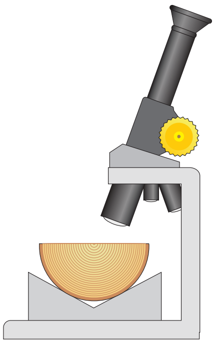
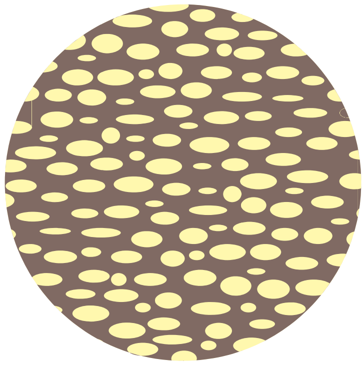
Wood Fuel for Log Boilers

The Fuel

The list of products that have been manufactured from wood including transparent film, quinine, turpentine, latex, tar, acetic acid, and of course paper, giving us the clue that the word "wood" does not begin to identify the hundreds of complex chemicals found in its structure. Fortunately, we are only interested in burning it, with the little added complication of wanting to do so cleanly and efficiently. This is made easier if we appreciate, that for burning, wood can be regarded as being made up of two distinctly different components, one that can be thought of as a sponge and the other, hard waxes that have been melted into it, then left to cool and solidify. When wood is heated these waxes soften and become a vapour. If the vapour cools after leaving the wood it will

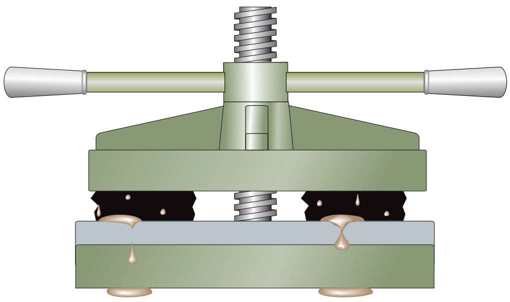


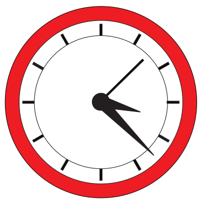


condense back into a nasty dark brown tar like substance that will deposit itself onto any surface it comes into contact with. If, instead of cooling, its temperature is raised sufficiently, all the unpleasant tar vapours will burst into flames and become gasses. Because of their behaviour, everything we described as having been poured into our sponge capable of becoming vapours are referred to as the volatile organic compounds, or more informally as V.O.C.s or simply as the "volatiles". These volatiles are a large variety of chemicals made up of the elements hydrogen and carbon bonded together, compounds which in turn are called hydrocarbons.

The sponge component remaining after removing all the volatiles is made up of the chemical carbon, not chemically attached to anything else, and because it never becomes a vapour or changes position before burning it is referred to as the "fixed carbon". This skeleton of the wood, will be recognised by every outdoor chef as charcoal, and he, or she, will also know that if it is of good quality with all the volatile matter removed, it is a wonderfully smoke free, long lasting, but visually unexciting fuel. The visual interest of a wood fire is provided by the display of flames given by the burning volatiles, but it is unfortunately these which are the source of tar staining smoke and virtually everything unpleasant about wood burning when burned incorrectly.

Charcoal is made commercially by heating wood hot enough to drive out the volatiles. A much slower way of treating wood to remove a proportion of its volatile content is to physically squeeze out the potentially volatile substances. This is not done commercially, but by nature burying it under several hundred tonnes of dirt and rock for several thousand years. This results in the wood being converted to coal, a fuel with a low proportion of volatiles and a high proportion of compressed fixed carbons, but it is only the proportions and not the content that differ between wood and coal. The finest coals are those that have been subjected to the highest pressures for the longest times.
If this process of compression continued for long enough the carbon becomes so pure that it eventually emerges





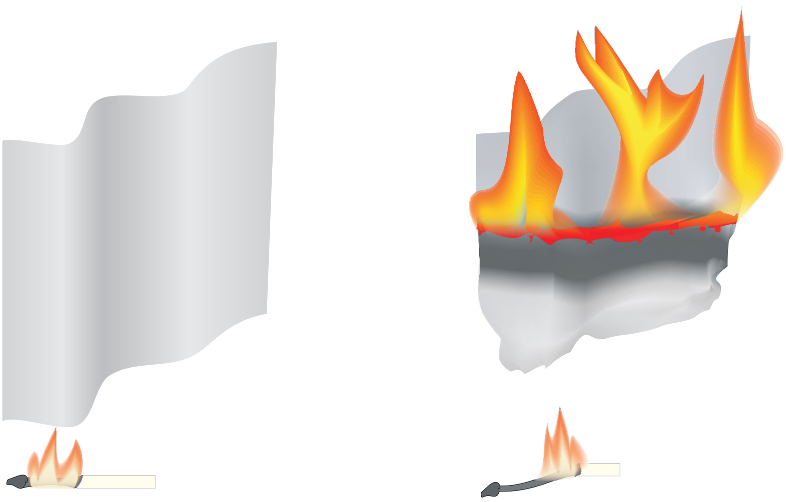
as a substance called diamond, the purest form of carbon. The HDG range of boilers were not designed to burn this form of carbon but advice and demonstrations can, at a special rate, be arranged.

The ratio of fixed carbon to volatile matter in coals like anthracite is so high that it is a naturally occurring "smokeless" fuel. Coals of higher volatile content can be processed to make them smokeless, by having much of their volatile content removed in a similar way to wood being converted to charcoal. Those old enough to remember a time before we were converted to natural gas will also remember the many "gas works". It was here that high volatile content coal was heated to extract the volatiles, which were purified into towns gas, with the remaining fixed carbon being called coke. The same process is utilized to produce coke as a source of carbon for the steel industry, with the gas produced being re-named as "coke oven gas".

Combustion

A fuel is a chemical which reacts with oxygen and gives out heat whilst doing so. We already know that wood and coal contain hydrogen and carbon. When heated sufficiently, and in air, they react by adding oxygen (oxidize) to themselves, with the carbon becoming carbon dioxide, CO_2 and the hydrogen becoming water, H_2O, or if you want to be smart, dihydrogen oxide. From this we know that all the burning volatiles which contain hydrogen will produce water, and if I add one last fact which is that it is the reacting carbon that causes the incandescence from both the fixed carbon and the carbon contained in the volatiles we will leave the chemistry for a while and look at what happens in a real fire.

