GUIDANCE DOCUMENT 1

WOODFUEL STANDARDS

FOREST FUELS

Forestry Commission England

South West of England Regional Development Agency

regensw sustainable energy agency

THE THREE DIFFERENT FUEL TYPES

When considering using a woodfuel boiler it is vital to fully understand the fuel it uses. Boilers use three types of woodfuel – pellet, woodchip or logs – and may be specific to one type of fuel, multi fuel or with modification capable of changing from one fuel type to another. For any boiler it is important not only to use the correct fuel, but also to know the correct specifications for that fuel. For this reason, recognised and consistent fuel standards are essential.

The successful and efficient operation of wood fuel boilers can be significantly affected by the quality of fuel provided. This Guidance Document aims to update readers on current fuel standards and highlight the problems encountered when fuel quality is compromised. It will also illustrate the importance of specifying the boiler type to the quality of fuel known to be available.

Automated log production using a low cost processor and mini tractor, with direct storage into and open barn for seasoning

LOG BOILERS

Firewood is a traditional source of energy for both heating and cooking in rural areas, where it has long been used on open fires or in log burners. Technology has moved on and modern wood-fired boilers can burn logs in an efficient, semi-automatic manner. Logs are widely available throughout the UK. They vary in length from 15cm to 50cm and are frequently split to dry them; ideally logs should be at around 25% moisture content or less when supplied. Logs can be produced using a chainsaw and splitting implement such as an axe, so there is no need to invest in specialist machinery.

Firewood logs are the form of woodfuel most suitable for self-production on a small scale. The raw material is often a by-product of farming, forestry, sawmilling and tree surgery activities and makes best use of low grade material.

PELLETS

Wood pellets are a compacted, high-density, cylindrical or spherical-shaped fuel. They are produced from sawdust, grinding dust, shavings, and bark or energy crops such as miscanthus and are manufactured by pressing the material through a pellet dye. This is a chokered tube which causes the temperature of the compressed material to rise as it is forced through the dye, so that the lignin bonds.

Pellets are predominantly 6mm in diameter, although pellets of 8mm, 25mm and greater do exist and are generally called briquettes. The length of pellets varies from 9mm to 30mm (though with briquettes significantly larger). They are produced from feedstock which has been previously dried to between 12 and 16% moisture content, which, often includes off cuts and residues from industries using kiln dried timber.

The finished pellet is dry (typically 7–12% moisture content), compressed and of a uniform size, allowing them to flow freely and making them easily stored and handled. They have a higher energy density than woodchip at around 10,800 to 12,600 kWh per cubic metres*. They occupy approximately three times the volume relative to oil for a given energy value and are suitable for both small and large scale combustion. The high energy density of pellets permits the use of relatively smaller storage space than that required for chip and consequently may present a solution where space is limited. They can also be delivered in bulk using tanker trucks into relatively low volume silos, typically, pneumatically via a hose that can be up to 30m long. They are also frequently sold in bags of various sizes, often of 10 to 15kg and up to 1 cubic metre "dumpy" bags.

Unlike chip, pellet is an internationally traded commodity and most pellets currently sold in the UK are imported from Ireland, Scandinavia and the Baltic States. Their large sawmilling and timber processing industries produce many hundreds of thousands tonnes of dry sawdust and other timber by-products perfect for pellet production. Availability of this material is a key factor to the economic production of pellets. In the UK we have less than a handful of sawmills operating at these scales. Many potential UK producers are looking to develop pellet production and in the South West Ecowoodfuels is the only pellet producer.

*Source Biomass Energy Centre

High quality finished pellet coming off the production line in readiness for bagging or bulk storage

WOODCHIPS

When many people think of woodchips they imagine the product from brushwood chippers, as used in tree surgery and arboriculture to reduce the volume of branchwood on a site. However, this is misleading as woodchip for fuel is prepared using specialist machinery which chips or crushes wood with the production of fuel chips as a specified end product. Woodchips for use in small heating boilers may be 1cm to 3cm in length, but chip size can be varied to suit the customer.

Chips may be produced from a wide variety of feedstocks including arboricultural arisings, sawmill residues, co-products from forestry, short rotation coppice such as willow, or clean recycled timber. All of these feedstocks have significant factors that may determine the quality of the finished woodfuel chip and therefore its suitability for different combustion processes and plant.

