Cleaning without chlorine

Chlorate residues in milk are a no-no for processors. Farmers, in turn, are concerned about heat-resistant 'thermoduric' bacteria. Fortunately 'chlorine-free' cleaning has now proven to be very effective in controlling thermoduric bacteria levels in milk.

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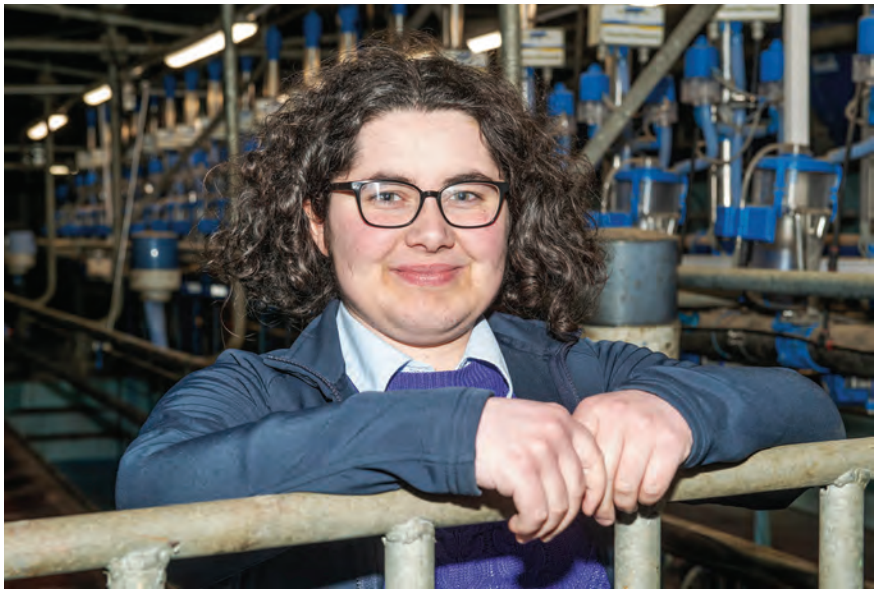

Lorna Twomey, Teagasc Moorepark *Photos: Fergal O'Gorman*

Extensive research by Teagasc has shown that to effectively clean milk equipment without chlorine you should follow some simple principles:

- Appropriate temperatures of the detergent solution at the start and end of circulation;
- The detergent solution being of suitable type/make and of appropriate strength;
- The machine receiving the correct number of both hot/acid washes during each week.

Collaboration with detergent companies and research on both Teagasc and commercial farms has led to (i) the current availability of very effective non-chlorine detergent products, and (ii) development of five milking equipment washing protocols to suit different milking plant sizes.

Detergents

It is very important to know the source of your detergent and that the product purchased is genuinely "chlorine free". Using chlorine detergents even as a "once-off" can result in significant issues in the milk supply entering a processing plant from a chlorate and TCM perspective.

Using chlorine detergents to "fix" thermoduric problems will cause a re-occurring residue problem. The long-term solution is to select one of the five "chlorine free" washing protocols that best suits your milking system and follow the steps exactly.

It is critical to establish the wash water levels used by measuring the trough. This will ensure that the correct levels of detergent are used for both hot and cold detergent washing as well as acid washes. When cold water is used, the detergent usage rate required is double (1% usage rate for cold washing) that recommended when using hot water (0.5% usage rate for hot washing).

Successful cleaning without chlorine requires changes to the previous cleaning protocols, e.g. increased use of hot water at higher temperatures and acid based products.

It is crucial to establish the appropriate protocol for your milking system and follow the steps of that wash protocol.

Thermoduric bacteria numbers can be reduced in the first instance by good management practices such as maintaining clean cows in a clean environment; cleaning cow teats/udders prior to milking. This is especially important during challenging weather conditions, e.g. during wet weather in spring and autumn.

Chlorate residue in water and its relationship with milk

Milk suppliers sometimes ask: "Is chlorinated water potentially impacting on chlorate levels in milk?" This question has arisen as a consequence of: (a) chlorinated water being used on a high number of farms and (b) chlorate being detected in a small number of milk bulk tanks on farms that used chlorine-free cleaning products.