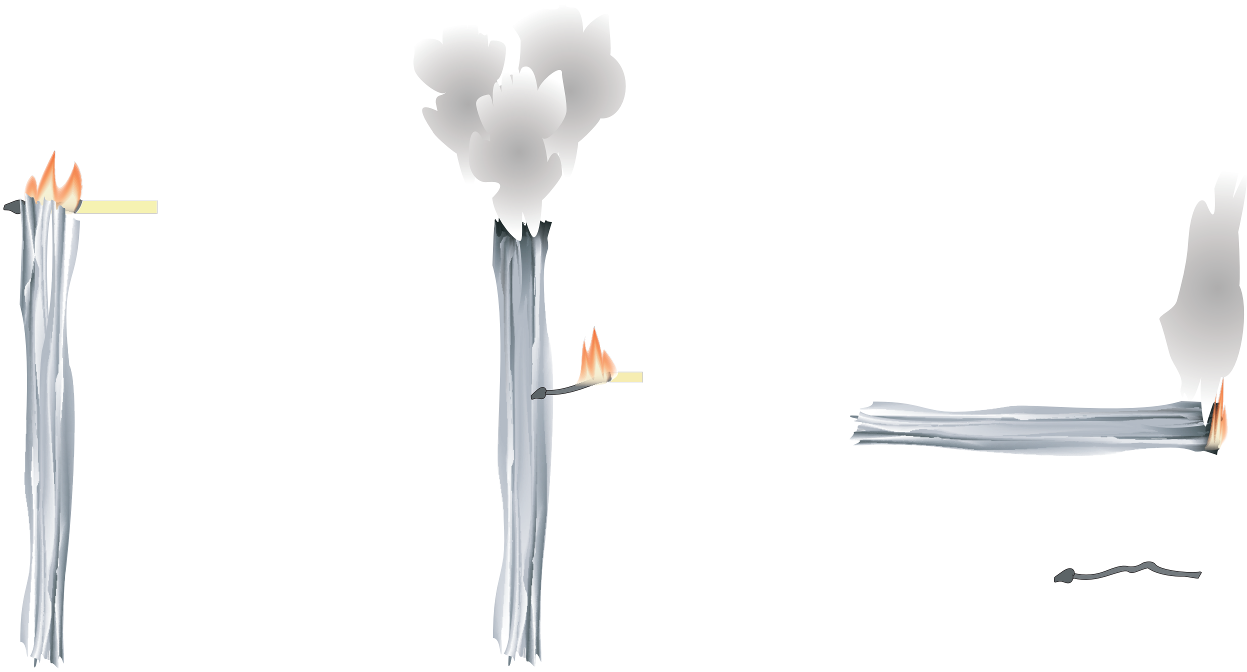
If a lighted match flame is placed under a piece of newspaper it would come as no surprise to anyone for the paper to begin burning. Useful to note is that newspaper is made from wood pulp, and although it may contain disagreeable editorial content it contains none of the smoothing and glossing agents that renders some paper almost fire resistant by making it impossible for air to reach the wood content.



When the match flame touches and heats the paper, the volatiles within the wood pulp are heated sufficiently to be driven out. The emerging volatiles are engulfed by the flame from the match and immediately reach their ignition temperature. This is the temperature necessary for the hydro-carbons in the volatiles to begin reacting with any available oxygen. Once ignited, the heat from outer edges of the flame maintain the temperature of any non burning volatiles until they are able to mix with enough air to react with. The colour, and length of the flame will depend on the heat of the reaction and the time taken for air to reach the heated volatiles. While this is going on, the flames at the bottom of the paper are passing upwards, heating the remaining paper and maintaining a supply of releasing volatiles until all have been exhausted.

Behind the line of flame travelling up the paper will be seen the twinkling red glow of the fixed carbon as it reacts with the oxygen, and behind this will be the line of whatever was in the wood pulp or used in the production of the paper that will not burn, which is the ash. Very little smoke, which is unburned carbon and hydrocarbons, will have been visible whilst the paper was burning because the volatiles were always above their ignition temperature and there was no restriction to the supply of oxygen. All the hydrogen would have been converted to water and the carbon into carbon dioxide. (The amount of water produced by the combustion of absolutely dry wood is just over half a pint for every pound weight of wood. If these measurements are incomprehensible to younger readers with a penchant for calculations, the conversion factors can be found on any one of several thousand web sites)

If identical paper to our previous experiment is screwed up tightly and a lighted match is used to ignite the top of the bundle it would not come as a surprise to see the paper burn dismally and extinguish unless turned to a horizontal position. However it is held it will burn with considerable smoke being produced from unburned volatiles.



The difference is that the paper is always being heated by the bottom of any flame, which is its coolest zone, rather than being engulfed by a complete flame, and so heating the paper to release its volatiles is only occurring, in a very small region. The paper burning at the perimeter of the bundle uses up oxygen before it reaches the core of the bundle and released volatiles have no air with which to react until clear of the outer flames, by which time they have cooled below their ignition temperature. Similarly the fixed carbons, although heated, have their air supply used by whatever volatiles are burning at the perimeter and will remain as charred paper. Turning the paper roll horizontally will make it easier for air to mix with releasing volatiles and put a hotter flame zone against the paper, but it will never have the unrestricted air supply of the flat paper.

With this experiment we have established that even for burning paper we need to ensure any volatiles are heated and maintained above their ignition temperature and need to have a plentiful supply of air; without either conditions the volatiles and carbon will not burn. As a boiler controls its burning rate by restricting the air supply to the fire we immediately have a problem. Loading a boiler with fuel, and restricting the air supply in order to achieve a small, but long lasting, fire is very similar to burning our tightly twisted paper. The outcome of cold and air starved vapours condensing back into tars to obscuring deposits on the heat exchanger and polluting the atmosphere is seeming to be inevitable.

Drying Wood

Wood needs to be stored for two reasons, firstly it would be impracticable to fell a tree whenever the boiler needed lighting and secondly, wood as a living plant, contained water which is the last thing we should be trying to burn. Storing wood to dry may be tedious but it costs nothing and you will be rewarded with a boiler that operates safely and more economically.

During combustion chemicals are broken apart and are reformed differently. The two prominent ones being formed are carbon dioxide, which is being formed constantly, and water, which is being formed when the volatile gasses are burning. This water is produced within the flame in the form of steam and within a properly running boiler and lined flue this should remain as a vapour until venting into the atmosphere and cause no problems. It will only become a problem when the boiler is run at a very low setting and the flue is allowed to cool, when the water vapour will condense on the flue walls. The HDG boilers are designed to burn off the volatiles first, when the boiler is operating normally and the temperature of the flue will be at its hottest, leaving the charcoal, which does not release water, to be used for at the end of the burning cycle.

No boiler has ever been designed to burn wet wood because burning wet wood is a waste of energy and potentially dangerous. The loss of energy when burning wet wood is usually given as the amount of heat needed to heat and boil off the water from the wood. Given that a loading of wet wood will contain a several kettles full of water, the energy lost will be all too apparent to anyone who has waited for a kettle to boil will realise that boiling a kettle dry would use a considerable amount of energy. Unfortunately, the energy used boiling off water is only the easily calculated heat loss, to make a quantitative prediction of the heat lost because of the affect the steam and water vapour has on the combustion of the volatiles is impossible.

Water is a far better conductor of heat than wood and so putting a wet log into a boiler cools both the space in which the volatiles are burning and the fire. Putting several wet logs into a boiler may reduce temperatures to the point were some of the volatiles' temperatures are reduced below their ignition temperature and extinguish.