Moisture content is the most critical factor affecting energy density and this varies considerably depending on species at the time of chipping. At 30% moisture content the average energy value of woodchip is 880 kWh per cubic metre*.

Woodchips have a lower energy density than wood pellets and, for a given energy value, occupy approximately nine times the volume of oil. However, the relatively wide range of feedstock sources and the lack of requirement for high capital-cost specialist pelletising equipment, make woodchip potentially a more readily available and cost-effective fuel source.
The supply chain for woodchip is still developing and includes, specialist energy supply companies, the traditional forest and woodland management sector, tree surgeons, sawmills, wood processing companies and the waste and recycling industry.

*Source Biomass Energy Centre

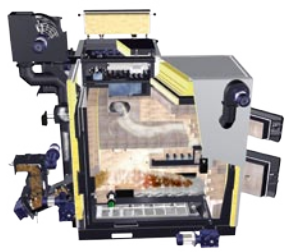
Large scale dry chip fuel store at distribution depot

SPECIFYING FUEL TO A BOILER'S REQUIREMENTS

Generally, woodfuel systems are specific to a fuel type – pellet, chip or log combustion – although some are hybrids and can burn more than one type. Most woodchip-fired systems can use wood pellets once adjusted to cope with a higher density woodfuel. However pellet systems cannot take woodchip. Some hybrid systems are available which can burn chips, pellets or logs (not at the same time) but they are generally less efficient.

The mechanical systems and combustion techniques used on any one boiler mean that it will run best on a fuel made to a specific standard. Log boilers are generally designed to run on a non-homogenous product whereas chip and pellet systems can be highly automated – running continually without regular intervention by automatically feeding fuel from a hopper or silo. These systems are designed with augers of a specific diameter and combustion chambers of a specific size, and must be fed with fuel of the exact specification.

Froling – FHG Turbo 3000 – Log boiler - 20 hour burn – up to 91.8% efficiency
Source Econergy



Froling Turbomat 320/500 – Conveyor grate permits through burning with high moisture content chip >35%
Source Econergy

LOG BOILERS

In addition to back boiler systems on traditional cast iron and Rayburn type stoves, there are now increasing numbers of highly sophisticated log boilers coming onto the UK market typically ranging from 20 to 70kW. The size of the logs are limited simply by the size of the boiler aperture and the firebox or cartridge capacity. As with all woodfuel, boiler efficiency is greatly dependant on the moisture content of the fuel, and logs should be at or below 25%. The main drawback of logs is their lack of uniformity, which prevents complete automation of wood-fired boilers. The closest log-fueled boilers come to automation is by burning a full combustion chamber, and capturing the heat in the form of hot water storage in an accumulator tank. The heating system then draws upon this hot water energy battery over time.

PELLETS

Typically, pellets are used at the two ends of the scale:

1. In domestic applications up to 100kW where storage is an issue and fuel consistency paramount
2. In power production where fuel is transported greater distances and therefore density becomes the primary concern.

Being dry, uniform and energy dense, the advantage of pellets over woodchip is that they "flow" easily and consequently are more suited to often smaller and more sophisticated storage and delivery mechanisms. Fuel problems arise from poorly manufactured pellets, which break up and turn to dust during storage and delivery. Contamination and poor pellet size control can also lead to difficulties.

WOODCHIPS

Automatic woodchip-fired boilers fall into two categories: those with fixed grates (for example underfed hearths) capable of taking low moisture content fuel (generally below 35%); or moving/step-grate boilers, capable of taking higher moisture content fuel (from 35% upwards). The upper limit is approximately 55% moisture content, about that of live timber.

This distinction is critical because high moisture content fuel fed into an underfed static hearth will fail to combust satisfactorily due to insufficient airflow around the material, and the auger fed mechanism will probably clog. The moving or step-grate in a high moisture content boiler cascades or moves the woodchips within the combustion chamber so that they dry within the boiler before charring, combusting and ashing.

When choosing the right fuel for a woodchip boiler it is also important to take into account the size and robustness of its extraction and auger mechanisms. These will dictate the size of the woodchips.

