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Trends in Milking and Cooling Technology

What a cow requires from a modern milking facility is based on complex physiological fundamentals. Daily milking must be complete, gentle, and speedy. The udder should stay active, efficient, and healthy. Basically, milking facilities must be designed in such a way that variations in the vacuum, which have negative effects on milking, must be avoided as much as possible. Vacuum and pulsation are the decisive parameters for udder health. The main goal is to maintain and exploit the potential of dairy cows over many lactation periods with good udder health.

Werkbild

Fig. 1: Quarter individual milking with the new IQ milking cluster by WestfaliaSurge (silver medal)

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Currently, simple herringbone milking parlours (HBM) as well as swing over, side-by-side, autotandem, and carousel milking parlours are used. Depending on the standing place of the milking personnel, the carousel milking parlours are subdivided into so-called interior or exterior milkers. Special HBM forms, such as polygon or trigon milking parlours, were not widely used. Bucket milking machines and pipeline milking installations are only used on small farms or in reproduction units of large dairy cattle facilities. Herringbone milking parlours have gained the widest acceptance followed by carousel milking parlours in larger units. In recent years, side-by-side milking parlours, which sometimes have more than 60 milking places, have increased their market shares significantly. In addition, more swing-over milking parlours are installed in some regions. Milking robots and AMS facilities are currently experiencing a real boom.

Milking parlours keep growing in size, and the requirements with regard to high animal throughput are increasing in particular in contractors´ operations. Current designs provide 20 milking places (2 • 10) per worker. The goal is to reach the highest possible milker performance in cows per hour. The daily times of operation of milking parlours range from 1.5 hours on family farms to 23 hours in contractors´ operations, which includes the cleaning and disinfection of the milking facility. Small carousels with less than 30 milking places have not proven themselves.

In order to guarantee problem-free cow traffic and, hence, high throughput, the entrance area of future milking parlours must be designed as openly as possible so that the entering cow has eye contact with the previous one. This in particular applies to carousel milking parlours. For the latter, both automatic turning speed control depending on the milk flow of the individual cow and an automatic stop function for unmilked cows are offered as standard. An automatic holding-back device in the carousel, which allows the cow to "go on another round" without any problems, is new in the programme. In addition, a group or individual index for better fixing of the cow in the milking parlour belongs to the standard product range of the milking equipment suppliers.

Milking Equipment

Regular udder stripping is an important condition for the maintenance of performance. The key prerequisite is the generation of readiness for milking by adequate stimulation and the maintenance of this readiness during milking. This is the precondition for animal-friendly milking. The optimal development of the milk ejection reflex is the basic prerequisite for the full exploitation of the given yield potential of the dairy cow, which is significantly influenced by stimulation. Therefore, almost all milking equipment suppliers offer automatic stimulation. Among these systems, a distinction is made between milk flow and time-controlled stimulation with the latter having certain advantages. However, current technical possibilities allow milk-flow-controlled stimulation to be largely adapted to the physiological needs of the cow during milking.

With regard to pulsation, the alternating mode is used more often than the simultaneous mode. The settings vary between 55 and 60 pulses per minute at a phase ratio of 60/40 to 65/35. However, different publications indicate that wide phase ratios lead to increasing loads on the teat tip and, hence, impair udder health so that a phase ratio of 60/40 at 60 double pulses is recommended. Today, all milking equipment suppliers can guarantee this. As a special form, so-called milk-flow-controlled pulsators, which change the number of pulses and the phase ratio depending on the current milk flow, are used.

The vacuum is showing a trend towards lower values. However, this depends on the configuration of the milking parlour. If heavy milking units and stripping equipment are used, it may be useful to work at slightly higher vacuum values of up to 42 kPa. If lighter milking units and corresponding teat cup liner configurations are employed, settings below 40 kPa must be kept. In all cases, however, it is the goal to keep acyclical vacuum fluctuations as small as possible. In order to guarantee this, central milking units holding 250 to 350 ml have proven themselves. In these units, great value is attached to optimal flow characteristics. The weight of the milking units does not show any clear trend. On the one hand, light plastic sleeves are favourable for the milking personnel

with regard to the work load. On the other hand, heavy stainless steel sleeves provide a higher degree of stripping. Here, semi-automatic positioning devices which swivel the milking unit under the cow must support the personnel. Positioning robots in particular for carousel milking parlours are being developed. However, they are not yet available.

Optimal milking unit positioning is an absolute requirement for fast, clean milk withdrawal and a high stripping degree. The products offered range from simple positioning aids to highly developed service arms. Instead of rigid units, the current trend is favouring flexible positioning aids which can be moved into the right position and compensate for every position change of the cow.

Due to the suction milking technique, which is currently applied in all milking parlours, strippings remain at the end of milking. If these strippings are not milked, this may lead to reduced persistence and endanger udder health. In order to be able to milk the strippings, so-called stripping arms are used, which should start working at a milk flow of 800 to 1,000 ml per minute. All systems available on the market can guarantee this as well as a sufficient stripping degree. It would be a desirable feature if the stripping unit could be automatically swivelled under the cow in order to facilitate the work of the milkers. Here, initial system solutions are available. In addition, special solutions provide accelerated milking due to rhythmic stimulation.

