On-Farm Water Reclamation

Joseph M. (Joe) Zulovich, Ph.D., P.E.
Extension Agricultural Engineer
University of Missouri

Overview

- **Water uses on dairy farm**
- **Water Conservation**
  - Repair Leaks and Adjust Float Valves
  - Adjust Feed Line Soakers and Holding Pen Sprinkler Nozzles
  - Adjust Milking Center Floor Flush System
  - Use of Cow Deck Washers (Wash Pens)
  - Evaluate Water Trough Protocols
  - Use and Control of Water Hoses in Parlor
- **Water Reuse**
  - Recycle Plate Cooler Water for Potable Uses
  - Capture milkroom wastewater for other washing uses
  - Equipment wash water reuse/recycle systems

Water Uses

Reference/Resource – Water Conservation for Next Gen Dairies presented at 2019 Western Dairy Management Conference.
Authors: Harner, Martin, Zulovich and Brouk

Categories of On-farm Water Use

- Drinking Water
- Milking Center
  - Equipment wash (milking & tank/storage)
  - Floor wash – Hygiene
  - Plate cooler
- Sprinkler Cooling
- Water “Disappearance” (Leaks and management)

- Overall Use as lbs. water per lb. milk (water to milk ratio) ranges from 5 to 7 +/- 2

Drinking Water

- Dependent on milk production level – more milk equates to more drinking water
- Dependent upon ration – higher silage or haylage rations have more moisture used to displace drinking water (estimate – 3 lbs. water per lb. dry matter intake)
- Weather condition impacts – cows in hot/warm climates can easily drink 20% to 25% more water

- Florida drinking water budget – 25 gpd/cow – range 22 to 32 gpd/cow

Water Usage at Milk Center

- **From an Australia survey – use tended to max out at 16 gpd/cow**
- **Survey study of California dairies – average of 78.5 gpd/cow with range 45 to 194 gpd/cow**
- **Second study of California dairies with water meters – use ranged from 44 to 51 gpd/cow**
- **Ontario study – average 5.97 gpd/cow**
  - Regular Parlor – 5.97 gpd/cow
  - Robotic – 8.95 gpd/cow
  - Rotary parlor – 3.67 gpd/cow
  - Tie stall – 5.10 gpd/cow

Conservation and Reclamation

Conservation versus Reclamation

- **Conservation**
  - Reduces initial water use
  - Some processes/uses just require a given quantity of water (washing, cleaning) so conservation is not really possible.
- **Reclamation/Reuse**
  - Does not really reduce initial water use unless reclaimed water displaces ‘new’ water for other uses.
  - Better than doing nothing

Focus on conservation first!

Fix Leaks & Adjust Float Valves

- A constant leak adds up over time – 1 gpm leak wastes 1440 gallons per day, 43,200 gallons per month or 525,600 gallons per year – if hauling manure/wastewater with 5,000 gallon spreader tank, 1 gpm continuous leak adds 105 tank loads per year to haul.
- Real observation – improperly adjusted float valve on water trough discharging 2.81 gpm into cow alley created about 1.5 million additional gallons of manure/wastewater to spread.

- What is the initial cost of the ‘wasted’ water?

Reclaim/Reuse Plate Cooler Water

- Plate cooler water usage is generally 2 to 4 lbs. water per lb. milk cooled.
- Ensure water flow is not higher than needed for plate cooler performance
- Water from plate cooler needs to be captured in a tank and then pumped for other uses
- Assuming 80 lbs. milk per cow, 3 water to 1 milk ratio, plate cooler would generate 28.8 gpd/cow for refilling water troughs or other uses (washing cow decks or sprinkler cooling)

Adjust water use for heat abatement

- Generally, heat abatement accounts for 10% to 30% of annual water consumption depending upon duration of hot weather.
- Water use for heat abatement during hot weather ranges from 17 to 100 gpd/cow. (Fresh manure – 18 gpd/cow)
- From 2019 literature review for feedline sprinklers, 0.25 to 0.35 gallons per 1 minute ‘on’ cycle per cow is adequate for heat abatement. Assume 15 minute on/off cycle and 24 hour operation, water use estimated at 24 to 33.6 gpd/cow. This type of operating scheme can minimize water running off cow into alley.

Use THI for heat abatement control

- Current heat abatement is typically controlled based on air temperature
- If sensors were available to reliably control based on THI (Temperature Humidity Index), water savings can be realized, especially in drier climate.
- Water savings estimated at 30% to 50% due to reduced cooling system operating time.

- What about sensors to spray/soak where only cows are located along feed bunk?

Milking Center Floor Cleaning

- Potable water generally required for parlor deck (cow platform) floor wash.
- Minimize the number of times deck flushed during day – flush volume can be estimated at 1-1.5 gallons per square foot per flush
- Reported ranges – 7.5 gpd/cow to almost 20 gpd/cow
- Use reclaimed milkroom wash water and/or plate cooler water to wash parlor floors – amount of water used for washing remains constant but no added water for floor washing is created. Size reclaim tank for only amount of water needed (available) for floor washing.

Cow wash pens – needed?

- Wash pens can be part of a holding pen where cow's udders are washed with potable water prior to milking.
- Wash pen water use reported to average 50 gpd/cow with a range of 19 to 93 gpd/cow. A recommended target of less than 40 gpd/cow.
- Challenge – Improve lactating cow housing hygiene so cows remain clean. Then wash pen is not needed.

Evaluate Water Trough Protocols

- What is frequency of draining or dumping water troughs for cleaning reasons?
- How deep is trough? Shallower trough requires less water to refill than deeper troughs.
- Frequency times volume is generated wastewater volume
- Reported water use due to trough dumping was as high as 35 gpd/cow with 4.7 gpd/cow being fairly common.
- Newer style shallow troughs use about 1 gpd/cow to refill
- Can a ‘skimmer’ or some other method be used to clean troughs instead of always dumping them?

Water hoses in parlor

- Consensus of milk center data collected shows water use in parlor for cleaning, such as rinsing manure off claws, ranges from 6 to 12 gpd/cow.
- Potential exists to reduce water use via hoses in parlor to 1 to 2.5 gpd/cow with numerous hose drops and effective nozzles.
- What about leaky nozzles?

Wash water reuse

- Some milking equipment cleaning systems incorporate wash water reuse capability.
- These reuse systems save not only wash water but also cleaning chemicals as an added benefit.
- Procedures must be followed to add proper amounts of cleaning chemicals and water reheat to ensure proper washing.
- If milkroom wastewater reclaiming is incorporated, these wash water reuse systems will reduce the amount of reclaimed wastewater available for other uses.

Summary

- Many different water uses exist on a dairy farm and quantities for the different uses can significantly vary.
- Water conservation should be evaluated/implemented first and typically is universal across different farms.
- Water reclamation varies by reuse/reclaim option being implemented and therefore tends to be farm specific.

Joseph M. Zulovich, Ph.D., P.E.
Extension Agricultural Engineer
University of Missouri

231 Agricultural Engineering Building
1406 E. Rollins Street
University of Missouri
Columbia, MO 65211-5200

Office Phone: (573) 882-0868
Email: ZulovichJ@missouri.edu