Larger, more robust extraction and auger mechanisms can take large, non-homogenous woodchips. Smaller boilers usually have smaller, more lightweight extraction and auger mechanisms – the smaller diameter of the auger means that these boilers must use woodchips of a more uniform and small size. If a significant quantity of oversized material is fed through such an in-feed mechanism it is likely to be blocked or damaged.

Woodchip-fired boilers generally range from 45kW up to several megawatts. The smaller ones use chips about 3cm^2; larger boilers use sizeable chunks of woody material greater than 15cm^2 – called hogwood fuel in the USA – which is relatively unrefined and unprocessed fuel with variable particle size and extreme oversized material.

EXISTING FUEL STANDARDS

USING RECOGNISED STANDARDS

The purpose of fuel standards is to identify key requirements and set parameters that boiler, chipper manufacturers and fuel suppliers can work to, and to provide the end user with confidence and a standard to which they should expect suppliers to conform. The key areas include particle size, moisture content, fuel density (pellet) and contamination.

The owner of a woodfuel boiler will be told by its installer the specification of fuel the boiler needs to run efficiently. This will cover details such as the type of fuel, particle size and moisture content. Most sets of standards also set out how such parameters are to be measured, sampling criteria and acceptable percentages of material outside the specified range. Standards enable the boiler user and their fuel supplier to communicate easily and precisely about which fuel is required.

Using recognised standards tells the user whether the fuel they are using is correct for their system. By complying with the standards the user should reduce problems with their boiler and can establish whether any they do experience result from the boiler itself, or from using fuel outside the ideal specifications.

Recognised fuel standards gives potential users of woodfuel boilers confidence in the emerging woodfuel industry. They can be assured that their woodfuel supplier can deliver material to a required specification and need not fear buying an unknown, unquantifiable or low quality product. If the woodfuel industry can adhere to a reasonable and uniform set of standards for its products, it will develop a professional and reliable image, which users will trust.

FIREWOOD

Although there is no accepted standard for firewood or logs in the UK, it is reasonable for consumers to expect suppliers to provide information about the product they supply. The lack of standards results largely from the dominance of the grey economy in the firewood supply sector. However, some businesses have developed standards, which cover the following areas:

- **Density of product**
  Most hardwood species are slower grown with a higher density and therefore of a greater calorific value per unit volume than softwoods, or faster-grown hardwood species such as poplar or willow.
- **Moisture content**
  Have the logs been seasoned for one or two years? Have they been stored under cover? For what period of time have they been split? The answers to these questions should indicate the degree of moisture content, from green, freshly-felled material at 55% moisture content down to two-year seasoned, split material with a moisture content of 20 to 25%
- **Size of material**
  Some indication of the size and diameter to which material has been cut and split helps the customer to ascertain whether the material can practically be burnt in their open fire or log burner.
- **Load size**
  One aspect of the firewood market which is continually criticised is the variability of a ‘load’. Firewood adverts tend to indicate that material is being sold by the load, or half load, or large load, or double load and this is an extremely unquantifiable volume measurement. It is, therefore helpful if a supplier gives some indication of the volume of material they are providing for a given price.

PELLETS

In countries with a more highly developed woodfuel industry such as Sweden, Austria and Germany, there are accepted classification systems for pellet woodfuels. These cover pellet size (diameter and length) and the ash content resulting from combustion of the fuel.

As all pellets are produced using kiln-dried compressed sawdust and bark the moisture content tends to range from 7% – 12%.

These classifications also include: the calorific value per kilogram, typically 4.7 – 4.9 kWh/kg; the density of the material; statements concerning the sulphur, nitrogen and chlorine content of the material and also whether any additives have been included in the pellet's manufacture (such as lignin or starch to aid binding of the pellet). Austrian standards cover both pellets for small-scale domestic boilers and briquettes for larger industrial applications.

In the UK, the classification for pellets currently covers only their diameter and length and the expected ash content as a percentage of fuel weight. It can be argued that these are the two most important factors: customers need to know whether the pellets' dimensions are suitable for their boiler and its in-feed mechanisms – especially important on small-scale pellet boilers, which have relatively precise requirements – and the ash production reveals whether the pellets are made from clean timber or bark.

