Tallow as a heating fuel

September 2002

Results for today; Ideas for tomorrow

Introduction

The prices obtained for the various grades of tallow have trended downwards between 1998 and 2000 such that they are now significantly below the cost of fuel oil. Although many larger meat plants have converted to coal-fired boilers for steam generation, a significant number of plants still use fuel oil, liquefied petroleum gas or natural gas. Fuel oil and LPG are subject to import parity pricing therefore, due to fluctuations in the value of the Australian dollar and increases in OPEC oil prices, their prices have increased significantly.

Tallow has a high energy value and has been used for some time by meat plants in remote locations to fire boilers for steam generation in place of fuel oil. There has been considerable interest recently in production of biodiesel from tallow and vegetable oils but other than a New Zealand publication in 1984, very little research work has been published on the use of tallow as a heating-fuel substitute. This summary is based mainly on the New Zealand work and experience from Australian plants.

Prices of tallow and fuel oil

Figure 1 shows the movements over the last five years in the prices of tallow and heavy fuel oil. It can be seen that since the beginning of the year 2000, the cost of fuel oil has consistently exceeded the price of tallow even with a recovery in tallow prices.

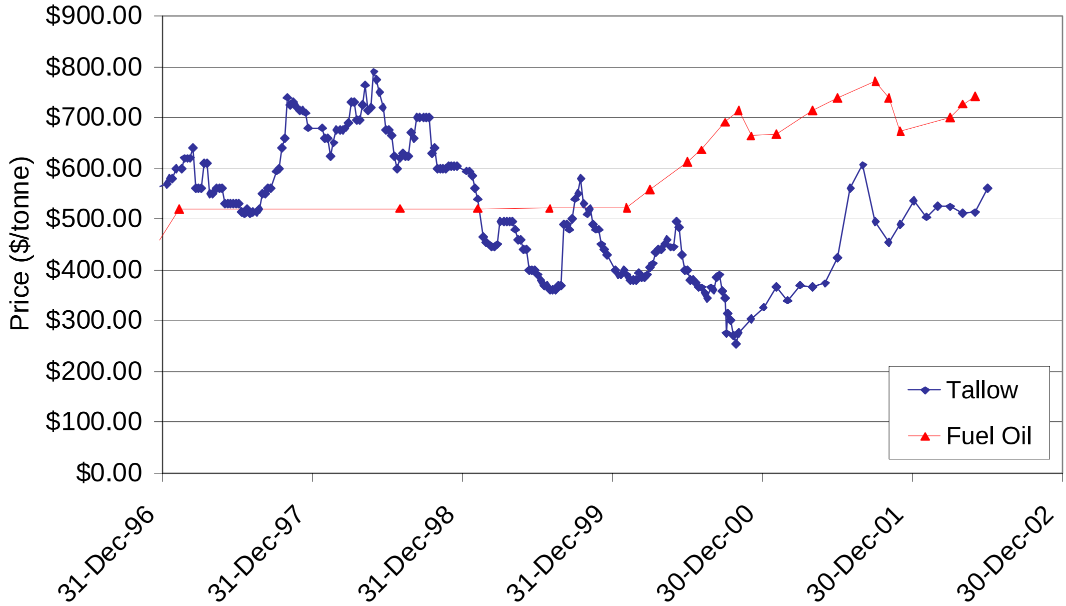

Figure 1: Prices of tallow and fuel oil

Figure 2 shows the relationship in $ per GJ for various fuels used by meat plants (Source ABARE, Gas Statistics Australia 2000). These prices are indicative only as actual prices are generally on an individual contract basis between the supplier and end user.

