Internal Project Information Note 15/08- Extended summary

Wood pellets production

Summary

This project provided an overview of pellet production issues and costs as guidance for potential UK producers, illustrating the underlying principles of manufacture.
The report:

- described the wood pellet production process from production/harvesting of feedstock through to pelletising, including transport options.
- identified the main suppliers and costs of wood pellet processing equipment available in the UK.
- identified viable operational production scales including volumes of raw material necessary to sustain production for equipment options identified.
- provided information on the variable specifications of pellets based on feedstock referenced to current European CEN standards.
- gave indicative figures for energy balance of wood pellet production

Note: the way drying is accounted for is critical in terms of energy balance calculation as this is by far the most energy consuming process. Elements that will bear an influence on the energy balance are;

- the boundaries of the pellet making process, especially in the case where the feedstock is a by-product of another previous process,
- the method chosen; if based on mass, the energy input to dry a sawdust 'by-product' is exactly the same per kg as that to dry the main product. If carbon/energy is apportioned on the basis of value, as the value of a kg of kiln dried timber in furniture for example is much greater than the value per kg of the sawdust, the majority of the energy is assigned to the primary product, not the sawdust by-product.
- the amount of air drying is undertaken before any active kiln drying, as this can lead to dramatic decreases in drying costs and embodied energy.

Findings

- Manufacturing process

The number of manufacturing steps required is primarily dictated by the feedstock, and its form and condition on arrival at plant; possible steps are listed below in a roughly sequential order:

- Reception of raw material - unloading of transport vehicles
- Storage – bulk storage in controlled conditions
- Pre-processing (e.g. debarking, chipping, milling)
- Cleaning – removal of impurities such as stones or metal particles by sieving and magnetic separators
- Conveying – horizontal and vertical conveyors move raw materials within the plant
- Drying of feedstock - down to 10-15% moisture content[1] (MC)
- Milling/grinding –hammer mills reduce and homogenise particle size
- Conditioning – homogenised wood particles are heated by steam to aid pellet binding
- Pelletising – forcing through a die at high pressure and temperature to form the pellets and bind them together with softened lignin
- Cooling - allowing pellets to lose temperature and moisture, hardening and maintaining fuel quality.
- Pellet storage - to avoid moisture gain or contamination
- Bagging – preparation of pellets for onward transportation
- Loading – loading of transport vehicles (road, rail, ships)

- The cost of setting up a pellet production facility is again very much dependent on production scale and feedstock used. An estimate of €100 investment for each ton of pellets produced per year appears to be the best rule of thumb for most production situations. There can be high deviation from this estimate however and its relevance to small-scale manufacture is untested.

[1] Moisture content wet basis, defined as ratio of weight of water on overall weight of wet wood

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- Production costs are most influenced by feedstock procurement costs and drying requirements, potentially representing 70% of total pellet production costs. Small-scale (1000–2000 t/yr) manufacture was found to be at greater risk of uneconomic manufacture and had manufacturing costs up to 86% of standard scales (15,000+ t/yr, 7000 hours/yr).

- Energy balance for a number of manufacturing options was assessed using ratios of primary energy inputs (PEI) related to pellet net calorific values. These were found to vary between 1:3.2 and 1:6.7 (corresponding to an indicative net energy value of 3 to 4 MWh/t) and to be most dependent on the amount of drying required in manufacture.

- Indicative energy balance for typical pellet production scenarios are:

(kWh/t pellets)	Green SRC Chip	Green Woodchip	Sawdust from sawmilling	Sawdust from kiln-dried furniture production)
Feedstock	SRC woodchips Harvesting + 90 km transport 160	Virgin wood chips (small scale) 90	Sawdust from sawmilling Harvesting + 110 km transport 100	Sawdust from kiln dried wood Harvesting + 110 km transport 100
Drying	From 60% to 10% MC 1,240	From 55% to 10% MC 990	From 40% to 10% MC 500	From 55% to 12% MC 970
Milling	20	20	20	Secondary processing 100 km transport 30
Pelletising	100	100	100	100
Total energy input	**1,520**	**1,200**	**720**	**1,200**
Pellet net calorific value	4,800	4,800	4,800	4,800
Energy Balance	**3,280**	**3,600**	**4,080**	**3,600**

Conclusions and recommendations

- Pellet manufacture should generally be undertaken pursuing specific markets and after realistic comparison to other outlets or manufacturing alternatives for feedstock. UK experience also suggests that procuring machinery on a piecemeal basis compared to working with a supplier to provide a 'turnkey' facility may be a false economy, ultimately requiring more time and resources to set up and coordinate machinery.
- Production costs can be seen to be heavily correlated with production scale and facility utilisation. Common production scales of more than 20,000 tons of pellets produced per annum and over 7000 operating hours were identified, below which unit costs become considerably higher.
- Feedstock can come from many sources and consideration must be taken of how it will affect pellet quality and processing stages, rates and costs. Of particular importance are the cost, moisture content and particle size of feedstock.

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