The employment of best practice TBC and thermoduric management strategies on dairy farms

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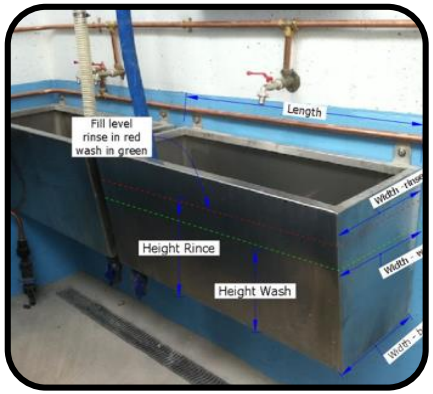
Agriculture and Food Development Authority

What are the topics that will be covered?

- What are the key management practices necessary for the production of quality milk?
- Troubleshooting milk quality issues on farm
- Questions/ discussion

What are the necessary elements of an effective wash routine?



Volume of solution

Measure the trough (cm);

$\underline{L \times W \times H = cm^3 / 1000 = litres}$

Repeat measurement for both rinse volume and wash volume (to water mark)

Solution concentration

Recommended detergent usage rate e.g. 225 ml/ 45 litres (0.5%)

E.g. 100 litres of water

x 0.5% detergent = 500 ml required

Correct chemical choice

- Caustic detergent – fats & proteins
- Acid descaler – minerals
- Peracetic acid – disinfectant
- 'One for all'

Solution temperature

Start: 75 - 80°C (trough)

End: 45 - 50°C

Circulation time

8 – 10 minutes maximum duration

Take home message

- Correct solution volume, concentration, temperature and circulation time are effective washing.

Washing the milking machine

50% of farms do not have an effective milking machine wash protocol in place

Detergent usage

- Liquid caustic products = 20 – 36% caustic
  - **66% of farms were using liquid caustic**
- Powder caustic products = 60 - 80% caustic
  - **33% of farms were using powder caustic**
- **Only 50% of farms with manual machine washing used powder**
- **Higher detergent usage rates are required when using cold water**;
  - Up to 50% more required (always the case)
    - » Example 100 litres water (detergent; 0.5% = hot 500 mls: 1% cold = 1 litre)
- **60% of farms were not using sufficient amounts of caustic when cold washing**

Acid usage

50% of farms were using insufficient amounts of acid

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Chemical analysis of a sample of detergent products collected at farm visits

Liquid products	
Product	% NaOH
Altradet CF	20.39
ArkAline	20.7
Avalaksan	23.18
BFS extreme clean	27.59
CIPSAN	27.75
Coolclean	23.45
Cryosan CF	29.73
Diversey cip cleaner	22.95
HYPRAL ONE	30.23
Nadal	18.2
Parlosan	25.85
Turbosan CF	27.32
Hydra Mil	12.36

Powder products			
	% NaOH	% Na_2CO_3	Combination
Asepto	68.11	12.16	80.27
KoldKleen	70.12	15.32	85.44
Altradet	64.78	22.6	87.38
Supercleen	69.42	15.36	84.78
RX5000 DELAVAL	49.91	30.49	80.4
Universan	56.96	30.58	87.54
Clearway	49.43	19.36	68.79
Purechem	74.28	16.92	91.2

Impact of the percentage of sodium hydroxide present in a detergent product in conjunction with the usage rate on the concentration of the working solution (ppm)

Usage rate	Sodium Hydroxide concentration				
	18%	20%	24%	28%	75% (powder)
0.5% (225ml/45L)	900	1000	1200	1400	3750
0.6% (270ml/45L)	1080	1200	1440	1680	
0.7% (315ml/45L)	1260	1400	1680	1960	
0.8% (360ml/45L)	1440	1600	1920	2240	
1% (450ml/45L)	1800	2000	2400	2800	

- **Target: working solution**
- **> 1200 ppm with hot water**
- **> 2000 ppm with cold water**

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Hot washes

- Minimum volume of 9 litres/unit
  - **30% of farms not achieving this**

- Minimum of 7 hot washes per week (**liquid**)
- Minimum of 3 hot washes per week (**powder**)
  - **60% of farms not conducting the required number of hot washes**

- Solution start temperature of 75/80^{o}C
  - **70% of farms not achieving this temperature**

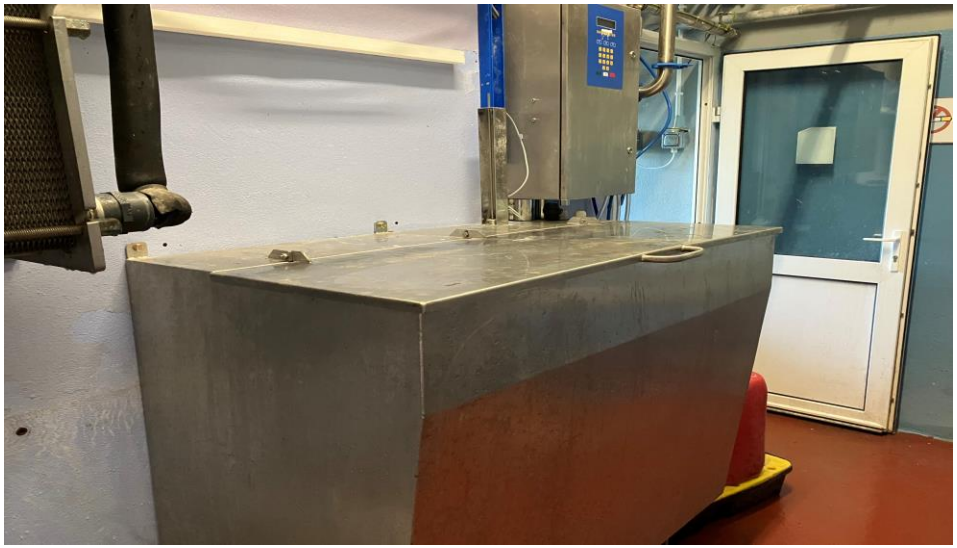
Acid washes

- Minimum of 3 acid washes per week (**liquid**)
- Minimum of 2 hot washes per week (**powder**)

50% of farms not conducting the required number of acid washes

Milking machine rinses

- Minimum of 14 litres/unit for rinsing
  - **60% of farms have inadequate volumes of rinse water**
- Post milking rinse;
  - **80% of farms use cold water for rinsing out milk**
- Final rinse;
  - **40% of farms use peracetic acid**



How can the temperature of the hot be maintained?