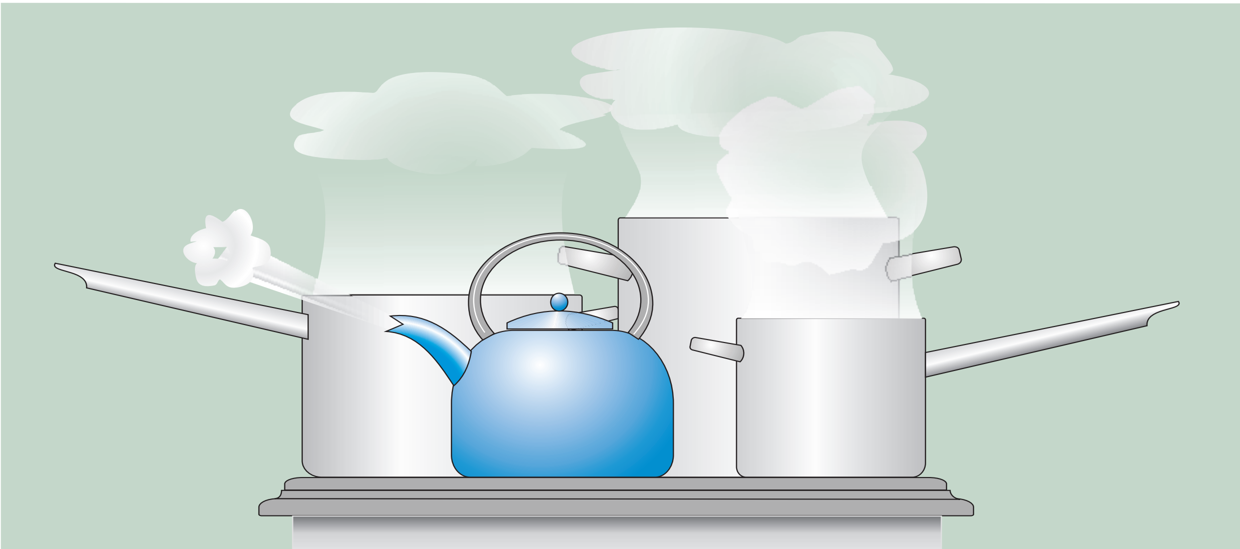
Water is such a good conductor of heat that it is possible to boil water in a paper bag over a flame because the water conducts heat away from the paper, keeping it below its ignition temperature.

Do not attempt to do this experiment yourself.

What happens to the wet log as it heats up is yet more wasted heat. As the outer layer of wood begins to warm it will begin to emit volatiles but behind the volatiles will be more steam and water vapour being driven from the wood. Water in a true vapour form, rather than a mist of water droplets, is water that is invisible, has expanded up to one and a half thousand times its original volume and contains no air. Not only will this be mixing with the volatiles to prevent them reaching ignition temperature it will also prevent air from being able to mix with them if they are heated sufficiently elsewhere in the boiler. The heat loss of these supplementary effects of water on the combustion will vary and are incalculable but they are significant.

Because the boiler is being cooled with water it will take hours to reach its operating temperature and will allow some of the unburned volatiles to condense back onto the boiler's surface as a dark brown tar. Those unburned volatiles that escape both the boiler and the flue will do so as smoke. Almost all smoke is visible proof that the boiler is allowing fuel to escape and provides you with a simple guide as to how well you are operating the boiler. You might argue that if it is cold enough to have lit the boiler it is too cold to stand outside watching the chimney pot for the sake of a little efficiency but it is not just efficiency, it is your ecological responsibility to make the best use of natural resources and not be a cause of pollution.

Having discussed efficiency we move on to the safety aspects of burning wet wood. If you were to boil pans of water on the boiler top you would expect to find the room becoming very damp and by burning wet wood the flue will become similarly wet, allowing undesirable conditions to develop. Firstly the gasses entering the flue are cooler than they should be and because the temperature difference between the flue way and outside air is reduced the flue gasses will travel slower causing an already struggling boiler to be operating with reduced draught.



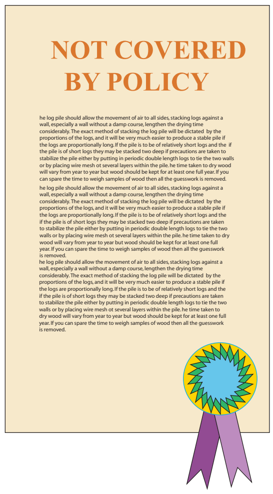
Water weighs more than air but water vapour is invisible and weighs less than air. Water vapour cools to become fine water droplets, which is the mist seen above a boiling saucepan.

Secondly the moisture in the cool flue gasses will readily condense onto the wall of the flue. If the flue is of an impervious material the liquid will run down and form puddles of water in the base of the flue or fall back into the boiler. It is important to understand that this moisture is not simply water it contains tars and acidic substances which the cooling water has prevented from being broken down during combustion. These acids will eat away mortar if the chimney is of brick construction and erode even a stainless steel lined flue, allowing acid to reach the chimney. Not only does the acid destroy the mortar to weaken the structure but it carries with it combustible tars deeply into the brickwork. At best it will eventually appear as tar staining on the outer walls or worse it will make the chimney unstable.

Evidence of this is sometimes seen on old houses in the parts of outer walls that formed part of the chimney wall, where the mortar is stained and has virtually disintegrated These were the chimneys of range cookers, very efficient for their day but because of their efficiency had cooler flue gasses than had been allowed for when the house was built. It shows so well on the outer wall because this would have spent much of its time being cold and wet, increasing the formation of condensate further.

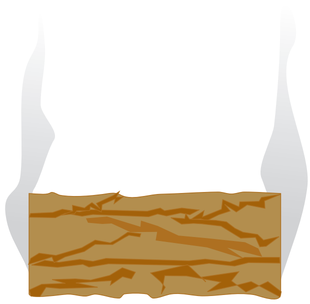
You might consider the gentle ageing of chimneys as a poetic accompaniment to wood burning but you should now consider the other outcome of tar in the flue which is that it will eventually ignite.

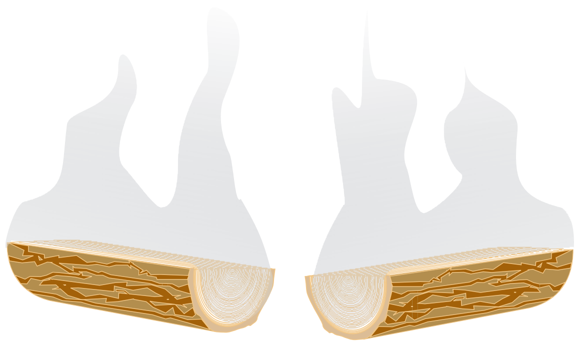
The result of any chimney fire can be catastrophic, but if the crevices between the bricks have been eroded and are full of burning tar it will be difficult to extinguish before bricks have become loosened. You will not have had time to prepare for the fire brigade who have little option but to pour many gallons of water into the flue, and that mixed with the tar, spread by busy fireman's boots will result in a smell and sight that is beyond your wildest imagination. Even the extinguishing of the fire will cause further damage to the chimney because the sudden cooling of the already damaged brickwork will inevitably cause serious structural damage needing immediate and costly repair work. Your house insurance policy may also bring a final unpleasant surprise. Many of them have clauses about ensuring that chimneys are periodically inspected and swept to prevent fires and unless you have a recent receipt from a registered chimney sweep you might find standing alongside a burned out chimney is not the ideal position to be in when attempting to convince the insurance agent of your diligence. If you were unconvinced as to the benefits of drying wood before the fire, by the time you have finished the legal wrangling with the insurance company, lived in lodgings while the house was cleaned, the chimney rebuilt and you have chosen new furniture, your existing supply of wood, if it was stored properly will be dry enough for you to see how much better it burns immediately you re-light the boiler.



