Updated Article on Water Supply

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A good water supply is extremely important for production, health and welfare of livestock. The water supply system must be good enough to supply adequate water needs in paddocks, the parlour and dairy, and the dwelling. On most farms the water system consists of a series of expansions or additions carried out over the years as requirements changed. Only when the system fails to cope, such as during a dry summer, do people realise how marginal their system has become.

A fact often overlooked, is that improving water supply can result in an increase in milk yield. A dairy cow can be satisfied long before she is full, so if the water is slow to come through to the trough, she may be quite contented, but milk yield can suffer by over 20%.

Common problems on most farms centre on inadequacies in areas such as, water source, pumping plant, pipe sizes, ballcocks and troughs.

Drinking behaviour

Peak water intake generally coincides with peak grazing periods. Peak demands occur especially after evening milking and to a lesser extent after morning milking. Water flow rates must be capable of supplying these peaks of demand. Allow trough space of 450mm (18 inches) per cow so that close to 10% of your herd to drink at any one time.

Water Source

A bored well is the most common source on farms. If the well is unable to meet peak demand, the installation of a reservoir of, for example, 9,000 litres (2000 gallons) which can be a pre-cast concrete tank will rectify the situation. The tank can be buried in the ground or placed overground.

A booster pump is then used to pump the water from the reservoir into the water supply system, at whatever flow rate and pressure are necessary. Frequently, this booster pump can double as the pump for a wash-down system as well. Modern frequency controlled centrifugal pumps will automatically maintain pressure and flow in response to demand. The pump speed will increase when an extra tap or ballcock comes into use and vica versa. In large scale units, where electric power is not limiting two of these pumps can be installed in parallel to efficiently cope with the demand for high flow rates.

Pumping Plant

Submersible or surface pumps may be used in water supply systems. In general, only submersible pumps should be used to pump from deep wells (boreholes). The running costs of a surface pump, being used to pump from a deep well, can be up to five times higher than for a submersible pump, because some water has to be pumped down into the well to bring water to the surface. Maintenance costs are higher also. Surface pumps can be used for shallow wells where the water can be sucked directly by the pump. Consider replacing an existing deep well surface pump with a submersible pump.

In deciding on pump size, take into account the depth of the well, the output of the well and the working pressure required to overcome any rise in ground level from the well to the top of the system. Where a new pump replaces a previous unit, the size of the electric cable used to supply the pump must be taken into consideration. Poor standards of installation lead to bad performance and unreliability. Lack of starter switches or wrongly adjusted starters fail to give motors adequate protection. Experienced pump suppliers will be able to help you in planning the system to suit your requirements.

Small Pipe Sizes

This is probably the most common problem with water supply on farms. Even on farms where piping was laid in recent years under-sizing of pipes still occurs. This is illustrated in table 1. Table 1 shows the pressure loss in psi for different pipe bores over a range of flow rates for 100 metres length of water pipe. For example, at a flow rate of $3m^3$ per hour (50 lit/min or 11gal/min) with a 32mm (1¼ inch) pipe the pressure is reduced by 4.83psi for every 100 metres of pipe. The reason the flow rate reduces because of friction between the water and the inside surface of the pipe.

Table 1 doesn’t take into account the extra pressure required if you are pumping uphill or the pressure gained pumping downhill. Pressure lost due to restrictions at ballcocks and fittings is also extra.

Table 1 doesn’t show values for 12.5mm (1/2 inch) pipes because at any of the flow rates shown the pressure loss would be very high. Where 12.5mm pipes are used on farms the flow rate is reduced to a trickle due to pressure loss.

Table 1 Pressure loss in psi for different pipe sizes at various flow rates for 100 metres length of water pipe					
Pipe bore (mm)	Flow rate m^3 per hour (litres per minute)				
	1 (17)	2 (33)	3 (50)	4 (67)	5 (83)
20	14.20				
25	3.27	11.50			
32	0.64	2.27	4.83	7.60	11.65
38	0.34	1.21	2.49	4.05	6.25
50	0.11	0.38	0.88	1.34	2.06

With regard to pipe size it’s the change in cross-sectional area in relation to its bore (diameter) that’s important. It’s hard to imagine that a 20mm (3/4 inch) pipe has approximately twice the cross-sectional area of 12.5mm (1/2 inch) pipe. Similarly, a 25mm (1 inch) pipe has four times the cross-sectional area of 12.5mm (1/2 inch) pipe, although it’s only twice the bore.