There is a gradual move in the UK to adopt the European CEN 335 standards for solid biofuels, which covers pellets, briquettes and woodchips. This can specify, in addition to the parameters above, information on mechanical durability, density and calorific value. This should help prevent poor quality pellets which can be prone to crumbling to sawdust, causing fuel feed difficulties.

Both pellet and chip fuels range in colour from 'brown' to 'white' fuel, which can change dependant on the raw material used, its age and presence of additives. If the fuel contains bark it will still combust satisfactorily in the boiler but produces more ash, which may affect the boiler's operation.

AUSTRIAN ONORM STANDARDS – SPECIFICATIONS AND PROPERTIES FOR PELLETS

Size classification

Pellet designation	Maximum diameter	Maximum length
D06	6mm + or - 0.5 mm	33mm
D08	8mm + or - 0.5 mm	43mm
D10	10mm + or - 0.5 mm	52mm

Ash Content Classification

Pellet designation	Ash content as % of fuel weight	Ash content definition
1	< 1	Low
A2	> 2	High

Ref: ONORM M7 133 and DIN 66 165 specifications for woodchip fuel

DRAFT CEN STANDARDS – SPECIFICATIONS AND PROPERTIES FOR PELLETS

Normative Parameters

Dimensions (mm) Diameter (D) and Length (L)	
D06	≤ 6mm ± 0.5 mm and L ≤ 5 x Diameter
D08	≤ 8mm ± 0.5 mm and L ≤ 4 x Diameter
D10	≤ 10mm ± 0.5 mm and L ≤ 4 x Diameter
D12	≤ 12mm ± 1.0 mm and L ≤ 4 x Diameter
D25	≤ 25mm ± 1.0 mm and L ≤ 4 x Diameter

Moisture (w-% as received)		Ash (w-% of dry basis)	
M10	≤10%	A 0.7	≤ 0.7%
M15	≤15%	A 1.5	≤ 1.5%
M20	≤20%	A 3.0	≤ 3.0%
A 6.0	≤ 6.0%		
A 6.0+	≤ 6.0%[a]		

Sulphur S (w-% of dry basis) Sulphur is normative only for chemically treated biomass and if sulphur containing additives have been used		Nitrogen, N (w-% of dry basis) Nitrogen is normative only for chemically treated biomass	
S 0.05	≤ 0.05%	N 0.3	≤ 0.3%
S 0.08	≤ 0.08%	N 0.5	≤ 0.5%
S 0.10	≤ 0.10%	N 1.0	≤ 1.0%
S 0.20+	> 0.20%[a]	N 3.0	≤ 3.0%
		N 3.0+	> 3.0%[a]

Mechanical durability[b] (w-%) of pellets after testing		Amount of fines (w-%, <3.5mm) after production at factory gate	
DU 97.5	≤97.5%	F 1.0	≤ 1.0%
DU 95.0	≤95.0%	F 2.0	≤ 2.0%
DU 90.0	≤90.0%	F2.0+	> 2.0%[a]

Additives (w-% of pressing mass)
Type and content of pressing aids, slagging inhibitors or any or any other additives have to be stated

Informative Parameters

Net calorific value $q_{p,net,ar}$ (MJ/kg as received) or energy density, E_{ar} (kWh/m^3loose)	Recommended to be informed by retailer
Bulk density as received (kg/m^3loose)	Recommended to be stated if traded by volume basis
Chlorine, Cl (weight of dry basis, w-%) Cl 0.10 and Cl 0.10+ (if Cl > 0.10 % the actual value to be stated)	Recommended to be stated as a category Cl 0.03, Cl 0.07,

[a]Actual value to be stated.
[b]Maximum 20 w-% of the pellets may have a length of 7.5 x Diameter

Extracts derived from Solid biofuels – Fuel specifications and classes DD CENT/TS 14961:2005. British Standards can be obtained in PDF or hard copy formats from the BSI online shop: www.bsigroup.com/Shop or by contacting BSI Customer Services for hardcopies only: Tel: +44 (0)20 8996 9001, Email: cservices@bsigroup.com

Galvanised and tapered pellet fuel store and boiler

Pellet boiler with integrated fuel hopper

WOODCHIPS

Standards for woodchips are also generally more developed in countries with a longer history of biomass use. The UK's most commonly used standard is based on the Austrian system and covers four areas: particle size and extremes, moisture content, material density and ash content. Particle size relates to the area of the woodchip in square millimetres and ranges from a G30 small chip to a G150 large 'chunk' chip. The standard for moisture ranges from under 20% to a 40 to 50% moisture content, but it is generally accepted that all users need to know whether material is below 35% or above; 35% moisture being where the line is drawn between "wet fuel" and "dry fuel". There is, however, some combustion equipment that specifies even tighter requirements for moisture content, such as below 25%.