Wood takes a considerable time to dry in the British Isles because the atmosphere has a high humidity, but the time will be considerably shortened if the wood is cut and stored correctly. The logs should always be split to break open the layers of growth rings and the waterproof bark, if they are left "round" the growth rings and bark act as concentric tubes, open only at the two ends through which the moisture can escape. Splitting the logs will also make it far easier and safer to stack the wood because the logs will not roll.

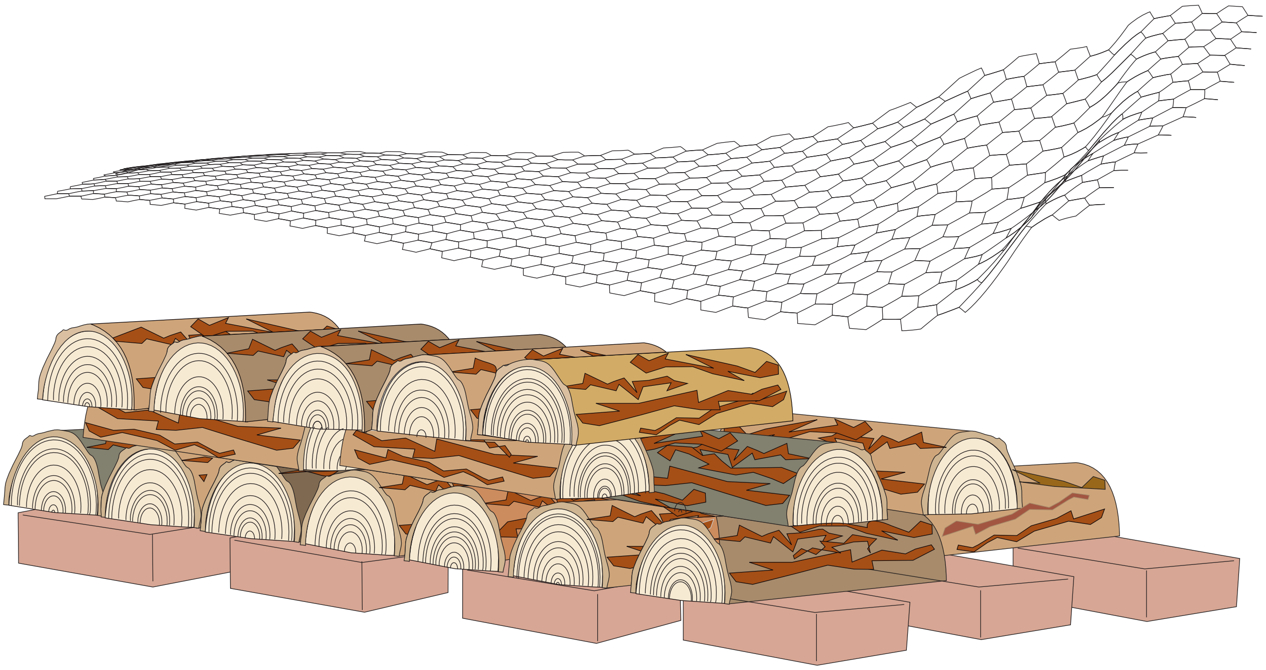
Having cut the logs to length and split them a suitable storage area should be found. Whilst the log pile should be

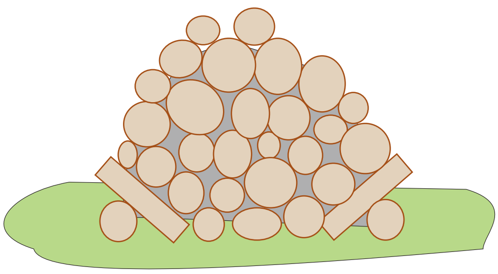


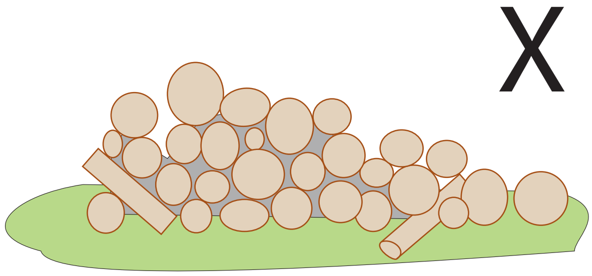


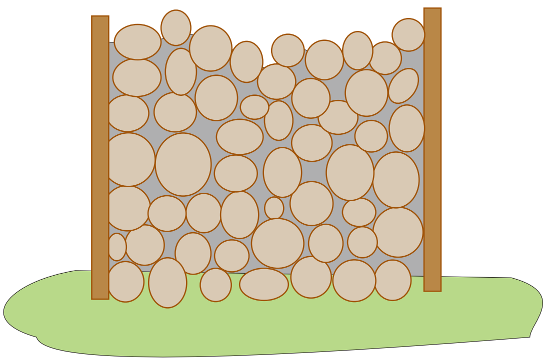
reasonably close to the boiler house, the practice of putting several years of wood supply into a barn attached to the house is something that should be avoided. Apart from the obvious risk to your family in the event of a fire, your insurance policy may take the view that wood piles on a bed of axed wood chippings adjacent to the house is not what they consider to be taking due precautions to the safeguarding of your home against fire. If the wood is cut anywhere but the open, all chippings and sawdust should be removed. It is perfectly acceptable to make log piles in the open if air circulation is allowed for under the stack, the logs are placed split edge downwards and the pile top has a water proof cover.