- Use plate cooler water for the post milking rinse
- Use warm water for the post-milking rinse: 20 - 30^{o}C
- Send the first 10 - 20 litres of hot water to dump before beginning circulation
- Circulation detergent 8 - 10 min; **NO LONGER**
- Fast fill hot water
- Insulated trough/lid

Drainage of post milking rinse vital

Deposits in the Claw Bowl- Key Area for Build-Up

Organic (milk) deposits

Inorganic (mineral) deposits

25% of farms have significant build-up on claw bowls

Ideal environment for thermoduric bacteria

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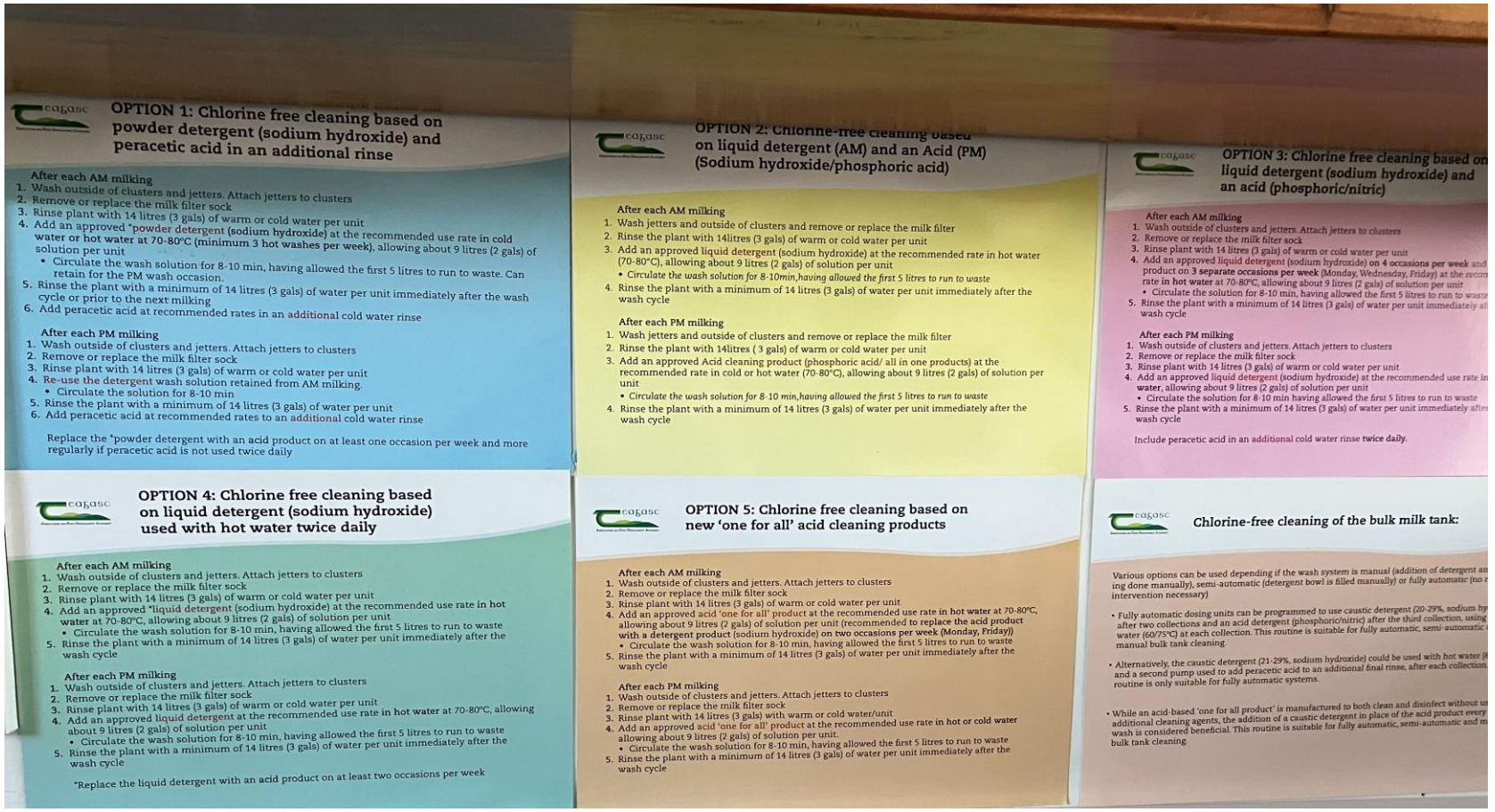
Teagasc wash routines



OPTION 1: Chlorine free cleaning based on powder detergent (sodium hydroxide) and peracetic acid in an additional rinse

After each AM milking

1. Wash outside of clusters and jetters. Attach jetters to clusters
2. Remove or replace the milk filter sock
3. Rinse plant with 14 litres (3 gals) of warm or cold water per unit
4. Add an approved *powder detergent (sodium hydroxide) at the recommended use rate in cold water or hot water at 70-80°C (minimum 3 hot washes per week), allowing about 9 litres (2 gals) of solution per unit
   - Circulate the wash solution for 8-10 min, having allowed the first 5 litres to run to waste. Can retain for the PM wash occasion.
5. Rinse the plant with a minimum of 14 litres (3 gals) of water per unit immediately after the wash cycle or prior to the next milking
6. Add peracetic acid at recommended rates in an additional cold water rinse