Moisture content is probably the single most important fuel factor determining energy efficiency. At 30% the energy value of loose chip is 880 kWh per cubic metre, the amount of energy derived increases per unit of measure as moisture content falls. Material density indicates the expected energy availability from the fuel – woodchip produced from low density softwood produces a lower energy output from a given volume than does high density chip produced from hardwood. The ash classification is the same as for pellets, as described above. Again, the European CEN 335 standards define categories of woodchips, sampling and testing criteria.

AUSTRIAN ONORM STANDARDS – SPECIFICATIONS AND PROPERTIES FOR WOODCHIP

Size Classification

Chip Designation	Maximum % Particulate Size				Maximum Extremes	
	<4%	<20%	60–100%	<20%	Area cm^2	Length cm
G30	<1mm	1–3mm	3–16mm	> 16mm	3	8.5
G50	<1mm	1–6mm	6–32mm	> 32mm	5	12
G100	<1mm	1–11mm	11–63mm	> 63mm	10	25
G120	<1mm	1–63mm	63–100mm	> 100mm	12	30
G150	<1mm	1–100mm	100–130mm	> 130mm	15	40

Moisture Content Classification

Chip Designation	Moisture content in % (wet basis)	MC Definition
W20	<20	Air dried
W30	20–30	Undercover store
W35	30–35	Limited undercover stored
W40	35–40	Wet
W50	40–50	Green

Material Density Classification

Chip Designation	Material Density in kg/m^3	Density Definition
S160	<160	Low
S200	160–250	Medium
S250	>250	High

Ash Content Classification

Chip Designation	Ash content as % of fuel weight	Ash Content definition
A1	<1	Low
A2	>1	High

Ref: ONORM M7 133 and DIN 66 165 specifications for woodchip fuel

DRAFT CEN STANDARDS – SPECIFICATIONS AND PROPERTIES FOR WOODCHIP

Normative Parameters

Dimensions (mm)[a]			
	Main Fraction > 80% of weight	Fine Fraction < 5%	Coarse fraction Max. length of particle,
P16	3.15mm ≤ P ≤ 16mm	< 1mm	max 1%a > 45mm, all < 85mm
P45	3.15mm ≤ P ≤ 45mm	< 1mm	max 1%a > 63mm
P63	3.15mm ≤ P ≤ 63mm	< 1mm	max 1%a > 100mm
P100	3.15mm ≤ P ≤ 100mm	< 1mm	max 1%a > 200mm

Moisture (w-% as received)			Ash (w-% of dry basis)	
M20	≤20%	Dried	A 0.7	≤ 0.7%
M30	≤30%	Suitable for storage	A 1.5	≤ 1.5%
M40	≤40%	Limited for storage	A 3.0	≤ 3.0%
M55	≤55%		A 6.0	≤ 6.0%
M65	≤65%		A 10.0	≤ 10.0%

Nitrogen, N (w-% of dry basis)		
N 0.5	≤ 0.5%	Nitrogen is normative only for chemically treated biomass
N 1.0	≤ 1.0%	
N 3.0	≤ 3.0%	
N 3.0+	> 3.0%[b]	

Informative Parameters

Net calorific value $q_{p,net,ar}$ (MJ/kg as received) or energy density, E_{ar} (kWh/m^{3}loose)	Recommended to be informed by retailer
Bulk density as received (kg/m^{3}loose)	Recommended to be stated if traded by volume basis in categories (BD200, BD300, BD450)
Chlorine, Cl (weight of dry basis, w-%)	Recommended to be stated as a category Cl 0.03, Cl 0.07, Cl 0.10 and Cl 0.10+ (if Cl > 0.1 % the actual value to be stated)

[a]The numerical values for dimension refer to the particle sizes passing through the mentioned round hole sieve size (3mm, 15mm, 16mm, 45mm, 63mm and 100mm). Dimensions of actual particles may differ from those values especially the length of the particle.