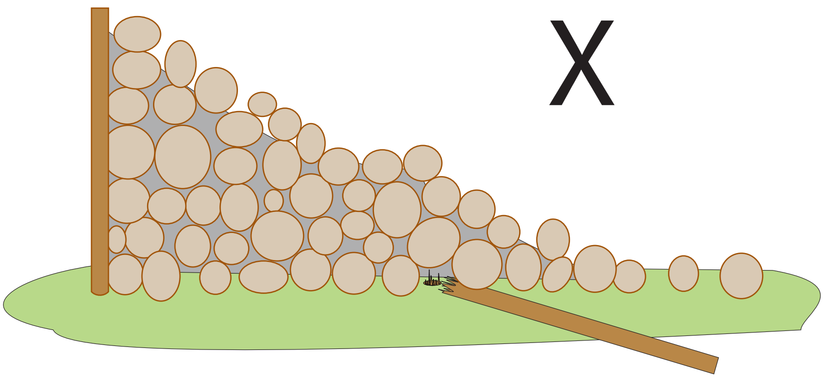
The log pile must be built to be stable and safe for anyone to remove wood from it; a wood pile ten feet high may look impressive but its collapse onto an eager little helper is something that may never be forgotten or forgiven. To prevent the wood absorbing moisture from the ground the pile should be supported on bricks or concrete blocks with spacing between them for ventilation. Logs do not come in uniform shapes to allow brick wall precision positioning, but they should be stacked with the logs at right angles to the previous layer to help stabilize the pile. If necessary further stability can be obtained by putting periodic layers of "chicken wire" within the pile, this will also curtail the nasty habit some people have of removing wood from the end of the pile nearest the door rather than methodically, always from the top. The practice of placing logs between stakes driven into the ground, or ramping the bottom end logs may look simpler, but its safety relies on nothing rotting or being disturbed



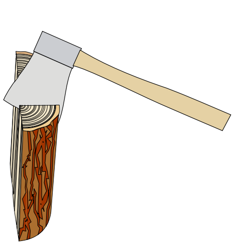




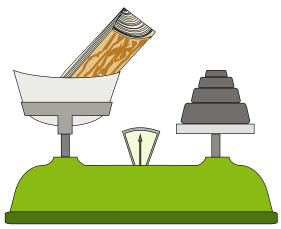


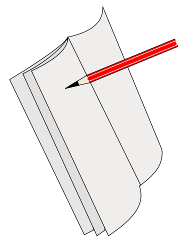


It is possible to purchase instruments which measure the moisture content of wood, by measuring the electrical conductivity between two electrodes pushed into the wood. In experienced hands these instruments can give very reliable and accurate moisture content values, but in inexperienced hands or if used only for a few minutes every week they may give readings that can be misinterpreted. The conductivity of differing woods vary and the more accurate meters require the wood species to be identified before making measurements and because the accuracy of the reading is dependent upon the measuring depth to which the probes are inserted it may be considered more trouble than it is worth. Another, if more protracted method, is to mark and then weigh several typical pieces of wood and by periodically re-weighing these pieces the loss of weight as the water evaporates. Another, more exacting, method is to weigh several typical pieces of wood, place them in a an oven at a temperature just above 100 degrees C for twenty four hours and re-weigh it to find the weight of water in the wood. Do not be tempted to dry the wood at a higher temperature as lost volatiles and charring will give false results. If a suitable oven is not available a warming draw or airing cupboard can be used, re-weighing the wood periodically until no further weight loss is measured. The weight loss which will give you the weight of water within the wood and enable you to calculate the percentage of water in the wood from which the samples were taken. Obviously the smaller the pieces of wood used the faster it dries, but the less reliably it represents the state of the larger logs.

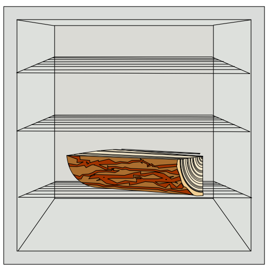


Split log into a manageable size.

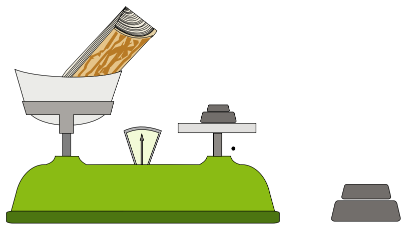




Weigh and record the log's weight.



Dry log in a warm oven (105 C) until no further weight loss can be measured.



The weight diference will be the weight of water in the log when split.

Various organizations give minimum percentages of water it is possible to achieve but many of these figures are based on atmospheric conditions found in other parts of the world. The final result will depend on many factors, including weather conditions which change from year to year, the area you live, the place and way in which the wood is stored and the species of wood you are drying. Pine cut in the winter and stored in ideal condition during a long hot summer may be as dry as it will ever be by the following winter, but oak, felled in the summer, stored during typical British summer may be better thought of as a maturing asset to mention in your will.

Wood Consumption

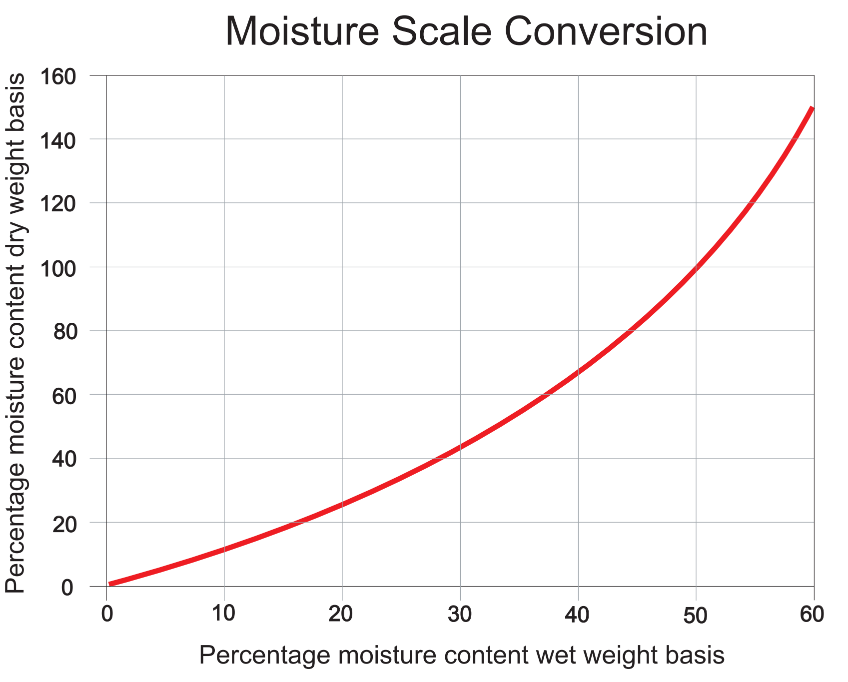
If you have ever read more than one of the many documents produced detailing the differing amounts of heat available from different species of wood you will have noticed that their results seldom concur. This is not because they are wrong but with trees such as oak extending to over two hundred species it is virtually impossible to find identical wood, and indeed even wood from the same tree will vary, depending on it having come from the trunk, branch or their junction, it can become even more confusing when woods are defined as being hard or soft wood.

The use of the terms soft and hard wood are often misused. Hard woods belong to a group of species known as dicots (plants that have two seed leaves, true leaves with netted venation, and form a vascular cambium). Commonly, all broadleaf trees that lose their leaves during the winter are classified as hard woods. Soft woods are conifers (pine and fir trees, for example). These two kinds of woods have basic structural differences, but the terms hardwood and soft wood are not accurate expressions of the density or hardness of the wood. For example, balsa, a tropical hardwood, is one of the lightest and softest woods, while hemlock, a conifer, produces wood that is harder than some hardwood species.