After each PM milking

1. Wash outside of clusters and jetters. Attach jetters to clusters
2. Remove or replace the milk filter sock
3. Rinse plant with 14 litres (3 gals) of warm or cold water per unit
4. Re-use the detergent wash solution retained from AM milking
   - Circulate the solution for 8-10 min
5. Rinse the plant with a minimum of 14 litres (3 gals) of water per unit
6. Add peracetic acid at recommended rates to an additional cold water rinse

Replace the *powder detergent with an acid product on at least one occasion per week and more regularly if peracetic acid is not used twice daily

OPTION 2: Chlorine-free cleaning based on liquid detergent (AM) and an Acid (PM) (Sodium hydroxide/phosphoric acid)

After each AM milking

1. Wash jetters and outside of clusters and remove or replace the milk filter
2. Rinse the plant with 14litres (3 gals) of warm or cold water per unit
3. Add an approved liquid detergent (sodium hydroxide) at the recommended rate in hot water (70-80°C), allowing about 9 litres (2 gals) of solution per unit
   - *Circulate the wash solution for 8-10min,having allowed the first 5 litres to run to waste*
4. Rinse the plant with a minimum of 14 litres (3 gals) of water per unit immediately after the wash cycle

After each PM milking

1. Wash jetters and outside of clusters and remove or replace the milk filter
2. Rinse the plant with 14litres (3 gals) of warm or cold water per unit
3. Add an approved Acid cleaning product (phosphoric acid/ all in one products) at the recommended rate in cold or hot water (70-80°C), allowing about 9 litres (2 gals) of solution per unit
   - *Circulate the wash solution for 8-10 min,having allowed the first 5 litres to run to waste*
4. Rinse the plant with a minimum of 14 litres (3 gals) of water per unit immediately after the wash cycle

OPTION 3: Chlorine free cleaning based on liquid detergent (sodium hydroxide) and an acid (phosphoric/nitric)

After each AM milking

1. Wash outside of clusters and jetters. Attach jetters to clusters
2. Remove or replace the milk filter sock
3. Rinse plant with 14 litres (3 gals) of warm or cold water per unit
4. Add an approved liquid detergent (sodium hydroxide) on 4 occasions per week and product on 3 separate occasions per week (Monday, Wednesday, Friday) at the recom rate in hot water at 70-80°C, allowing about 9 litres (2 gals) of solution per unit
   - Circulate the solution for 8-10 min, having allowed the first 5 litres to run to waste
5. Rinse the plant with a minimum of 14 litres (3 gals) of water per unit immediately af wash cycle

After each PM milking

1. Wash outside of clusters and jetters. Attach jetters to clusters
2. Remove or replace the milk filter sock
3. Rinse plant with 14 litres (3 gals) of warm or cold water per unit
4. Add an approved liquid detergent (sodium hydroxide) at the recommended use rate in water, allowing about 9 litres (2 gals) of solution per unit
   - Circulate the solution for 8-10 min having allowed the first 5 litres to run to waste
5. Rinse the plant with a minimum of 14 litres (3 gals) of water per unit immediately afte wash cycle

Include peracetic acid in an additional cold water rinse twice daily.

OPTION 4: Chlorine free cleaning based on liquid detergent (sodium hydroxide) used with hot water twice daily

After each AM milking

1. Wash outside of clusters and jetters. Attach jetters to clusters
2. Remove or replace the milk filter sock
3. Rinse plant with 14 litres (3 gals) of warm or cold water per unit
4. Add an approved *liquid detergent (sodium hydroxide) at the recommended use rate in hot water at 70-80°C, allowing about 9 litres (2 gals) of solution per unit
   - Circulate the wash solution for 8-10 min, having allowed the first 5 litres to run to waste
5. Rinse the plant with a minimum of 14 litres (3 gals) of water per unit immediately after the wash cycle

After each PM milking

1. Wash outside of clusters and jetters. Attach jetters to clusters
2. Remove or replace the milk filter sock
3. Rinse plant with 14 litres (3 gals) of warm or cold water per unit
4. Add an approved liquid detergent at the recommended use rate in hot water at 70-80°C, allowing about 9 litres (2 gals) of solution per unit
   - Circulate the wash solution for 8-10 min, having allowed the first 5 litres to run to waste
5. Rinse the plant with a minimum of 14 litres (3 gals) of water per unit immediately after the wash cycle

*Replace the liquid detergent with an acid product on at least two occasions per week

OPTION 5: Chlorine free cleaning based on new 'one for all' acid cleaning products

After each AM milking

1. Wash outside of clusters and jetters. Attach jetters to clusters
2. Remove or replace the milk filter sock
3. Rinse plant with 14 litres (3 gals) of warm or cold water per unit
4. Add an approved acid 'one for all' product at the recommended use rate in hot water at 70-80°C, allowing about 9 litres (2 gals) of solution per unit (recommended to replace the acid product with a detergent product (sodium hydroxide) on two occasions per week (Monday, Friday))
   - Circulate the wash solution for 8-10 min, having allowed the first 5 litres to run to waste
5. Rinse the plant with a minimum of 14 litres (3 gals) of water per unit immediately after the wash cycle

After each PM milking

1. Wash outside of clusters and jetters. Attach jetters to clusters
2. Remove or replace the milk filter sock
3. Rinse plant with 14 litres (3 gals) with warm or cold water/unit
4. Add an approved acid 'one for all' product at the recommended use rate in hot or cold water allowing about 9 litres (2 gals) of solution per unit.
   - Circulate the wash solution for 8-10 min, having allowed the first 5 litres to run to waste
5. Rinse the plant with a minimum of 14 litres (3 gals) of water per unit immediately after the wash cycle

