1.3 Yard washdown

Yards are cleaned by floodwash, hand-held hose or high-pressure hydrant. The resulting flow rates affect effluent collection and must therefore be taken into account.

Fixed high-pressure systems

Fixed high-pressure outlets for yard washing can be located at points around the perimeter of the yard, hoses can be installed on backing gates or booms, and hydrants can be installed at select locations around a yard. All rely on the need to convert pressure to kinetic energy, thereby providing an adequate velocity for the entrainment of manure. With fixed high-pressure outlets, the volume of water used and the outlet pressure will need to be much greater than that for hand-held systems unless the fixed system allows for sequential use. Obviously in the case of remotely operated, fixed high-pressure outlets, the demand for labour and time is lower. Multiple-hydrant high-pressure hose systems minimise the length of hose needed to command a milking shed yard. These multiple-outlet connections are convenient, but wear can lead to leakage of water and loss of pressure. Single proprietary hydrant systems which are not reliant on a high-pressure hose are available, applying the washdown water as a surge or fan. They can be installed as single hydrants or as multiple units in larger yards, particularly when the yard exceeds 10 m $\times$ 15 m. A range of hydrants and outlets and associated configurations are available, some being available off-the-shelf, others being made by farmers keen to save time.

Pressures

Pressures up to 900 kPa can be used as long as the pressure class of the pipes and associated hose is acceptable. Unless the installed system allows for sequential cleaning, the volume of water used and the outlet pressure will need to be much greater than for hand-held systems. Given the pressures used, the rating number of the pipe needs to be at least PN9 (Class 9), preferably higher. If there is any prospect of water hammer, operate valves in a sequence and avoid butterfly valves unless pressures have been checked.

Specifications and coverage

A 75-mm-diameter pipe operating at a design pressure of 200 kPa could deliver a flow rate of 10 $L \cdot s^{-1}$ to an outlet. At this flow rate, 1 m^2 of yard would be covered by 10 mm of water in a second (but more likely 4 m^2 by 2.5 mm). Under these conditions, the flow velocity through a 25-mm nozzle would be about 4 $m \cdot s^{-1}$. It would be possible to water a yard 10 m $\times$ 20 m in a few minutes with good coverage. In 5 min of application at 10 $L \cdot s^{-1}$, the volume applied would be 3000 L. This is approximately 50% greater than what would be achieved with a hand-held hose, which would take about 20 min. The spacing of outlets depends on the size of the yard and the water supply available. Multiple outlets are a feature of large yards, and are typically spaced 5 m apart.

Water quality

Water quality can influence the performance of high-pressure hose systems. Standard practice is to source water with low clogging potential. To minimise particulate matter, install a strainer on the pump suction and, if necessary, as an in-line filter. Centrifugal and helical screw pumps are used for high-pressure hoses (Garrett *et al.* 1991). Both types are prone to damage when pumping particulate matter, particularly abrasive solids such as sand. If the water is saline there is a risk of damage to metallic fittings;

corrosion can be aggravated by the use of recycled water, which tends to have higher salinity than fresh water.

Recycled water can be used for high-pressure washdown if it is drawn from ponds so as to avoid solids and the effluent is treated to a high enough standard. However, the high-pressure application of recycled water can increase the risk of microbial pathogen contact with humans and stock by splashing, and there is an increased risk of aerosols. Floodwashing of surfaces gives a lower risk of spreading aerosols than a nozzle, jet or sprinkler application. The risk of viable microbial pathogens being present in washdown is reduced markedly with increased standards of treatment.

Yard surfaces

The jet of water striking the yard surface can gradually remove fines and dislodge the concrete, a process further aggravated by hoof traffic. The concrete surface receiving the jet must therefore be prepared to withstand scour. Ideally the outlet or hydrant should be designed or periodically moved or redirected to avoid excessive intense localised application. Standard practice is to ‘scabble’ the concrete or impress the surface with a grid to improve hoof traction, but the rougher the surface is, the more difficult it is to clean. Bunding is essential to ensure that splash from the yard does not erode surrounding earth and to direct the washdown water to a sump. The sump must be sized for the flow without reliance on an effluent pump to control the level of effluent.

