The Role of the Milking System in Udder Health

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Mastitis continues to be recognized as the most costly and difficult problem in the dairy industry in spite of decades of research and thousands of annual studies. Current data suggests that mastitis and udder health problems have only worsened with the growth of herd sizes and associated need for automation. Data from the USDA National Agriculture Statistics Service shows that US cull rates have nearly doubled to over 45% in the past 40 years which is likely driving the demand for sexed semen. The University of Minnesota reported[1] that only 26% of all herds are able to meet an SCC standard of 400,000.

Consumer concerns for general food quality continue to rise as more high profile food safety issues arise. The dairy industry is not immune to serious illness from contaminated products. There are reports[2] of thousands of consumers having been sickened by Staph aureus contaminated milk. The extent of the mastitis problem and its associated costs should drive the industry to ask what is going wrong with the milking process when the majority of dairy farmers are following recommended processes and procedures for animal care and milking.

The heart of the milking process lies with the direct interaction of the milking machine and the teat which is the manner in which the liner provides the milk and rest phases. The remainder of the entire milking system is nothing more that a collection of pipes and hoses to move the milk from the cow to the tank and to provide assistance in removing the machine and tracking milk production data. It is the manner in which the milking machine treats the teat during the milking process that directly impacts the physical health of the teat and level of pain the cow experiences during that process.

The intent of the pulsation and liner is to provide relief for the teat from the harmful effect of the vacuum used to pull the milk from the teat sinus. If one were to attempt to milk a cow with the vacuum only the teat would soon swell and milk flow would cease and the cow would experience a high level of pain. Periodically reducing or eliminating the milking vacuum is intended to provide the necessary relief. Pulsation combined with a liner enables a milking machine to switch between the milk and rest phase with the intention of providing the relief.

The problem is that the relief provided by conventional milking machines is not adequate and results in physical damage to the teat canal and swelling of the teat itself. A study[3] by Dr. Sybren Reitsma discloses the fact that the minimum required duration of the rest phase is directly related to the vacuum level used for milking. The study determined that the rest phase must be about .48 seconds for a vacuum level of 46kPa (13.5 inHg). It also shows that the rate of new mastitis infections is directly related to the duration of liner closure. Durations of less than . 34 seconds result in considerably increased rates of mastitis infections. The study also concluded that rear quarters were infected more readily than front quarters and that teat swelling is related to new infections.

Research[4,5] completed by Teagsac in Ireland also provide similar data. That research proves that the conventional milking machines tested caused both teat swelling and teat canal (teat sinus injury) damage. The typical cow experienced teats that are swollen after removal of the milking machine and is a common problem that is easily observed. Research by Gehm[6] has shown that the swelling can be fully eliminated if the pulsation provides the proper massaging liner action of sufficient duration.

The Teagsac research proved that the typical milking action of conventional milking machines causes physical damage of the teat sinus and was termed as teat sinus injury. This is noted by observing cows with slow milking quarters. The teat sinus injury is physical damage to the teat canal that is in the form of scar tissue that obstructs the full flow of milk and swells during the milking process blocking the flow resulting in an quarter that will not

milk out with a machine. It is possible to feel that scar by lightly pinching and rolling the last half inch of the teat between the fore finger and thumb.

Randy Dingwell of Atlantic Veterinary College completed research showing that 23.4% of teats fail to properly seal after 6 weeks past drying off. This provides further evidence of the physical harm caused by an improper and inadequate rest phase. The inability of the teat to naturally self-seal has driven many farmers to use a teat sealant. The use of this product has been proven[7] to cause black spot defect in cheddar cheese as a result of the milk being contaminated by the active ingredient bismuth which remains present after the cow again starts producing milk.

It is possible to provide a rest phase that is of sufficient duration and with a liner action that physically massages the full length of the teat. If the C phase of the pulsator, measured at the shell, is 60 milliseconds or less the liner can be moved such that it will gently compress and massage the full length of the teat instead of just pinching the end of the teat. The rest phase must be about .5 seconds long which yields a pulsation rate of about 45 pulses per minute. This rest phase duration combined with the compressive massage will provide the teat with the required action to eliminate swelling and physical pain enabling the cow to milk faster, pain free and completely. A study[8] by Gehm has shown that there is a physical difference in liner wear characteristics if this liner action is achieved. It is possible to feel the actual difference in liner action by placing a finger into a working liner/machine. A true compressive massage will feel comforting and gentle along the full length of the finger instead of a painful sucking and pinching action at the tip of the finger. The failure of a milking system to provide the proper liner action and rest duration will subject the cow to pain that will increase adrenaline flow counter acting the oxytocin thereby degrading milk flow and resulting in kicking. A cow will kick an average of .4 times per minute while milking based on research by Van Reenen[9].

There are other important aspects of achieving the correct rest duration and liner action. The typical pinching action creates a reverse milking action that drives bacteria back up the teat canal causing infections. The pinch at the tip of the teat creates a force on the teat that is the opposite of hand milking causing bacteria to be moved backwards up the canal. Research in England has determined that the bacteria is non-motile (cannot move on its own) and that a mechanism must exist that pushes the bacteria up the canal and into the teat sinus to cause the mastitis infection. Another study[10] by Reitsma provides evidence that mastitis infection rates increase with pulsation type. The lowest infection rate exists with simultaneous pulsation with increased levels caused by alternating and the greatest rate caused by sequential pulsation. The reason is based in the fact that the closing of liners causes pressure pulses in the claw that drive bacteria back up the liners if some liners are open (milking) when others are closing (resting). This is similar to squeezing one end of a balloon and having the other end expand out.

Dairy farmers need to evaluate their milking systems to determine if their pulsation is providing the desired performance. The cows can be observed to determine if they are kicking/stepping while being prepped and while milking. The condition of the udders can be observed after machine removal to determine how many are uneven, how many teats are swollen and how many are wetted with milk. One simple evaluation is to place a finger into a working liner for the duration of time it takes on average to milk a cow to gain an appreciation for the level of pain the cow is enduring. A pulsation system providing a proper compressive massage action with a .5 second long rest phase will result in substantially improved udder health and 20% faster milking time.

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