The traditional method of disinfecting or maintaining microbial quality of public water supplies involves adding chlorine to water. However, during the storage of the chlorine-based disinfectants, e.g. sodium hypochlorite, chlorine can degrade resulting in chlorate development.

So, when that chlorine disinfection product is used to disinfect water, there is potential for chlorate to be added to the water supply. The EU limit for chlorate levels in water is 0.7 mg/L and those supplying water for consumption must ensure that chlorate levels in their supplies comply with this limit.

A limited number of water samples (n = 59) taken at different commercial dairy farms in Ireland all complied with the EU limit. Levels found were 0.02 mg/L in non-chlorinated private wells and 0.16 mg/L and 0.17 mg/L in group water and Uisce Eireann supplies, respectively.

Investigation into chlorinated water at Teagasc Moorepark

A four-week trial was conducted in November/December 2021, at the 30-unit side-by-side milking parlour on the dairy research farm at Teagasc Moorepark. A standard chlorine-free wash routine was completed after each morning milking.

Three rinse treatments were applied using chlorinated water containing 0.10, 0.50 and 2.00 mg/L of total chlorine, respectively, which were based on the minimum, average and maximum levels found in chlorinated water supplies (Uisce Eireann and group supplies).

The resulting waters contained 0.079, 0.112 and 0.325 mg/L of chlorate, respectively. The milking plant was rinsed with the chlorinated water within 30 minutes preceding milking and milk samples were obtained from the first three rows of cows milked on each test day, via an in-line sampling tap.

Results

Chlorate was detected in milk sampled from the first row of cows milked at each milking but not from the second and third rows, regardless of treatment (Table 1). Freezing point depression (FPD) is used as a measure of extraneous water in milk.

Extraneous water was detected in milk sampled from the first row of cows milked as well, but not from the second row of cows; normal unadulterated milk has a FPD of 0.540 whereas milk from the first row of cows milked in this study displayed a FPD of 0.450.

The treatment with the lowest FPD value (which indicates higher levels of extraneous water) was also the treatment with the highest level of chlorate in the milk.

We concluded that the chlorate observed in milk was due to residual water containing chlorate coming in contact with milk from the first line of cows as the milk started to flow through the milking system.

The possibility of chlorate from the rinse water remaining on the inside surface of the milk-line and subsequently causing chlorate contamination of milk was also considered but ruled out as a significant source of contamination.

Table 1: Chlorate and freezing point depression (FPD) levels of in-line milk samples taken from the first row of cows milked

Treatment	Mean chlorate of the rinse water (mg/L)	No of samples	Mean chlorate of 1st row milk (mg/kg)	Mean FPD of 1st row milk (°C)
0.10 mg/L	0.079	9	0.017	0.436
0.50 mg/L	0.112	9	0.024	0.431
2.00 mg/L	0.325	9	0.020	0.497

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It is critical to establish wash water levels by measuring the trough.

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Importance of water drainage from the milking plant

The main mechanisms by which water and milk can come in direct contact are (a) water remaining in the milking system after rinsing (following the wash protocol) due to poor drainage of the plant, and (b) allowing the contents of the milk inlet pipe to enter the bulk tank before the water has been eliminated from the system.

This can be minimised by:

- Installing sufficient automatic drainage valves in the milking system e.g. on the receiver vessel and milk filter housing;
- Draining clusters before vacuum is applied to prevent suction of water into the system pre-milking;
- Ensuring that only milk enters the bulk tank (not a mixture of water and milk);
- Monitoring the bulk milk tank post washing to ensure that it is draining properly.

Aside from the risk of chlorate contamination, poor drainage and subsequent water retention in any type of milking equipment will reduce the circulating temperature of the main wash solution, which should commence at 75-80°C.

Poor drainage may also result in milk residues from the post milking rinse coming into contact with the detergent solution potentially reducing its effectiveness. So poor plant drainage will adversely impact both chlorate residues and thermoduric counts in milk. Not for the first time, poor drainage is the farmer's enemy.

The possibility of chlorate from the rinse water remaining on the inside surface of the milk line causing chlorate contamination of milk was considered but ruled out as a significant source of contamination.