The pressure loss is also affected by the pipe length. The pressure loss and the resultant reduced flow rate are directly proportional to the length of the pipe, i.e. if you double the length of the pipe you double the pressure loss. You can use table 1 to judge how much pumping pressure is lost with various pipe sizes and flow rates, while taking the pipe length into account.

The net effect of pressure loss is reduced flow rates. Increasing system pressure to maintain flow rate is not a good solution. It would be extremely energy inefficient and give rise to damaging levels of pressure. The answer is to use the right pipe size.

Ring system

If you are installing a new main line, incorporate the existing line as well if it's in good condition and not too difficult to do. This is worthwhile where pressure is low or the main line is long and the end of the new line and the existing line are not too far apart. Connecting up the ends of two main lines (of the same size) to form a ring main will almost double the flow rate.

Laying pipes

If you are using a mole plough to lay the pipe, do it in stages, using a digger to make holes at intervals where connections are going to be made. Try to get the pipe down to a depth of 450mm or more. Tractors with double-acting rams on the arms can add enough weight to the mole plough to get the depth. Do a “dummy run" first before feeding in the pipe and allow the pipe time to recover from the stretching before making connections.

Ballcock Problems

Very often the ballcocks are the weak link in an otherwise satisfactory water supply system. Ballcocks are frequently over restrictive, even on systems where the pipe sizes are adequate. A high pressure 12.5mm ballcock in the drinking trough is not capable of allowing an adequate flow rate, which is in most situations about 16 to 22 litres per minute (3.5 to 5gal/min).

In general, standard ballcocks are described by their size and pressure. Ballcocks can have high, medium or low pressure jets (see photo 1). The high, medium and low pressure refers to the pressure the ballcock can withstand without leaking when the trough is full.

Photo 1: High, medium and low pressure jets

The high-pressure jet has the smallest hole and the low-pressure jet the biggest.

The high pressure jet in a standard ½ ballcock is only 1/8 of an inch in diameter whereas the medium jet is ¼ of an inch in diameter. Other ballcocks are available that have openings of ½ inch or greater.

In most systems medium pressure ballcocks will provide an adequate flow rate (see table 2). In practice, most standard ballcocks are sold with high pressure jets in them, which is one reason why so many farms have flow rate problems.

High or medium pressure jets will fit into all 12.5mm ballcocks (see photo 2). The low pressure jet will not fit up against the gasket in standard 12.5mm ballcocks. If you want the option of using a low-pressure jet get the 12.5mm ballcock that can take any size of jet. It has a bigger plunger and a bigger gasket (photo 3)

Photo 2: Two standard ½ inch ballcocks, one showing a shorter float arm. High and medium pressure jets can be used with this type of ballcock.

Photo 3: This is a bulkier version of the ½ inch ballcock, in which fits the low pressure jet as well. Note the bigger seating gasket for the jet inside.

Using a longer float arm or a larger float can solve the problem of leaking ballcocks by increasing the force on the gasket with the extra leverage. Longer float arms are available or they can be lengthened by braising on a piece.

Ballcock jets should be checked from time to time to see that they are free flowing because they can become encrusted with lime scale or partially blocked with dirt.

Table 2 Flow rate l/min (gal/min) with a standard 12.5mm (1/2 inch) ballcock and a system pressure of 3.6 bar (52psi) for different jet sizes

	12.5mm (½") Ballcock		
Jet type	Low	Medium	High
Jet size mm (inch)	10mm (3/8")	6mm (1/4")	3mm (1/8")
Flow Rate l/min (gal/min)	42 (9.25)	32 (7)	8 (1.75)

Table 2 shows the effect of using different jet sizes on flow rate. I put the three different jets in turn into the same standard 12.5mm ballcock at a trough in a paddock. The system pressure at the trough with no water flowing was 3.6 bar (52psi). The most striking finding is the massive increase in flow rate between the high and medium pressure jets, going from 8 to 32 litres per minute.

