

Forestry Commission Job Report 077 - Extended summary
Active woodchips drying trials - 2

Summary

Active drying of woodchips using a drying barn and hot air boiler was investigated. A trial with 20 tonnes (c. 60m3) of mixed species woodchips achieved a reduction in moisture content wet basis from 51.3% to 21% over four and a half days. The system used a 750kW hot air boiler coupled with a 30kW fan feeding warm air through a drying floor.

Material	Mixed species
Particle size distribution	P31.5
Weight of woodchips (t)	20
Volume of woodchips (m3)	c. 60
Duration (h)	101.5

In the case and conditions studied there appeared to be a good balance between the drying system and the amount and characteristics of the fuel being dried, allowing the woodchips to be heated throughout with minimal energy loss.

Although final moisture content was lower than target moisture content, the trends recorded in the trial of substantially negative energy balance and high drying costs would be valid in 'normal' business practice, and indicate that active drying should be limited to the unavoidable minimum.

Study description

Angus Biofuels uses a woodchips drier at their plant in Forfar to rapidly dry woodchips to target moisture content at time of peak demand.

The site consists of a covered barn with one open side, with a drying area divided by a wall into 2 drying bays of c. 50m2 each. The incoming hot air is blown under the drying floor, and a door allows the hot air to be directed to either of the drying bays. The 30kW drying fan and 750kW boiler are located in a different section of the barn, fully separated from the drying section by a wall.

Drying barn with visible drying front



Hot air boiler



Hot air pipe and drying fan



	Variables measured	How	Frequency
Ambient air	Temperature, relative humidity (RH)	Datalogger	10 minutes interval
Woodchips	Temperature	Dataloggers (6) in chips	10 minutes interval
	Particle size	Composite sample ¹ + test	Start of trial
	Moisture content (MC)	Composite sample ¹ + test	Start and end of trial
	Weight	Weighbridge	Start and end of trial
Boiler fuel	Moisture content, calorific value	Composite sample ¹ + test	Start of trial
	Weight of fuel used	Weighbridge	Start and end of trial (+ refills)
Drying air	Temperature, RH, air speed	Datalogger	10 minutes interval
Electricity	kWh consumption	Meter readings	Start and end of trial

Results

Energy balance data

	Unit	
Initial moisture content (net CV)	% (kWh/t)	51.3 (2,228)
Final moisture content (net CV)	% (kWh/t)	21.0 (4,076)
Final net calorific value	kWh/t	4,076
Total calorific gain	kWh	6,236
Total energy input	kWh	21,327
Total energy balance	kWh	-15,090
Energy balance per m ³ woodchips	kWh/m ³	-252
Energy balance per t woodchips at final moisture content	kWh/t	-1,211

Summary of active drying costs

	Unit	
Total cost	£	2,448
Unit cost per m ³ woodchips	£/m ³	41
Unit cost	£/t	196.5

- The boiler and drying fan delivered air warmer than ambient temperature by c. 9°C throughout the trial.
- Overall the moisture content achieved was lower than the standard target moisture content. This increased timelines, costs and energy input compared to a 'real' scenario, however the trends recorded remain valid.
- The air flow recorded, c. 35,000m³/h was consistent with the range observed or recommended in published trials.
- The temperature recorded on top of the pile of woodchips was slightly higher than ambient temperature, indicating that the entire height of the chips pile was heated through and that there was little energy loss. This is likely to be very variable however depending on weather conditions and woodchips characteristics.
- The temperature dataloggers in the woodchips clearly identified a 'drying front' from the bottom to the pile of the woodchips.
- The final moisture content of 21% is lower than the target moisture content of c.30%, and although the precise relationship of MC loss to time is not known, it can be assumed that in these trial conditions, the woodchips could be dried to target MC in about 3 days (c. 72 hours).
- Although the accuracy of calculations is affected by the use of assumptions and standard ratios, there is a clear indication that in the set-up studied here;
 - significant moisture content loss can be achieved over a period of several days, even with adverse weather conditions (high hygrometry and low temperatures),
 - the energy balance to dry chips to target moisture content (c. 30%) will be significantly negative, and
 - although the high cost of drying was compounded by the fact that the woodchips were dried to a lower MC than required, active drying will remain very costly in relation to the market price of wood chips.

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¹ As per (BS EN 14778-2011)