[b]Actual value to be stated.

Extracts derived from Solid biofuels – Fuel specifications and classes DD CENT/TS 14961:2005.
British Standards can be obtained in PDF or hard copy formats from the BSI online shop: www.bsigroup.com/Shop
or by contacting BSI Customer Services for hardcopies only: Tel: +44 (0)20 8996 9001, Email: cservices@bsigroup.com

FUEL CONTAMINATION AND POOR QUALITY FUEL

Oversize material causing blockage in feed auger

Wire contaminant in woodchip

PROBLEMS OF POOR FUEL QUALITY

Oversize material, weak pellet binding, contamination, incompatible particle size and moisture content are all issues of poor fuel quality, with consequent impacts on boiler efficiency and operation.

OVERSIZE MATERIAL

In both chip and pellet boilers oversize material, or the supply of an incompatible and larger specification of fuel, will lead to blockages in the fuel delivery systems and the automatic shut down of the boiler. At this point a manual intervention is required to unblock/free the fuel delivery system, which is both time consuming, frustrating and could potentially have serious consequences for the end user without an alternative backup boiler.

WEAK PELLET BINDING

Incomplete binding will lead to rapid degrade of pellets as they disintegrate during transportation and delivery. Fuels with high dust content are likely to lead to blockages with consequent impacts on boiler operation.

MOISTURE CONTENT

Excess moisture can reduce boiler efficiency, and over long periods degrade components of the boiler and inevitably exacerbate the problem of blockages in the fuel delivery system,

CONTAMINATION

It is critical that both woodchips and pellets be free from contaminants. Some contaminants such as stones or soil produce clinkering or physical wear inside the boiler or its feed mechanisms. Clinkering occurs when high temperatures cause the melt point of the ash to be passed, creating a glass like substance. Chemical contaminants may produce unacceptable flue emissions, and may cause wear to the boiler. Fuel must also remain “clean” in order to be classified as a fuel source: if not, its combustion is designated incineration of waste material.

Both wood-chips and wood-pellets must be free from the following contaminants

General contamination such as stones, metal, rubber, plastic and other unidentified foreign bodies.
Heavy metal compounds as a result of treatment eg Copperchrome Arsenate (CCA) (identified by green colour)
Halogenated organic compounds, eg lindane (identified by yellow colour)
Creosote (identified by dark brown stain and smell)
Painted wood, MDF, hardboard, fibreboard

Ref: ONORM M7 133 and DIN 66 165 specifications for woodchip fuel

DIRECT

- **Blockages** If chips and pellets exceed the specified moisture content, or chips include long slivers, they can cause substantial blockages in the in-feed mechanism for the boiler. Wet chips clog up augers and also combust poorly, if at all, in an underfed hearth. Wet pellets expand and break down into a pulpy material and rapidly block augers. When blockages occur due to poor fuel quality it is likely that the in-feed system and boiler will require cleaning and potentially the whole fuel store emptied and refilled. In extreme cases with very dusty fuels the auger may shear.
- **Smoking** Material with too high a moisture content for the boiler or with excessive compostable leafy material or needles can produce smoke or steam output even when the boiler is operating at capacity.
- **Ashing up** Excessive fines in woodchip can deposit a high level of ash inside the boiler and increase the risk of coating the heat exchangers, which reduces the efficiency of the boiler. Excessive twiggy, bark or leaf material can increase the ash output substantially from below 1% to above 2.5% by weight. Even with automatic de-ashing this can reduce the operational capability of the boiler and requires disposal.
- **Chemical damage** Contaminants, certain woody chemicals contained in bark and foliage, and also particularly straw and straw based pellets, can produce alkaline/acidic gases which corrode the internal surfaces of the boiler.
- **Physical damage** Stones and metal contaminants can excessively wear machinery during the chipping and processing stage. They can also cause wear inside the boiler and to its in-feed mechanisms.
- **Clinkering** Contamination of the fuel with slate, stone, soil, metal, glass or ceramics is likely to produce clinker, as illustrated in the photograph. This can cause a glass-like residue to build up on the grate of the boiler, preventing cooling of the metal grate by the primary air fan and causing the lifespan of the grate to be substantially shortened. Again, straw and straw based pellets including miscanthus are particularly prone to this as the ash has a lower melting point due to the high mineral content.
- **Boiler Efficiency** The use of poor quality fuel can reduce the efficiency of the boiler and cause operational problems. For example, condensation inside an underfed hearth boiler can block fuel in-feed sensors and pressure sensors so preventing efficient control of the boiler. Poor quality fuel may also invalidate the boiler's warranty from the manufacturer or installer. In a number of cases boiler suppliers and installers have either refused to commission boilers or invalidated warranties following the use of low-grade fuel below the specified standard of the boiler. The use of sub-standard fuel may also cause the boiler, even running at its optimal level, to be reclassified as an incinerator rather than a boiler due to unacceptable and illegal chemical or particle emissions.