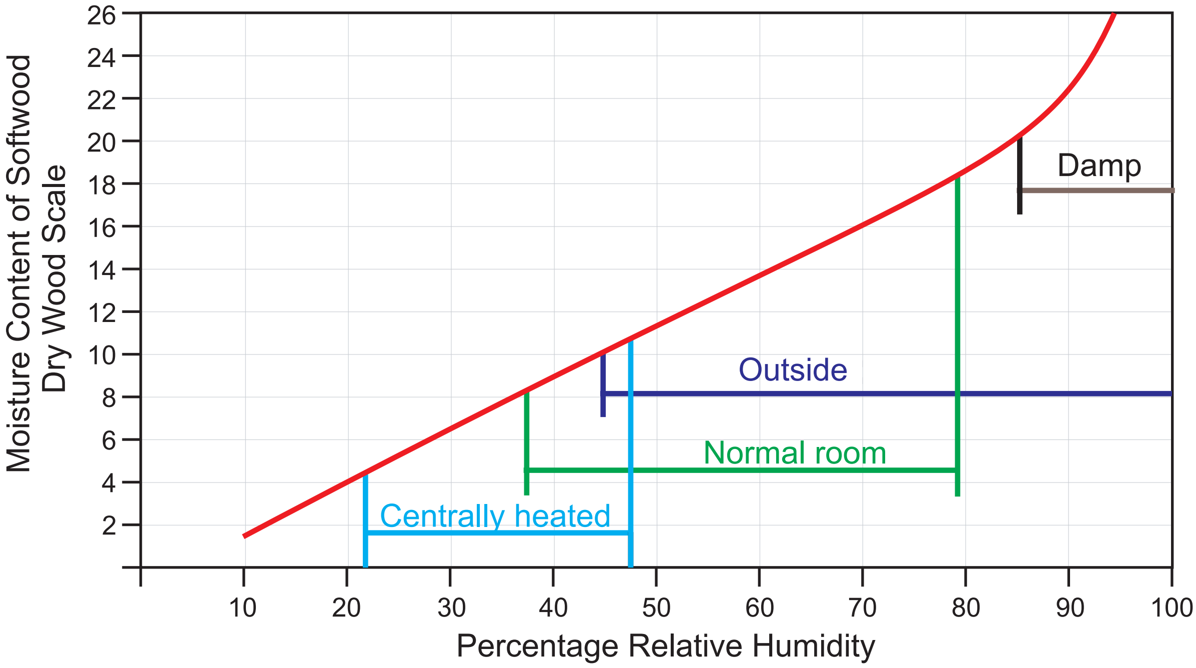
There are heat output differences between hard and soft woods, although you will find very few woods with calorific values based on weight not within 10% of each other, but these are of less importance than the way in which they burn. Soft open structured woods tend to burn much faster than dense structured woods and so make better choice if a rapidly developing high output fire is needed, hard woods should always be chosen if the boiler is to be operated continuously. If you have the storage facilities, utilize the wood's burning characteristics, to fine tune your boiler to meet your requirements. By burning soft wood to develop a fire rapidly, followed by loadings of hard wood to give steady, continuous burning,

Far more important than the differences between the potential heat from differing woods is the amount of water in the wood. This is referred to as the Moisture Content and is measured by two systems Dry Basis and Wet Basis. The Dry Basis gives the weight of water compared with the weight of the wood when dry, and can result in a figure above 100%, Wet Basis gives the proportion of the wet wood's weight that is water, which will always be below 100%.

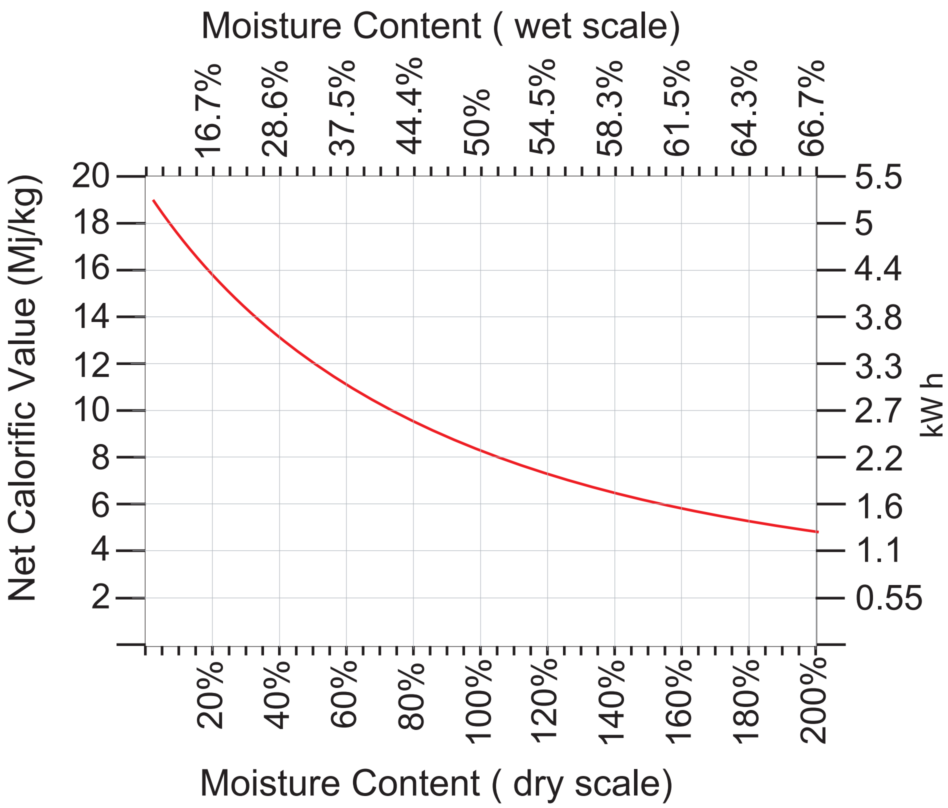
As a growing tree, wood will contain a great deal of water and the term "seasoning" is used to describe wood being left for this water to evaporate. How fast and how much of this water will evaporate will depend upon the wood being protected from rain, access to air flow, the size of individual pieces, whether the wood's diameter has been split, the density of the wood and the relative humidity of the atmosphere. It is therefore of little interest how long a supply of wood has been seasoned but rather how well the wood was prepared and the conditions under which it was stored.



The chart below illustrates the relative humidity that can be expected in the United Kingdom, and whilst the chart is accurate, its interpretation needs to be done with caution. Drying wood is not an irreversible process and whatever moisture is lost after several dry days will be replaced after several wet days. The relative humidity falls during the summer months when you have no desire to burn wood and it increases with the rain and low temperatures of winter when the wood begins to regain the moisture it lost during the Summer. Putting wood in a warm room will give the impression of drying quite rapidly because it will feel dry to the touch but the inner layers will take considerably longer to dry.

