farm energy centre

10 Technical Note

Reducing Dairy Water Heating Costs

Introduction

On a typical dairy farm water heating can account for 25 - 50% of the total electricity consumption. Ensuring that this is carried out as efficiently as possible can have a significant impact on electricity costs.

Use of hot water includes hand washing, calf feeding and bulk tank washing. The greatest use is for circulation or acidified boiling water cleaning of the parlour. Newer parlours, in particular those with large bore pipelines and milk meters, need up to 18 litres of water at 85°C per milking point per wash.

A number of simple measures can reduce water heating costs by as much as 90%. In order of priority these measures are:

- Use a well insulated water heater;
- Heat as much water as possible during the cheap rate tariff period;
- Use a refrigerant to water heat recovery unit.

Insulation

Tank

Water used for circulation cleaning has to be heated to 85°C which is much higher than for domestic use. The heat loss from an uninsulated tank is very high even during the summer months when ambient temperatures are higher.

The water heater should be insulated to better than 0.45 W/m^2 °C, this is equivalent to 50mm of sprayed polyurethane foam or 85mm of glass fibre quilt. Poor, damaged or missing insulation, especially if wet, will result in high heat loss and high running costs. An uninsulated tank will lose about 50% of its heat over a 17 hour period. This can be reduced to 5% with good insulation.

For example, Farm Energy Centre work has shown that maintaining 65°C in a 137 litre (30 gal) uninsulated water heater, costs £240 p.a. in standing losses. This compares with £60 p.a. for a similar insulated heater with water at 85°C.

Fitting a glass fibre quilt to an existing uninsulated water heater is cheap and very cost effective. However, a pre-insulated water heater will have much lower heat losses and be more cost effective in the long term.

Pipe work

The pipe work from the water heater to the point of use should be as short as possible to minimise heat losses. The pipes should be insulated with at least 12mm (1/2") of cladding, preferably 19mm (3/4") and should cover the entire pipe surface and be taped at the joints.

Electricity Tariff

The most economical way of heating water electrically is to do so during the cheap rate tariff period. These tariffs give around 7 hours of cheaper electricity usually between 00:30 and 07:30. All Public Electricity Suppliers (PES) offer such tariffs though they may vary in name and in the timing of the low cost periods.

The cost of heating 227 litres (50 gal) of water to 85°C during the daytime is £583 p.a. compared with £199 during the cheap rate tariff, a saving of £384. Changing to a cheap night tariff is normally free and can be arranged by your electricity supplier.

It is common for dairy farmers who wash their parlour twice daily to have a water heater that is big enough for only one wash. This is normally heated-up during the cheap rate for the morning wash and reheated during the day for the afternoon

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wash. Considering the level of savings (£384 for a 210 litre tank) it is often worth installing a second water heater dedicated to the second wash that can be heated up during the cheap rate. A short boost will be required just before use to ensure the water is at the correct temperature but the cost of this is minimal if a well insulated water heater is used.

If additional water heater capacity is required for tank cleaning, calf feeding and hand washing, the better option may be to use the existing water heater for these tasks and buy a single two-wash capacity water heater. If a two-wash capacity water heater is used it is important to ensure that cold water cannot enter until the second wash has been completed. This can be done automatically using a time switch controlling a solenoid valve on the water supply.

Poor insulation can significantly reduce the benefits of heating water during the cheap rate. This is especially true if the water is to be used for the afternoon wash.

A disadvantage of many cheap rate tariffs is that the standing charges and day rate electricity are slightly higher than with a standard tariff. Typically at least 13% of electricity consumption needs to take place during the cheap rate period to break even. Considering that at least 20% of dairy farm electricity consumption is water heating, a typical electricity bill will be cheaper on a low night rate tariff even before allowing for milking during the cheap rate.

Heat Recovery Units

The heat rejected by the milk cooling system can be transferred into water, pre-heating it before it enters the water heater. At the point the refrigerant leaves the compressor, the temperature can be as high as 80°C.

Work jointly funded by Farm Energy Centre and the Milk Development Council has shown that the use of heat recovery units (HRU) can reduce water heater electricity consumption by up to 70%. However if you are doing everything as efficiently as possible so far, the savings amount to around £139 p.a. (227 litres, 85°C). Detailed information about the different types of HRU and their installation/ operation can be found in the FEC Technical Note 68 *'Heat Recovery Units for Dairy Farms'* (available from the Farm Energy Centre).

What Now ?

- Make sure that you have a well insulated water heater, otherwise the effectiveness of any other measure will be limited.
- Check that you are on the correct tariff. Most dairy farms should be on a tariff with a cheap rate component.
- Find out the precise times of the cheap rate tariff period and whether it changes from GMT to BST and vice-versa.
- Heat as much water as possible using cheap rate electricity. In many cases the purchase of additional water heating capacity will pay for itself in 2 –3 years.
- Consider the use of a heat recovery unit. Although the payback time is much longer, (5–10 years), as a long-term investment it is still worthwhile.

Housekeeping

Even if you have taken all the practical measures to control your water heating costs it is easy to let things slip.

- Dripping taps and valves don't just waste water, the cold water replacing it in the tank increases electricity use.
- Check time switches regularly. Few continue to work if the power goes off. So the timeswitch will register the wrong time. This will increase the use of day time electricity and might even mean the water isn't at the correct temperature when you need it.
- Any damage to the water heater and its insulation should be repaired as quickly as possible. Moisture ingress reduces the insulation value of tank covers - especially with fibreglass insulation.
- Check the water temperature. Too hot and you're using more electricity than you need to. Too cold and you are risking poor cleaning.
- In hard water areas 'furring up' affects the performance of the immersion heater and considerably reduces its life. De-scale regularly using an approved acid treatment and use an 'incoloy' or titanium sheathed immersion heater for longer element life than standard types.

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