INDIRECT

- **Loss of revenue to suppliers** A boiler fed poor quality fuel consumes a higher rate of fuel in order to compensate. It also reduces the revenue of woodfuel suppliers selling on an energy basis as they must provide an additional volume of fuel to compensate for the poor quality, with associated additional fuel production costs.
- **Breach of contract** Finally, poor quality fuel may cause breach of contract for a fuel supplier: assuming that the supply of fuel is under a fuel supply agreement or contract any divergence from the specified fuel quality may both erode client confidence and constitute a breach of contract.
- **Confidence** Issues with fuel quality undermine confidence in the biomass sector and provide a justification for decision makers nervous of this seemingly "unproven" technology.

Metal contamination and stones found in boiler system supplied from arboricultural arisings and recycled material

G30/P16 – W30 specification woodchip oversize material/shards

High level of dust in woodchip – very dry woodchip with dust has the potential to cause clinker due to high boiler temperatures unless regulated by exhaust gas recirculation

Clinker – glass like substance created as ash melts resulting in damage to the boiler grate

SOLVING THE PROBLEMS OF POOR FUEL QUALITY

Problems caused by poor fuel quality can be solved either by altering the specification of the boiler to compensate for poor fuel quality – a high cost solution – or by improving the fuel standard. A clear understanding of the fuel quality and availability prior to boiler selection should be an integral part of the decision making process.

BOILER SPECIFICATION

Boilers capable of burning pellet or chip – or indeed pellet, chip and log – are less fussy about fuel quality, so using these boilers can alleviate fuel quality problems. Another possibility on automatic boilers is to use larger, more robust augers and in-feed mechanisms which can deal with both a larger and a less uniform chip, with greater extremes of sizes.

If the budget and boiler size allows, using a moving or step grate permits the use of less uniform and higher moisture content fuel and is more capable of dealing with higher ash output. Automatic de-ashing and heat exchanger cleaning equipment inside a boiler can accommodate fuels with a greater proportion of fines, or fuel likely to produce high ash output. The addition of exhaust gas recirculation (EGR) can help alleviate quality issues, such as clinkering, inside the boiler, by regulating fuel chamber temperature.

FUEL QUALITY IMPROVEMENT

In summary, although retro-fit boiler and fuel handling adaptations may allow flexibility of fuel type, the simplest and cheapest option is to ensure the right fuel type is being provided for each boiler's specification. As fuel quality problems often arise from how the initial feedstock was processed, transported and stored, Guidance Documents 3, 4 and 5 will go into these areas in further detail.

This document is part of a series – other guidance documents available include Woodfuel Supply Contract Options, Woodfuel Processing, Woodfuel Storage and Woodfuel Distribution

Further Information

Biomass Energy Centre
www.biomassenergycentre.org.uk

British Standards Institute
www.bsi-global.com

The South West Woodfuel Advice Line
08450 74 06 74

The South West Woodshed
www.southwestwoodshed.co.uk

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Richards, G – CWAP
Riggett, D – Econergy
Treble, J – Treco
Barker, P – Bristol City Council
Owens, A – Wood Energy
Rickwood, D – Forest Fuels
Whatmore, S – Forest Fuels
Wilding, J – Clinton Renewables

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