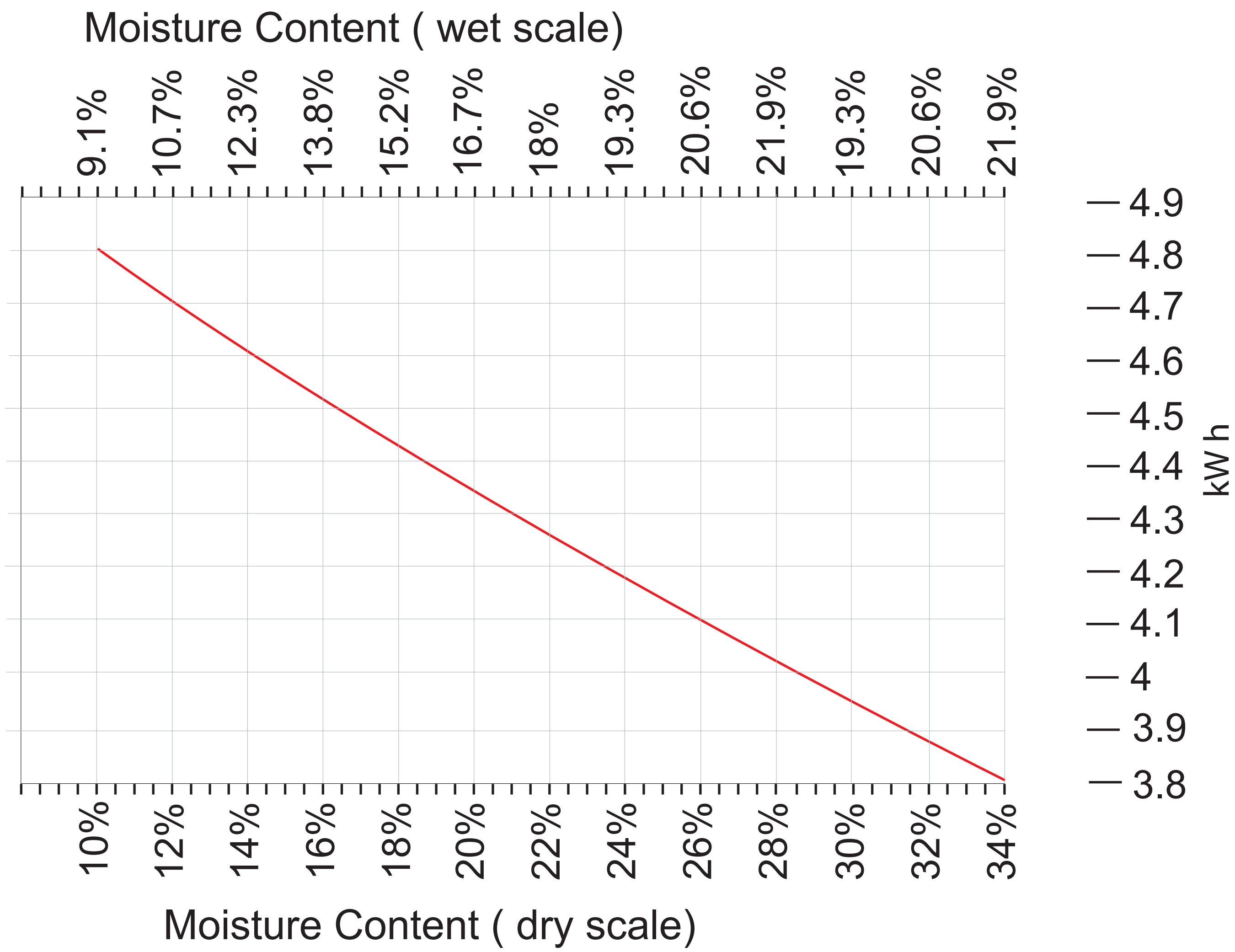


The theoretical maximum heat obtainable from wood containing absolutely no moisture is 5.5 kW/h, per kg., If the wood contains 40% moisture (Dry Scale) the heat output figure falls to 3.6 kW/h per kg. You are unlikely to achieve a moisture content below 20% (Dry scale) in the U.K. because wood that has dried below this during a dry summer will begin absorbing moisture from the atmosphere during winter, but this will give you almost 4.5 kW/h per kg. What should be a very sobering thought is that wet or freshly cut wood will produce less than 1.0 kW/h per kg, assuming you can manage to light it.

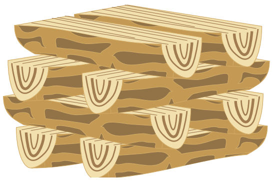


Wet vs Dry

Wet Basis		Dry Basis	
$MC_w = \frac{\text{mass of water}}{\text{mass of wet wood}}$		$MC_d = \frac{\text{mass of water}}{\text{mass of dry wood}}$	
10%			11%
20%			25%
40%			67%
50%			100%
$MC_w = \frac{MC_d}{1 + MC_d}$			$MC_d = \frac{MC_w}{1 + MC_w}$

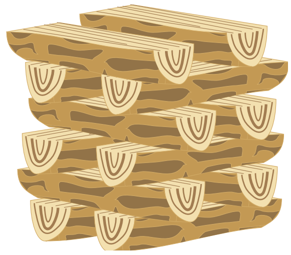


Below is a pictorial impression of what these figures represent in logs, logs that you have to pay for and carry. These figures represent only the heat lost because the burning wood will be used to boil and vaporize the water



DRY WOOD

20% MC



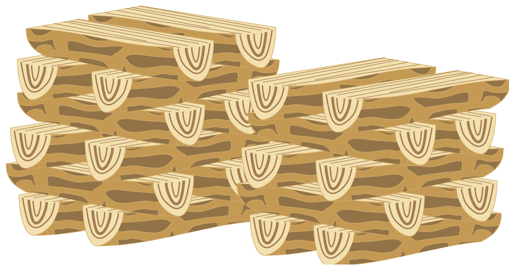
40% MC

Comparison of Fuel Needed to Produce Equivalent Heat Dry Scale

in the wood not burning. This makes the assumption that the water has no affect upon the way in which the wood burns, but the water vapour will hold some of the releasing gasses below their ignition temperature and the gasses will escape unburned, allowing much of the potential heat to be wasted. It would be impossible to estimate the loss of heat this would cause and it would be likely that the variations possible in any practical experiments would result in wildly differing results, but it would certainly make the previous chart a very conservative estimate of lost heat.