Hand-held hoses

Flexible hoses are available in a range of diameters and materials that are resistant to abrasion and damage from exposure to sunlight. Vanderholm (1984) made the following recommendations for hand-held washdown hoses:

- Wash-down equipment should be designed for a flow of 3 to 4 $L \cdot s^{-1}$ with 100 to 140 kPa of pressure at the nozzle. Many of the centrifugal pumps now available deliver this quantity of water at the required pressure.
- Place the pump as close as possible to the storage tank to minimise suction lift.
- Calculate the interaction between pipe size and head loss and incorporate it into the design.
- Use a delivery pipe between the pump and the wash-down hose with a minimum diameter of 38 mm.
- Use a wash-down hose with a minimum diameter of 38 mm and a maximum length of 9 m. Provide a delivery pipe with multiple draw-off points to achieve this, if necessary.
- Fit a quick-action valve at each draw-off point and between the hose and nozzle.
- Install an overhead gantry or hooks along the yard wall to lift the hose off the ground during use and for storage.

Pre-wetting yards before milking is recommended to assist cleaning. Supplementary feeding can change the characteristics of manure, and rough concrete yards can impede cleaning. Calculations and recommendations that cover these issues more thoroughly are given in a more recent document from New Zealand Dairying and the Environment Committee (2006).

If the hose is wider than about 75 mm, it can be difficult to lift and manoeuvre, so this is the usual size limit. Hose sizes range commonly from 38 to 50 mm. The combination of hose diameter, orifice size and available pressure dictates flow rate. Operating pressures of at least 100 kPa are recommended, and maximum pressures of about 200 kPa are considered safe. Although operating pressures of 50 m (500 kPa) are possible, control of the hose will be difficult, and the hose will need to be firmly restrained when

fitted with a nozzle. The nozzle dictates the velocity of the water jetting out. Once this velocity exceeds about 4 $m \cdot s^{-1}$, manual control of the hose will be difficult, and the jetting water can injure stock, exposed skin and concrete. To minimise these problems, the orifice should not be less than one-third of the pipe diameter. To assist flow control and to avoid water wastage, install a control valve at the end of the hose. Commercial nozzles are available with an integrated valve, which provides an adjustable high-flow or jetting capability.

Where recycled effluent water is used for washdown, the hose should be periodically flushed with fresh water and specially marked for the purpose. If the recycled water or washdown water has a salinity level exceeding 1000 $mg \cdot L^{-1}$ TDS, use stainless steel fittings or high-impact-resistant HDPE fittings. The longer the pipe, the greater the loss of pressure due to friction, and couplers and connections cause additional losses: each connection has an equivalent pressure loss of about 1.5 m of hose.

The amount of water and time needed for cleaning a yard with a hand-held hose depends on:

- surface area
- the roughness of the yard surface
- the slope of the yard surface
- the dryness of the yard surface
- the amount of built-up manure and track material
- prevailing weather conditions
- the farmer's preference.

A range of studies indicate that there is marked variation in the cleaning volume required for a unit area of yard: between 10 and 40 $L \cdot m^{-2}$; a design volume of 15 $L \cdot m^{-2}$ is common. If we assume that a 50-mm-diameter hose is connected to a hydrant and carries 4 $L \cdot s^{-1}$ at 175 kPa, the hose could be used to clean an area of about 10 m^2 in 5 min. An advantage of high-pressure hose and hydrant systems is the ease of cleaning irregular-shaped yards when floodwashing is unviable; a typical application is a circular yard which can be readily cleaned by four hydrants installed at 90° positions on a ring main around the perimeter. These systems can also be installed on fluted yards where the stock entrance narrows; in such systems the spacing of hydrants increases as the yard funnels outwards.

Safety considerations

High-pressure pipes, bayonet fittings and nozzle connections must be maintained to avoid bursts which could injure workers or livestock. The frequent starting and stopping of water increases fatigue of components, so regular inspection and replacement of worn components is critical to the maintenance of performance. If recycled water is used for cleaning, people should remain clear of outlets to reduce the risk of ingesting aerosols. Periodic flushing with fresh water will reduce the build-up of slime on nozzles and outlets. This cannot be done when workers or stock are in the path of the jetting water, which can travel further than 10 m at 5 $m \cdot s^{-1}$. Although common sense should prevail, accidents can happen, particularly when nozzles are left open as pumps start up.

References

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1.3 Yard washdown

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