Chlorine-free cleaning of the bulk milk tank:

Various options can be used depending if the wash system is manual (addition of detergent an ing done manually), semi-automatic (detergent bowl is filled manually) or fully automatic (no intervention necessary)

- Fully automatic dosing units can be programmed to use caustic detergent (20-29%, sodium hy after two collections and an acid detergent (phosphoric/nitric) after the third collection, using water (60/75°C) at each collection. This routine is suitable for fully automatic, semi-automatic manual bulk tank cleaning.
- Alternatively, the caustic detergent (21-29%, sodium hydroxide) could be used with hot water (and a second pump used to add peracetic acid to an additional final rinse, after each collection routine is only suitable for fully automatic systems.
- While an acid-based 'one for all product' is manufactured to both clean and disinfect without u additional cleaning agents, the addition of a caustic detergent in place of the acid product every wash is considered beneficial. This routine is suitable for fully automatic, semi-automatic and m bulk tank cleaning.

https://www.teagasc.ie/media/website/animals/dairy/milking-machine-cleaning-routines.pdf

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Maintenance

Vacuum Line

40% of farmers never wash the vacuum line

Plate Cooler

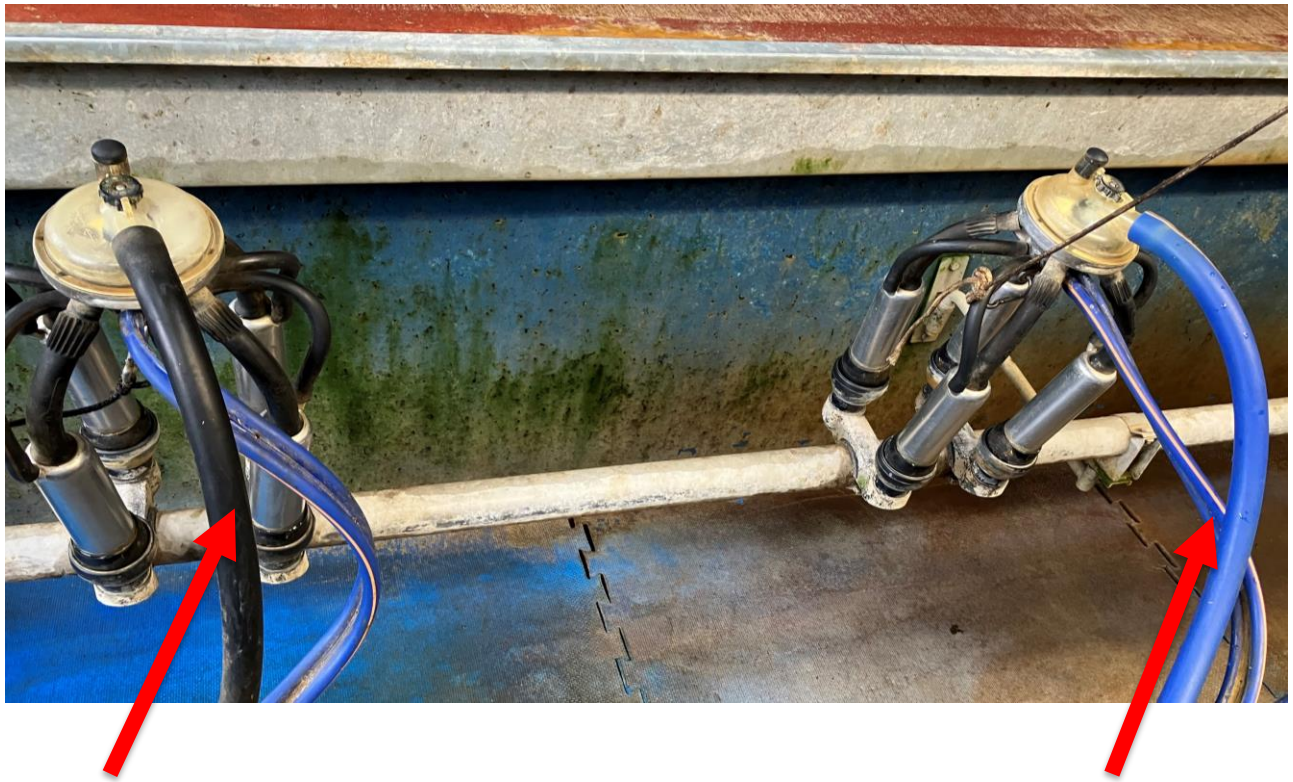
On 50% of farms the sock is removed for the wash

On 60% of farms the plate cooler has never split and cleaned

Rubber ware

On 30% of farms rubber ware is worn

Silicon or Rubber



Rubber
More prone to wear and tear
Change every 2 years

Used on 70% of farms

Silicon
More durable
Change every 3 - 4 years

Used on 30% farms

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Teat preparation

On 60% of farms no routine teat preparation conducted

Where teat prep is conducted;

- **Correct method of teat cleaning/ disinfection: 14% of farms**
- **Incorrect method of teat cleaning/ disinfection: 26% of farms.**

Incorrect teat prep;

- **Bacteria risk**
- **Residue risk**

Collecting yard cleanliness

40% farms had 'dirty' collecting yards.

33% farms cleaned the collecting yard after every milking.

66% cleaned it either daily/ every second day

Maintaining the cows environment in a hygienic state is essential to minimise the incidence of thermoduric bacteria.

Dirty collecting yards = dirty cows = dirty teats = thermoduric bacteria in milk (in the absence of effective teat prep)

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Clipping tails

On 90% of farms cows tails are clipped either twice or three times per year

Keeping cows tails clipped is vital to minimise the amount of soil they retain.

This aids in the minimisation of udder/ teat contamination and thereby helps reduce the thermoduric bacteria burden.