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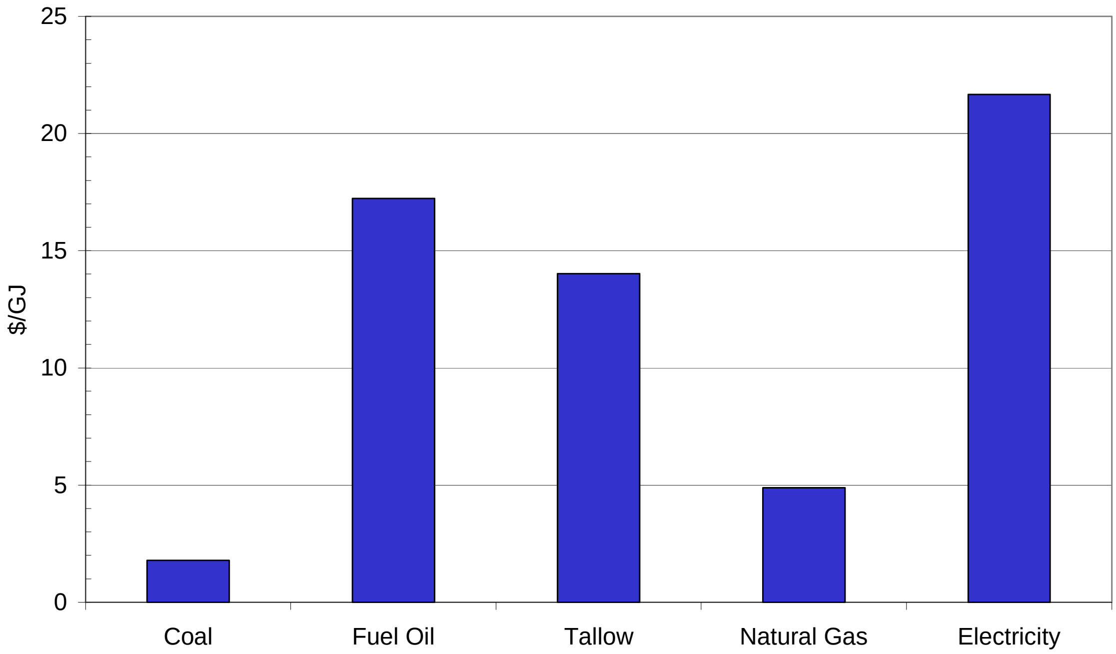

Figure 2: Comparison of energy prices of various fuels

Properties of tallow and fuel oil

Table 1 compares the properties of the commonly used fuel oils and tallow.

Table 1: Physical and combustion properties of tallow and three grades of fuel oil (Spiers, 1955)

	Diesel	Light Fuel Oil	Heavy Fuel Oil	Tallow
Ultimate composition (%)				
Carbon	86.3	86.2	86.1	70
Hydrogen	12.8	12.4	11.8	11
Sulphur	0.9	1.4	2.1	0
Oxygen	0	0	0	19
Specific gravity at 15.5ºC	0.830	0.895	0.949	0.920
Calorific value (kJ/kg)	45,700	44,200	43,100	40,000
(kJ/L)	39,700	39,500	40,400	36,800
Combustion air requirements:				
kg dry air/kg fuel	14.40	14.20	14.00	15.60
m^3 air/kg fuel (0ºC, 760 mm Hg)	11.09	10.99	10.85	12.04
Composition of wet flue gas (%)				
Carbon dioxide (CO_2)	13.4	13.6	13.8	13.9
Water (H_2O)	12.0	11.7	11.3	13.1
Sulphur dioxide (SO_2)	0.1	0.1	0.1	0
Nitrogen (N_2)	74.5	74.6	74.8	73.0
Flash point (ºC)	75.5	79.4	110.0	288 - 316

There are several differences between tallow and fuel oils. Tallow does not contain sulphur, therefore the problem of formation of corrosive acids from condensation in the stack does not exist. Flue temperature is normally kept above 150ºC with fuel oils to prevent condensation. Therefore lower flue temperatures can be used resulting in a net increase in boiler efficiency.

Tallow has a slightly lower calorific value than fuel oils and a slightly greater combustion air requirement. It also has a significantly higher flash point (288 – 316ºC compared to 75 – 110ºC), indicating that the minimum furnace temperature for efficient tallow combustion would be around 300ºC. This would not normally be a problem with burners that have a refractory-lined combustion chamber.

Practical aspects

Oil-fired boilers can quite easily be converted to operate on tallow. Gas-fired boilers would require the additional expense of provision of an atomising oil burner. The main modification to existing fuel supply systems is that provision must be made to start and shut down the boiler on a fuel oil (diesel or fuel oil). The heated fuel oil is required to preheat the fuel lines to prevent solidification of the tallow while fuel oil at shutdown is required to flush out the lines. Tallow has a melting point of 50 to 60ºC. Alternatively diesel could be mixed with the tallow at about 10% to lower the melting point. A layout of the fuel supply system is shown in Figure 3.