Water Troughs

Cows can drink anything from 10 litres of water on a cold, wet day to 60 to 110 litres on a really hot day. They can typically drink at the rate of 14 litres a minute from a trough. Allow cattle 10 to 15 litres per 100kgs of body weight per day.

Carefully consider trough location; cows don't like to walk more than about 250 metres to get a drink. Locate water troughs away from paddock gateways and farm roadways. This will shorten the walk to water, prevent bottlenecks, and reduce the wear and tear at gateways.

Check water troughs regularly to ensure that ballcocks are working properly and that there are no leaks; a leak at a water trough is a real disaster.

Flow rate should be considered before trough size in ensuring adequate supply. However, large troughs provide more drinking space and can compensate a bit for poor flow rate at peak drinking time. The main advantage of big troughs is they give more space for drinking. Each cow drinking at a trough needs 450mm of space measured along the trough rim. For large herds it may be necessary to install a second trough in the paddock. The troughs should be spaced suitably so that cows have no more than 250 metres to walk to water.

Siting troughs underneath a paddock wire fence will more than halve drinking space. Heifers and timid cows may also get bullied if adequate drinking space is not available. The area around the trough should be able to take a lot of cow traffic i.e. a similar surface to a farm roadway and ideally have good drainage (See photo 4)

Photo 4: This is a typical 0.5m^3 (110 gallon) rectangular water trough. It is located on a high point in the field with a good surface around the trough. The length of the rim of the trough all around is 4.8m (16ft.) which is more than expected. It could allow in theory about 10 cows to drink together. A 1.6m^3 (350 gallon) round trough has a drinking rim of almost 6m (20ft.), which in theory is room for about 13 cows.

Calculating water flow rate

Assuming a daily demand of 80 litres per cow, almost 50% of which is consumed in a three hour period soon after evening milking, means that an hourly flow rate of 13 litres per cow per hour is required (i.e. 80 x 50%/ 3 = 13 litres/cow/hour.). Therefore, for a herd of 100 cows the flow rate needs to be about: 100 cows x 13 litres/hour = 1300 litres/hour or 22 litres per minute.

To check the flow rate on your farm:

- Mark the level of water in a trough
- Tie up the ballcock and empty, say, 25 litres from the trough
- Release the ballcock, hold it down and measure the time it takes (in minutes) to refill to the original mark
- Divide the 25 litres by the time taken to refill, e.g. if it takes a minute to refill then the flow rate is 25 litres per minute (25/1 = 25)

If the flow rate measured is less than that required for your herd, then your water supply system needs to be improved. Check the flow rate of troughs around the farm.

Leaks

Troughs can overflow and pipes can leak. Leaks can make a mess and add considerably to water bills. Overflowing troughs and leaking pipes frequently go unnoticed. A leak in a metered supply downstream of the meter may lead to massive water bills. Leaks in a private supply are costly also because electric motors are very expensive to run, if running continuously. Use quality fittings and install isolation valves on pipelines to isolate different sections of the paddock water supply. Isolate all the sections during the housing period.

Portable water troughs

It may be necessary to use portable water troughs in some situations e.g. strip grazing. To provide a portable trough use frost-proof gate valves and good quality non-restrictive quick-couplers. Connection points should ideally be away from fixed troughs because they can be damaged and some valve types can be opened by stock, causing leaks.

Key points

- Daily drinking water requirements vary but can be 60 – 110 litres per cow
- Milk production and animal health are affected by inadequate water supply
- Many water systems are inadequate especially for expanding herds
- Allow 450mm (18 inches) drinking space per cow so that close to 10% of your herd to drink at the same time
- Main pipelines should be at least 25 or 32mm and 38 or 50mm for larger herds
- Use 12.5mm medium pressure standard ballcocks or newer bigger types; avoid high pressure ballcocks
- Correct siting of water troughs is important