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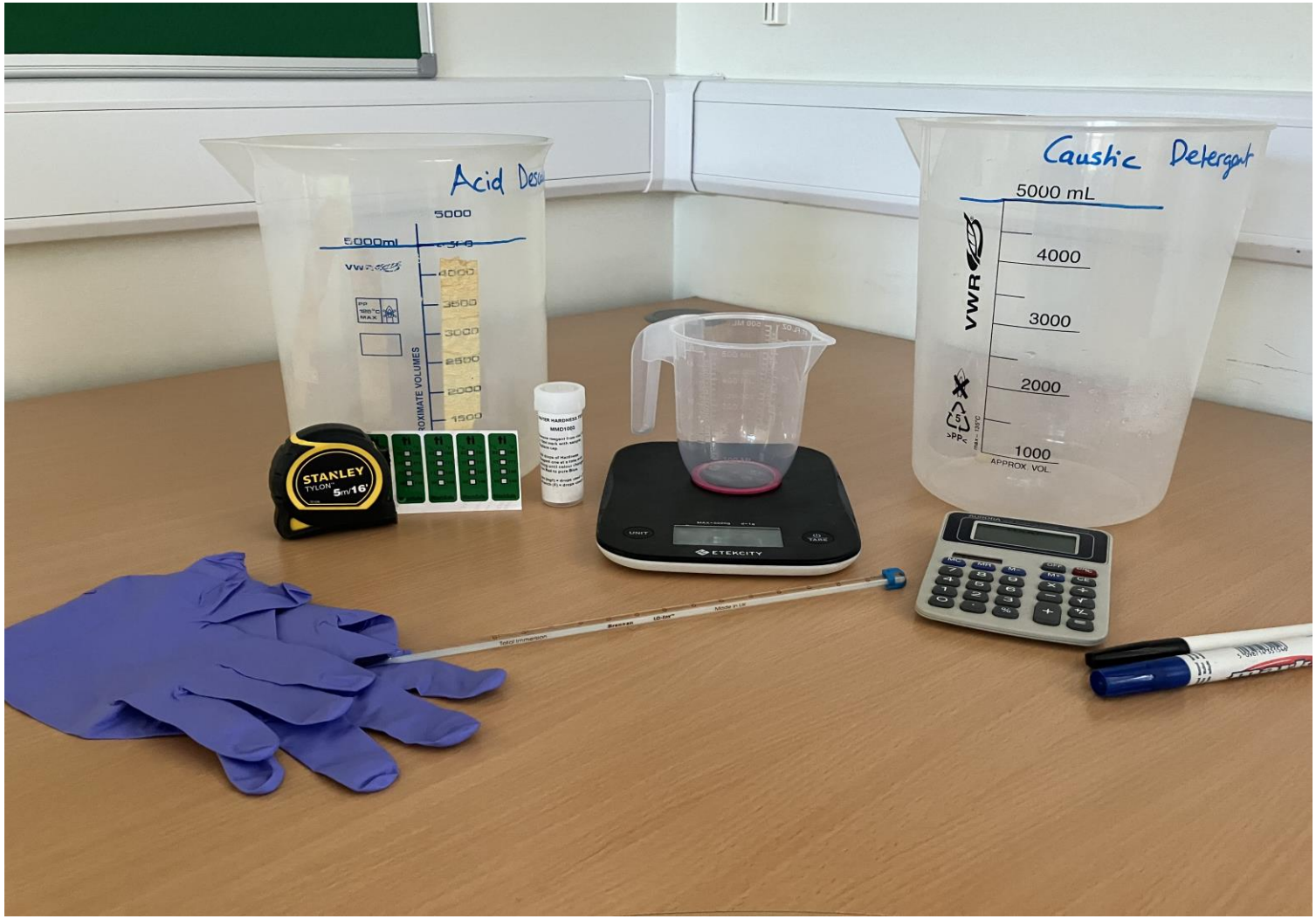
Bulk milk tanks

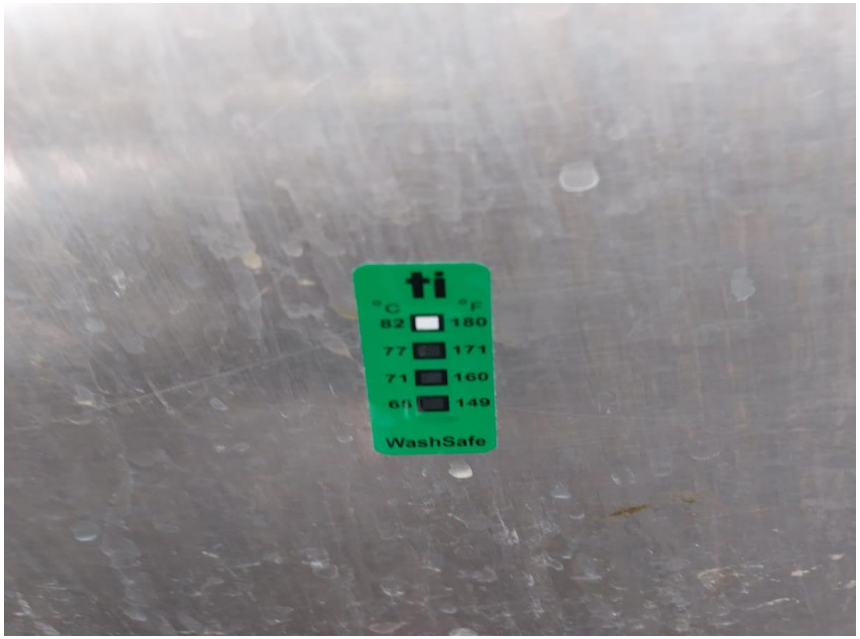
- 33% of farms don't have a bulk tank service contract
- 25% of farms have an incorrect bulk tank wash protocol
- 33% of farms are only cooling milk to ≥4 degrees C


Troubleshooting milk quality issues on farm

Troubleshooting Tool Kit



Temperature strips for stainless steel wash trough



Temperature Indicators Ltd, Manchester, United Kingdom.

