Guidelines for choosing milking clusters

1. Introduction

A complete cluster, also known as a milking cluster, comprises a claw and four fully-assembled teatcups (that is, four sets of shells, liners, short milk tubes and short pulse tubes). This Quick Note provides generic information to help farmers choose, use and maintain clusters that are best suited to an individual milk harvesting system.

2. Interpretation and relevance to Australian conditions

Poor milking characteristics in many herds result from the wrong match of equipment in the cluster. The most common problems include:

- clusters that are too light or too heavy in relation to the bore of liner used and/or the system vacuum;
- clusters that do not hang evenly on the udder because the connecting hoses are too long, too short, twisted, or poorly aligned in relation to the cow;
- uneven weight distribution between the four teatcups because the teats are not at a uniform height or at a convenient distance apart;
- a mismatch between the claw inlet and the short milk tube causing partial closure of the short milk tube where this tube joins the claw.

3. Relationship to CowTime goals

A good milking machine should harvest the available milk from cows' udders as quickly, gently and completely as possible, with minimal corrective help required by the milking staff. A milking cluster that has correctly-matched components for a given milking system will significantly improve the labour productivity of milking and also make life easier and more pleasant for both staff and cows.

4. Features and effects of clusters

Cluster weight

The weight of commercially available clusters varies from about 1.6 to 3.5kg. The main benefit of increasing cluster weight is to reduce the amount of milk ('strippings') left in the udder when teatcups are removed. The main disadvantages of increasing weight of the cluster are the reduced operator comfort (or increased milker fatigue) and increased slipping and falling of teatcups. Any increase in frequency of cup slippage can increase the risk of mastitis. Therefore, choice of an 'optimum' weight usually involves a compromise based on the type of liner used and the preferred vacuum setting.

Cluster weight in relation to liner bore

Other things being equal, a liner with a mid-barrel bore of 24mm will produce an upthrust due to vacuum about 20% greater than the upthrust in a liner of 22mm mid-bore. Cluster weight should be increased by about 20% to counter this greater upthrust. (See Quick Note 4.1 for advice on matching liners to the average size of teats in the herd).

Cluster weight in relation to vacuum level

The average vacuum level in the claw during the peak flow period of milking should be within the recommended range of 36-42 kPa. If average claw vacuum is 42 kPa (perhaps because the primary goal is fast milking), then cluster weight should be up to 16% heavier compared with the optimum weight at the lower end of the recommended vacuum range (36 kPa). This is because the upthrust due to the higher vacuum is 42/36 = 1.16 or 16% greater.

Clusters that do not hang evenly on the udder

Uneven weight distribution between the four quarters of an udder is one of the most common causes of incomplete milking, uneven milk-out, and liner slips. Ideally, the milking unit should hang squarely on the udder so that about 25% of the total cluster weight is applied to each udder quarter throughout milking. This rarely occurs in practice. Usually, the main culprit is the long milk tube. Care in cutting this tube to the optimum length, ensuring it is positioned to minimise pulling, twisting or 'drag' on the cluster, and having a simple method of adjustable support to cope with udders of different heights can make a huge difference to the success and efficiency of milking. Often, milking performance can be improved by using a combination of relatively heavy teatcups with a light claw. Such a combination helps to maintain a more uniform distribution of cluster weight between the quarters.

Mismatch between the claw inlet and the short milk tube (SMT)

Flattened or kinked SMTs indicate common errors in matching liners and claws. When a liner with a small bore SMT is pushed onto a claw nipple designed for a bigger diameter tube, the cross-sectional area of the SMT may be reduced by 50%, resulting in slower or less complete milking. Sometimes, the wall thickness or rubber hardness of SMTs is too low, resulting in a tendency to kink especially when liners start to age. The internal diameter of short milk tubes ranges from about 7-14mm. A bore of 10-11mm is sufficient to ensure that the milk pathways from liners to claw will drain freely enough to minimise milk flooding within the liner below the teat. Larger-bore sizes tend to be less flexible and they may make the cluster less well balanced between the four quarters.

Claw features

Scientific studies suggest there is some benefit in using claws with an effective volume of at least 150mL to minimise cross-flow and contamination between quarters. Other, more important claw characteristics include:

- unrestricted inlet nipples and claw outlet to allow free flow of milk;
- good visibility of milk flowing into the claw bowl from each quarter;
- ruggedness in a tough environment, especially for plastic components;
- the elusive but important quality of 'personal feel and handling characteristics'; and
- visibility of milk in the claw bowl to help detect problems such as blood in the milk and to provide an indication of the end of milking for individual cows.

Cluster air admission

All clusters have a small air vent or hole that admits air during milking, preferably in the range 10-12 L/min per cluster. This vent helps to remove milk from clusters especially when milk is lifted to an overhead milkline. Cluster air admission dampens vacuum fluctuations in the cluster caused by the pumping action of the liners as they open and close in each pulsation cycle, and it helps to reduce the vacuum drop associated with moving milk from the claw to the milkline. Excessive air admission (greater than 12 L/min) tends to reduce claw vacuum, cause more milk frothing and increase free fatty acids in milk due to damage to milk fat globules (lipolysis).

5. Potential challenges with implementation

Because the choice of cluster is so important for both cows and milking staff, it is worth trying several different types for a few weeks to help narrow the final choice. Most local dealers or equipment companies are willing to loan one or more demo clusters to farmers who are close to making a decision on an equipment upgrade. This is a good way to evaluate the 'personal feel and handling characteristics' of different clusters as well as to compare their relative abilities to milk cows out completely. Another good way to 'road test' a new cluster on your shortlist is to visit other farmers who use these clusters and ask for permission to milk in their dairies for an hour or more.

6. Robustness of this information

Monitoring the completeness of milking

Countdown Downunder Farm Guidelines (Guideline 6, page 34) have been modified based on new research results. Completeness of milking should be estimated by hand-stripping at least 20 cows or 80 quarters. According to the new guidelines, assume that a problem of incomplete milking exists if more than 20% of quarters contain strip yields of about 100mL or more. Consistent differences between strip yields from rear versus front quarters, or between quarters on the right versus the left side of udders, usually indicate a problem of poor cluster positioning or uneven weight balance between the four teatcups.

7. References and further reading

AMMTA (2002) Milking Machine Specifications Handbook. Australian Milking Machine Trade Association, Box 219, Bendigo, 3552. (Also available via consultation with any milking machine technician who is a current member of AMMTA).

Brightling et al. (1998) Countdown Downunder Farm Guidelines for Mastitis Control (Guideline 6, pages 31-36), Dairy Research and Development Corporation, 3/84 William St., Melbourne, 3000.

Mein, G.A. (1992) Action of the cluster during milking. Chapter 4 in "Machine Milking and Lactation" edited by AJ Bramley, FH Dodd, G.A. Mein and JA Bramley, Insight Books, Burlington, VT, USA.

CowTime Guidelines for milk harvesting - Chapter 5, edited by Klindworth, D. et al (2003). Available on the CowTime website www.cowtime.com.au

Quick Note 3.2: Checklist for making changes to milk harvesting infrastructure