If no automatic stripping unit is used, an automatic cluster removal system for the avoidance of dry milking is meanwhile standard. However, the threshold values for the determination of the time of removal are shifting. While a milk flow of 200 ml per minute was assumed to be the right switching point in the past, values of 250 to 350 ml per minute (in the case of three-time milking even 400 ml per minute) are chosen as settings more and more frequently. This process is controlled by milk flow indicators (sensors) or milk quantity measuring instruments.

An entirely new development is milking without a collecting piece, which is known from automatic milking systems. Without a collecting piece, disadvantageous turning, lever, and pulling forces acting on the udder are intended to be reduced. Thanks to the low weight, the physical load on the workers is small. A remarkable feature is the option to clean the outside of the teat cup liners automatically, which is currently not possible in units from other manufacturers.

For teat cup liners, nitrile rubber (black) and silicone are currently used as materials. The advantages and disadvantages of both materials are largely known. However, the silicone teat cup liner is considered to have certain advantages due to its considerably longer period of use and its smoother surface. Currently, teat cup liners with flexible heads and lips are being developed. Liners with a conical form are also available. The goal is slip reduction and the optimization of stripping.

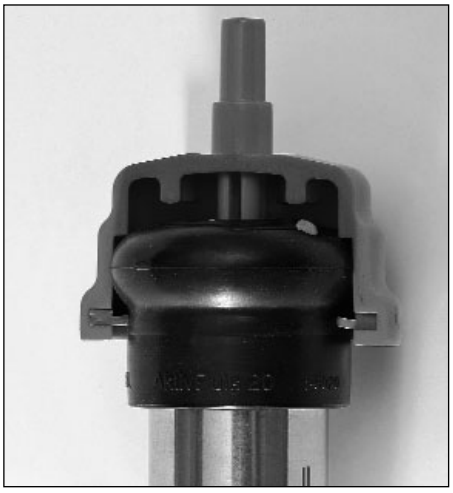

Fig. 2: The new ClearWash milking cluster rinsing-receiver cleans the teat cup liner also at the outside *Company photo*

For easier operation of the milking units, a large, hand or knee-operated start button underneath the pit edge is going to establish itself. Simple lifting of the milking unit for starting is another intelligent solution for the future.

For protection against soiling, more and more models are equipped with protective covers for all elements, which has the advantage that inconveniently installed parts are no longer a problem. Even milk quantity measuring instruments, milk tubes, and locks are installed underneath the milking parlour (cellar). However, high investment expenses will make it difficult for this feature to gain in acceptance.

Work Place Design

The design of the milker´s work place is meeting with more and more interest. In addition to work safety, work comfort is playing an increasing role. In the future, milking parlours will be used which improve the working conditions of the milkers. Initial studies in this field have been completed. Body posture, the weight of the milking unit, and positioning height are important factors. Lifting floors which provide the option to react to the different sizes of the milkers are installed more and more often. Enough light as well as air and temperature are other conditions which are given more attention during planning. Sophisticated ventilation systems are able to keep flies out of the working area of the personnel. For the winter, radiation heating (dark radiators) is going to establish itself. Floor heating and warm air fans are only conditionally suitable for use. For improved standing comfort, the milker´s pit should be equipped with rubber mats or plastic grids. Another goal is the optimization of the work place, which also includes the minimization of unnecessary ways as well as manual work and operation. For this reason, level milking parlours without a milker´s pit are preferred.

Cleaning and Disinfection

Currently, circulation heating (connected loads 9 to 36 kW) or cleaning with boiling water (4.5 kW for heating to a temperature of 77 °C within two minutes) are used. In larger milking parlours, it is difficult to observe these parameters so that circulation cleaning seems safer. The latter works with an alkaline and an acid cleaning and disinfection agent. During cleaning with boiling water, an acid solution is added at the beginning in order to prevent lime deposits.

Even though heat recovery systems are integrated, the energy required to heat the rinsing solution is still a problem. In order to reduce electricity consumption as far as possible, attempts are being made to optimize the rinsing process. In order to guarantee sufficient plug formation, air injectors are installed in order to provide an optimal effect of turbulence. The latter is generated while the water is being pumped out of the milk lock. This allows the duration of rinsing to be limited to less than 10 minutes. Since a sufficient quantity of heated water is available, reheating during the main rinsing phase is no longer necessary.

Efforts are also being made to save the water needed for pre-rinsing. For this purpose, cleaning agents are used which guarantee the cleaning and disinfection of the milking unit in combination with the milk residues.

For the metering of the cleaning agents, metering pumps of the newer generation are used. In older systems, functional reliability and metering accuracy were not guaranteed. For this reason, semi-automatic systems (manual metering in a tank) were installed in the past. Both variants will continue to exist in the future.

The rinsing of the teat cup liner head from the outside is currently being entirely neglected. Solutions based on this principle exist (*Fig. 2*). However, they are not accepted by the market.