Trouble shooting a high TBC or Thermoduric count

Trouble shooting a milking machine cleaning program	Guide
High TBC or Thermoduric reading	Open a couple of claw-piece covers and if the internal surface is greasy or contains yellow/brown material- indicates a cleaning issue
Check if detergent tubes are in the correct drum	Red tube is for the acid drum
Measure detergent/Acid usage rate	Use a plastic beaker filled with a known quantity of detergent or acid
Are you using sufficient water?	Measure the water level in the trough for the detergent (9litres/unit) and rinse cycles (14litres/unit)
How do I measure the trough?	Length x width x height (1 cubic meter = 1000 litres of water)
How much detergent should I be using?	Read the product rate for hot and cold wash on the drum label-higher if using cold water (e.g. 1%). Detergent usage rate depends on water quantity used for the detergent wash and if the water is hot or cold (50% more detergent required if cold water)
How many acid washes are used per week?	Minimum of 3 per week (less with powder if using Peracetic acid twice daily)
How many hot washes used per week?	Minimum of 7 per week with liquid caustic products
What is the start water temperature?	75/80^0 C Measured in the filled trough prior to circulation
What is the end water temperature?	45/55 ^{0} C Measured water before starts going to dump
How long is your wash cycle time?	Ideally 8 minutes no greater than 10 minutes
Is the first water from the hot circulation going to dump?	Option to dump first 10/20 litres, will help to maintain wash temperature
Do you use a warm post milking rinse?	Helps maintain plant temperature for the subsequent hot wash
Is the Jet wash operating during the wash?	Should empty and fill every 40 secs approx

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Trouble shooting a high TBC or Thermoduric count

Are you recycling the liquid detergent solution for a second wash occasion?	Best advice is not to recycle the solution
Do you know the caustic strength of the product being used?	Check Teagasc list to see products caustic content; ideally greater than 20%
Are you following a recommended wash protocol?	Check the 5 Teagasc cleaning protocols and establish if there is a shortfall in your cleaning steps
Is the plant & trough draining completely between each wash cycle?	Best way to evaluate a wash program is to be present for a complete wash occasion
Are the claw-pieces at the furthest point from the Dairy getting sufficient water during the wash?	Best way to evaluate this is be present for a complete wash cycle
Is the water supply 'hard water' (≥300ppm)?	Option is to include an additional acid wash and/or install a water softener
Are you using Peracetic acid in rinse water?	Ideally should be used in an additional rinse, at least one hour before next milking at a rate of 0.15 to 0.3%. Additional pump required with an auto washer. Good disinfectant
Where are the detergents stored?	Out of direct sunlight, cool area, on pallets to avoid frost, in a chemical store, avoid stock piling. Products will crystalize if in situ for a long period.

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Other things to consider

Is the milk filter sock replaced before the first rinse cycle?	Remove the dirty filter sock and replace with a clean sock before the rinse cycle, protect the plate cooler
When were milk liners last replaced?	Every 2,000 milking's/ every 6 months; whichever comes first
Is rubber-ware cracked and worn?	Replace rubber when signs of wear
Was the vacuum line washed during the machine service?	Vacuum lines should be washed when milk enters the line from broken milk liners or overflowing milk receiver jar & at annual machine service
If a dump line is present, is it washed twice daily with the machine?	Critical to wash the dump line , twice daily as part of the machine wash, even if not used to transfer milk
If automatic cluster cleaning is present, is it cleaned twice daily with the machine?	Critical to include the cluster cleaning setup as part of the daily wash program, even if not used for individual cluster cleaning daily

Bulk Milk Tank -Milk Cooling

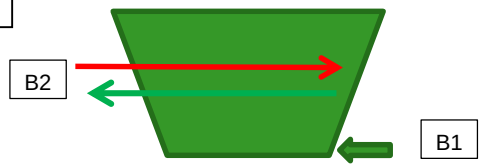
Trouble shooting a bulk milk tank	Guide
What temperature is the milk in your bulk tank?	Ideally 3 to 3.5^{O} C
How long does it take to cool the milk to the required temperature?	Ideally within 30 min of finish of milking- reason for longer time- compressor size, plate cooler not working correctly
What temperature is the milk entering the tank?	Ideally 14 to 15^{O}C for single stage and 6 ^{0}C for dual stage cooling- reason for higher temperature- ratio of milk to water 2:1
Is the lid on the bulk tank closed during milking?	Dust can enter if not sealed
Is milk partially collected?	Not ideal as harder to clean surfaces that were milk soiled and dried
Is the tank getting a hot wash after each collection?	Critically important
Was the auto-washer re calibrated after the move to chlorine-free?	Viscosity of new chlorine-free products is higher (suck up rates lower). Should know how long each drum should last
Is the milk outlet clean?	Often not cleaned properly after taking off milk for the house or cat!
Is there a rubber milk transfer pipe sitting in milk?	The outside of this pipe is not cleaned properly (as in part of the wash routine)

What to look out for on farm visits – Volume of Water Available

Length (cm) x width (cm) x height (cm) = cubic centimetres/1000 = volume in litres

Green line indicates height of water for main wash cycle

Red line indicates height of water for rinse cycles



Step 1: To establish the width of tapered troughs: measure (cm) the length across the trough at the bottom of the trough (B1) and then at the water level (B2).

