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Energy Efficiency in Dairy Farming

INTRODUCTION

This guide explains how dairy farmers can make their businesses more energy efficient. Energy efficiency is of primary benefit to businesses as it reduces costs and cuts harmful emissions which cause global warming and pollution.

PLATE HEAT EXCHANGERS FOR MILK PRE-COOLING

Milk has to be reduced in temperature from 40°C down to about 4°C and this is normally done using refrigeration equipment. However mains or borehole water can be used through a plate heat exchanger to pre-cool the milk before it enters the tank. Plate heat exchangers reduce milk cooling costs by around 30%. Savings in energy have to be weighed against the capital cost of installation and the cost of water. Water cost savings can be made by re-use in drinking systems or for washing.

Existing plate heat exchange systems should be checked to ensure that the number of plates is optimised and that the ratio of the flows of milk to water running through the system is correct. You should also check that the timer settings for the solenoid valve on the water system allow enough time for the milk to be cooled but are not so long as to cause water waste.

DIRECT EXPANSION TANK WITH A TWO-STAGE COOLER

Direct expansion (DX) tanks are those which do not build ice and cool the milk using direct contact with refrigeration coils. These systems use less energy than ice-bank tanks because energy is not lost through the use of a secondary cooling system. For the ultimate in low energy/low cost use for milk cooling, a DX tank fitted with a two stage pre-cooler is the ultimate. Here milk is first pre-cooled with mains water. Then water is taken from a separate ice builder which operates during the night to provide secondary pre-cooling. When the milk finally enters the tank, the DX system has only to remove a small amount of heat, to achieve the final required temperature. This system can give cooling cost as low as 4.2p per 100 litres of milk cooled. (compared with 18p per 100 litres for a conventional ice bank tank)

USE A WELL INSULATED STORAGE WATER HEATER

After milk cooling, water heating is the second largest consumer of energy for a dairy. Most systems use an electric immersion heater fitted into a tank. It is fundamentally important that the water heater is well insulated and that heat losses, especially from lids and pipes, is minimised using insulation. Water heating systems can take advantage of cheap night great electricity tariffs by operating during these periods.

To make the most of the availability of cheap rate electricity, the storage capacity of water heaters should be such that all heating can take place during the night and the water stored for use later in the day. Adequate capacity must therefore be installed. Also, a time switch should be fitted to the immersion heater. The setting of this should be checked regularly to ensure that the does not get out of synchronisation with cheap electricity rate times.

HEAT RECOVERY FOR WATER HEATING

During the process of cooling milk heat is rejected from the condenser coil of the refrigeration system. It is possible to recover this by passing the hot refrigeration gas through a heat exchanger which is immersed in water. Water temperatures of over 50°C can be achieved by using this technique. Careful configuration of the water heating system needs to be carried out so that the heat recovery can deliver the maximum benefit without compromising the operation of

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the milk cooling system.

NIGHT RATE CONTROLLER FOR ICE BANK TANKS

Most ice-bank tanks can be controlled to delay ice building following the evening milking until the start of the cheap night rate period. This can be done using a time switch, but using a special controller with ice sensors to ensure that the ice store does not become too depleted, is a safer option.

The use of pre cooling reduces the load on the ice-bank which means a greater proportion of the ice building can take place at night. Night time cooling is more efficient as the refrigeration system works more effectively at lower outside temperatures.

CONVERT TUNGSTEN LIGHTING TO DISCHARGE LIGHTING

Using conventional light bulbs or in fact any lamp type which relies on a tungsten element, can be very inefficient. They should only be considered where lighting periods are very short – less than one hour per day.

There are a wide range of alternatives which are much more efficient, including compact fluorescents which can be used as a direct plug-in replacement, and high pressure sodium lamps which can be used to light yards and cubicle buildings. Lighting costs can be cut by as much as 80% by using the right type of lighting. Taking out 2 x 150 watt bulbs and replacing with 1 x 70W sodium light will reduce lighting cost by up to £100 per year.

TIMESWITCHES ON LIGHTING OR DAWN TO DUSK SENSORS

Lights are often left on unnecessarily during the day. A time switch or a 'dawn to dusk' sensor will ensure that lights are only switched on during the hours of darkness.

FROST PROTECTION WITH TRACE HEATING AND INSULATION

In cold conditions, it's inefficient to heat a whole parlour area to stop pipes freezing. A better idea is to use trace heating cables and insulation. Trace heating uses a low wattage heating cable or tape to raise the temperature of the pipe a few degrees. A full trace heating system for a parlour might only use a few pounds worth of energy for the whole winter period - much less than for heating the whole area.

HEAT PARLOURS USING SHORT WAVE INFRA-RED HEATERS

Heating a draughty and un-insulated parlour to an acceptable working temperature on a bitter winter morning is almost impossible. A better solution is to use localised radiant heat to warm the local working area. Short-wave infrared heaters produce heat instantly and they are immune to low air temperature and draughts. Running cost for a 1.5kW heater operated during the cheap period is about 9p per hour.

VARIABLE SPEED DRIVES FOR ELECTRIC MOTORS

Three phase electric motors can now be driven at reduced speeds using variable frequency drives. This is useful for applications like pumping or ventilation where the output requirement often changes. Reducing the speed of a pump or fan by 50% can cut energy use by as much as 75% so it makes sense to tailor the speed to the exact requirement at any time. Irrigation

pumps and milk pumps can benefit from this technology especially when the speed is linked to the flow or pressure requirement of the system.

SCROLL VACUUM PUMPS WITH VARIABLE SPEED DRIVES

Vacuum pumps are usually of the oil vane type and operate at a constant speed to provide the required vacuum for the milking system. Precise vacuum level is controlled using an automatic valve which allows air to enter the system to stop the vacuum getting too low. Bleeding air into the system is wasteful as it wastes the energy supplied by the pump. A scroll pump fitted with a variable speed drive is more efficient. These pumps can operate effectively at lower speeds, so if linked to a variable speed drive to give the correct pressure, they run slower and consume much less energy. Savings of more than 50% have been reported.