practical implications) involved in taking on new practices and technologies on a farm (**People**).

Our **Forages** work aims to produce more home grown feed from the same area of land. We are investigating the potential to concentrate resources (water, fertiliser and management) onto more favourable land. We have produced on average more than 40t DM/ha/ over each of the past three years. We used a 'complementary forage rotation' based on growing three crops a year - a bulk crop (eg maize); a legume for nitrogen fixation (eg clover); and a forage to provide a pest/disease break and to improve soil aeration (eg a brassica).

Our **Feeding** work is researching if it is more profitable to use extra bought-in feed to feed more cows (ie increase stock numbers) or to increase production per cow.

FutureDairy is investigating a number of **Innovations** that could improve farm efficiency, labour management and lifestyle. We have a major study on automatic milking systems (AMS), the obvious labour saving innovation. We are adapting automatic systems to be profitable and suitable for Australia's pasture-based, large herd situation.

We are also studying innovations that allow precision farming without increasing labour needs. Some examples include remote sensing of animal function and pasture status, and the use of video cameras to monitor paddock activities (eg calving) remotely via a computer.

FutureDairy's key **sponsors** are Dairy Australia, NSW DPI, the University of Sydney and DeLaval. Other sponsors include DairySA, DIDCO and the Dairy Research Foundation.

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