Step 2: Add both measurements and divide by 2 to establish the average width. (B1+B2/2)=average width

Step 3: Measure the height (cm) of water (red or green line)
Step 4: Measure the length (cm) of the trough

Step 5: Multiply the width x height x length = cubic centimetres/1000

Target water levels for Rinse Cycles – 14 litres per milking unit
Target water levels for the main wash cycle (hot or cold water) - 9 litres per milking unit

It is better to ascertain the actual amount of water available as opposed to assuming the correct amount is there and thereby focusing on the number of units.

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Dairy Wash Trough Calculator

https://www.teagasc.ie/rural-economy/farm-management/farm-machinery/machinery-calibration/dairy-wash-trough-calculator/

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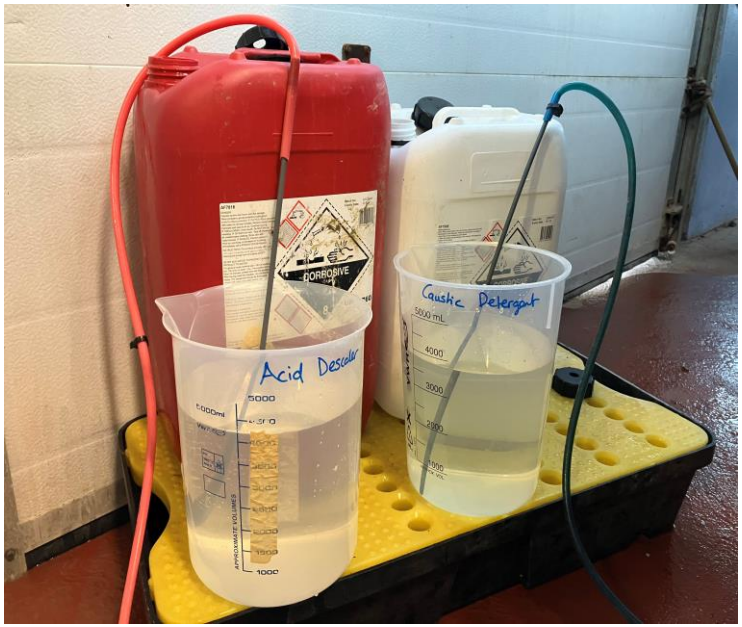
What to look out for on a farm visit - Detergent



RED = ACID

BLUE = DETERGENT

2 x acids/ 2 x caustics instead of one of each on bulk tank

If using a 'One For All' acid ensure that both tubes are in the drum (not PA tube though)

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What to look out for on a farm visit - Environmental Hazards

Opportunity for dirty water accumulation

Dirty collecting yards

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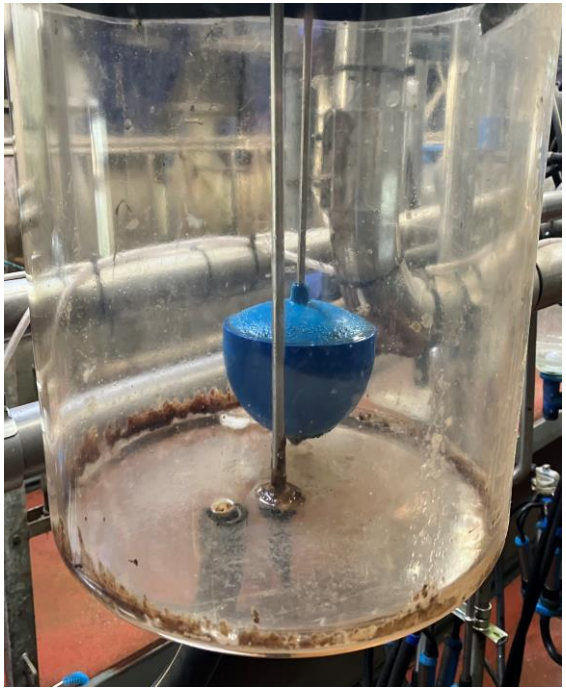
What to look out for on a farm visit – Filter Socks

Are reusable socks hygienic?

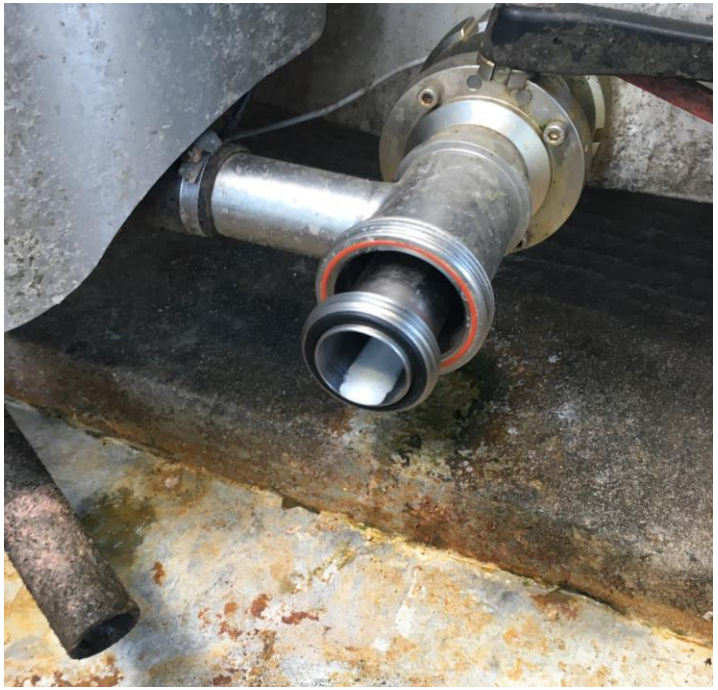
Are disposable socks being reused?

What to look out for on a farm visit – Are All Areas Being Washed?