The main points to consider when converting a boiler to run on tallow are:

1. Fuel lines should be kept accessible and as short as possible.
2. Clean, polished, or centrifuged tallow is required. Problems of deposits at the rear end of the boiler have been experienced with low-grade tallows.
3. The tallow temperature in the lines should be kept above 90ºC to prevent gumming of filters. Insulated or trace-heated fuel lines would be advisable in cooler climates. A tallow fuel tank temperature of 120ºC will provide a viscosity suitable for atomisation.
4. If insulated and trace-heated lines are used, it is possible to operate solely on tallow without the need to start and stop on a regular fuel.

Will there be enough tallow?

Study of the plant records will indicate if sufficient tallow is available to meet the plant fuel requirements. As a guide the quantity of tallow produced by a plant depends on the type of animals processed and the extent of processing. For example, a plant processing for the domestic market and despatching all carcases in quarter form will expect to produce about 15 kg of tallow per head, whereas a plant processing predominately grain-feed cattle that are all boned for export would produce about 115 kg of tallow per head.

A survey of Australian meat plants in 1978 indicated that the average fuel usage for plants with boning, chilling and rendering facilities was 4,440 MJ per tonne of dressed carcase processed.

As an example, a plant processing 600 cattle per day at an average dressed weight of 300 kg per body with all bodies boned for export would produce about 36 tonnes of tallow per day with an aggregate calorific value 1,440,000 MJ. The plant's fuel requirements would be approximately 800,000 MJ per day.

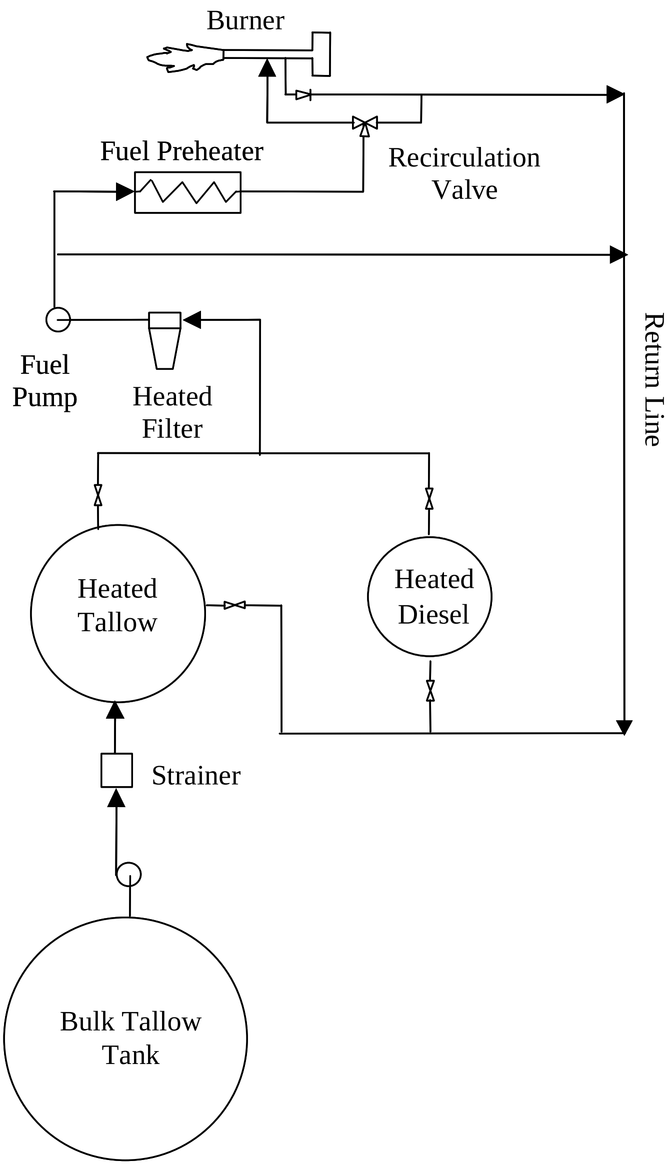

Figure 3: Layout of fuel system

Further information

Spiers, H M (1955) Technical data on fuel. 5th ed. British National Committee World Power Conference, London.

Downey, J and McDonald, B (1984). Raw tallow as a fuel-oil substitute. MIRINZ 828.

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