Sanitary trap

Milk filter housing



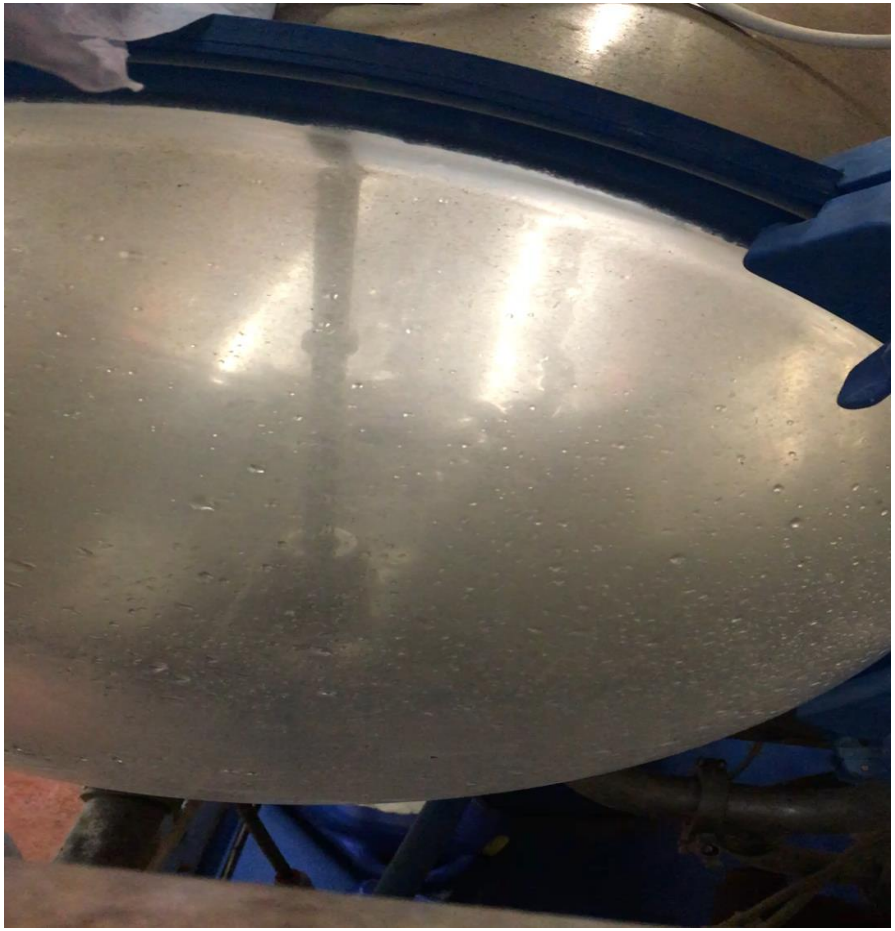
Bulk tank outlet

What to look out for on a farm visit – Rubberware

Perished milk tubes

Cracked air tubes

What to look out for on a farm visit – Effective Drainage



Is there latent water in the recording jar post draining?

Is there latent water in the filter housing post draining?

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Summary

What is required to achieve consistently low TBC and thermoduric counts?

Clean environment

Keep collecting yards and roadways as clean as possible to minimise teats becoming dirty

Clean cows

Clip tails 2 – 3 times per year and remove excess udder hair

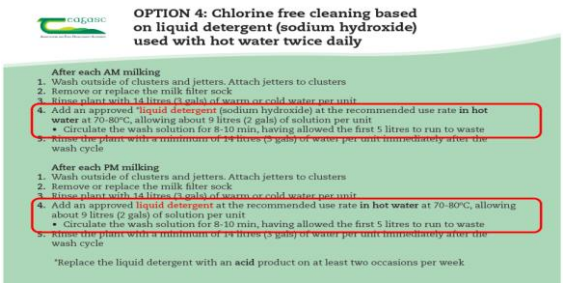
Hygiene at 'milking'

Attach clusters to clean, dry teats to minimise thermoduric bacteria entering milk

Regular maintenance

Change rubber ware routinely as cracks can harbour unwanted thermoduric bacteria

Effective & consistent wash routine



OPTION 4: Chlorine free cleaning based on liquid detergent (sodium hydroxide) used with hot water twice daily

After each AM milking

1. Wash outside of clusters and jetters. Attach jetters to clusters
2. Remove or replace the milk filter sock
3. Rinse plant with 14 litres (3 gals) of warm or cold water per unit
4. Add an approved *liquid detergent (sodium hydroxide) at the recommended use rate **in hot water** at 70-80°C, allowing about 9 litres (2 gals) of solution per unit
   - Circulate the wash solution for 8-10 min, having allowed the first 5 litres to run to waste
5. Rinse the plant with a minimum of 14 litres (3 gals) of water per unit immediately after the wash cycle

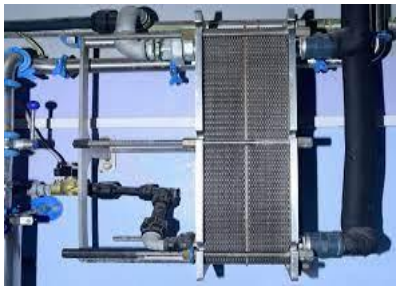
After each PM milking

1. Wash outside of clusters and jetters. Attach jetters to clusters
2. Remove or replace the milk filter sock
3. Rinse plant with 14 litres (3 gals) of warm or cold water per unit
4. Add an approved liquid detergent at the recommended use rate **in hot water** at 70-80°C, allowing about 9 litres (2 gals) of solution per unit
   - Circulate the wash solution for 8-10 min, having allowed the first 5 litres to run to waste
5. Rinse the plant with a minimum of 14 litres (3 gals) of water per unit immediately after the wash cycle

*Replace the liquid detergent with an **acid** product on at least two occasions per week

Implement a chlorine-free wash routine that involves frequent hot washing at 75 – 80°C, frequent acid washes and the correct amount of chemical for hot and cold washing

Fast and efficient milk cooling



Efficiently cool milk to 3.5 - 4°C quickly by utilising pre-cooling


Questions/ Discussion