It is not only the moisture content of wood that has a dramatic effect on the ease, cleanliness and running costs of wood burning. The design of the appliance and the way it is operated will also depend upon the efficiency of the wood burning. Your HDG boiler is capable of operating with an efficiency above 90% whilst some boilers will struggle to reach 50%. The differences in running your boiler with wood as dry as can be expected in the UK compared with wood not fit for burning in a poor quality boiler is shown below.
The figures given for heat lost are theoretical and based upon having to boil away the water content. They do not

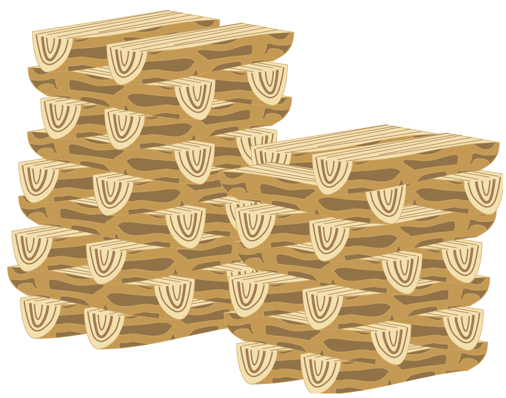
HDG boiler burning 20% MC dry scale wood at 90% efficiency



Another boiler burning 60% MC dry scale wood at 50% efficiency

take into account the resultant poor combustion. The final illustration represents something nearer to a reality of wet wood, poor combustion and failure to follow the operating procedure detailed by the manufacturer.
The pile of wood on the right not only represents a colossal waste of money and labour it should be remembered

Boiler burning 20% MC wood
at 90% efficiency
Operated correctly



Poor wood.
Bad boiler
Incorrectly operated

that all wood not converted to heat is deposited as soot and tar. Burn the driest wood you possibly can, make sure your boiler is a HDG boiler and follow the operating instructions to the letter.

On Using a Moisture Meter

If you are contemplating the purchase of a moisture meter with the idea that it will enable you to periodically go out to your wood store, or the wood merchants lorry, and pronounce the wood's exact moisture content in seconds, you have to have to rethink. A moisture meter is a convenient and simple method of assessing the water content of wood but it should be regarded as a means of producing a reliable approximation rather than an absolute figure, but used correctly it will give you a good idea as to the state of your wood simply and rapidly.

How it Works

The meters have two metal pins which are pushed into the wood, and the meter measures the electrical resistance between these pins. If the wood is fresh and still full of sap the electrical resistance will be low, as the sap dries out the electrical conductivity of the wood falls and the resistance rises and the meter will give a moisture content corresponding to this resistance value. As with all things sounding so simple there are a multitude of uncertainties that may add up to make readings inaccurate.

What it Will Not Do

Unless you purchase a very expensive meter it will not be accurate at either the very dry or wet ends of its readings, but it will be more than adequately accurate for the moisture levels associated with wood burning. It is important to know that sap and water do not conduct electricity identically so the meter will not give similar readings for wood with a similar water content if one piece is still drying and the other has been fully seasoned but allowed to become wet with rain. Differing wood species also give differing conductivities so unless your meter has differing scales for different wood and you have the ability to identify the wood, the meter readings may have inaccuracies. If I throw in that the temperature of the wood will also affect the readings you might have begun to doubt that a meter will have any practical value. However these variations are generally small and what you are looking for is a guide to the woods moisture.

What it Will Do

With a little thought the meter will allow you to compare new deliveries of wood and the drying progress of older woods within seconds.

The Technique

Always read the instructions that come with the meter, some are better than others but all are worth the benefit of the doubt. Always split open the wood immediately before testing it as this will allow you to measure both the dryer outer surfaces and the wetter core of the log. Ignore any readings taken which may be affected by the bark. Always put the pins to measure across the grain, never with the grain or into the log end, and where the meter instructions do not give a specific depth to which the pins should be pushed , try to be as consistent as possible, pushing the pins in too far which will eventually result in them being damaged. It is more important that you know the meter reading of wood that burns well rather than worrying about trying to establish an exact moisture content.

Wood of 20% moisture dry scale is the ideal but wood with slightly higher moisture levels is acceptable, although needing proportionately more effort to burn. To many, a moisture meter purchased as a luxury has become a vital tool for successful wood burning.

Euroheat offer a Wood Moisture Meter, ask your Euroheat retailer or visit www.euroheat.co.uk

Wood Log Sizes

HDG SL

HDG Bavaria recommends split logs in lengths of 300 mm (11 1/2"), with a maximum edge length of 120 mm (4 3/4") and a residual moisture content of 20 % dry scale.

HDG Navora & Euro

HDG Bavaria recommends split logs in lengths of 500 mm (19"), with a maximum edge length of 120 mm (4 3/4") and a residual moisture content of 20 % dry scale.

HDG Turbotec

HDG Bavaria recommends split logs in lengths of 1000 mm (39"), with a maximum edge length of 120 mm (4 3/4") and a residual moisture content of 20 % dry scale.

Log Storage

1 srm = 1 m3 of poured wood (loose)
1 rm = 1 m3 stacked split wood (stere)
1 fm = 1 solid metre of wood (without gaps)

Logs stacked @20%MC dry weight = 300-550 kg/m^3

Calorific values and kg per litre

@20% Moisture dry scale

Wood Type	kWh/kg	kg/litre
Spruce	4.67	0.43
Beech	4.13	0.75
Pine	4.50	0.53
Fir	4.62	0.41
Oak	4.33	0.68
Ash	4.21	0.67

(x1000 kg/m^3)

Summary

Always burn dry wood. Burning wet wood is damaging to the atmosphere, your boiler and flue. The resultant tars in the flue will restrict its performance and become a fire hazard.

Never burn painted wood or wood that has been chemically treated in any way. Never burn any of the wood products made from wood particles such as chipboard or MDF. Never burn plastics or refuse.

Have the flue swept regularly.

Follow the service schedule for the boiler to maintain high efficiencies.

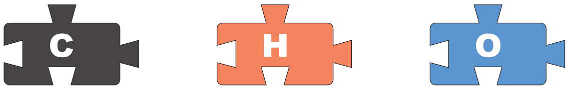
Euroheat and HDG have a policy of continual research and development for their products and they reserve the right to modify any appliances without prior notice.

Whilst every effort is made to ensure that the information provided in this document is correct and accurate at the time of printing, any future product changes may cause some details to become inaccurate. For the latest editions of all our documentation please visit our web site at:- **www.euroheat.co.uk.**

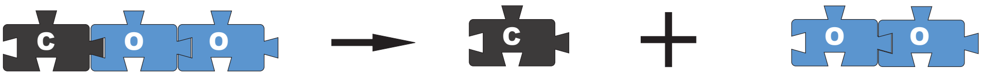
We would welcome any suggestions for information this, or any other documentation , has omitted that you feel would be useful to yourself or others.

Wood, an Environmentally Friendly, Renewable Fuel.

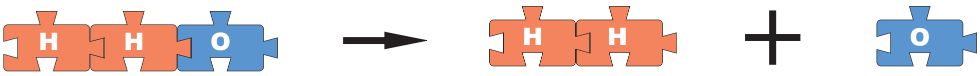
It is not necessary to be a chemist to understand the basics of wood combustion because it only concerns three of natures building blocks, “carbon”, “oxygen” and “hydrogen” which, while growing, the tree uses to combine in specific forms for its structure, and which combustion breaks down to their original form.



During growth a tree absorbs carbon dioxide, which is one carbon brick linked to two oxygen bricks, from the atmosphere.

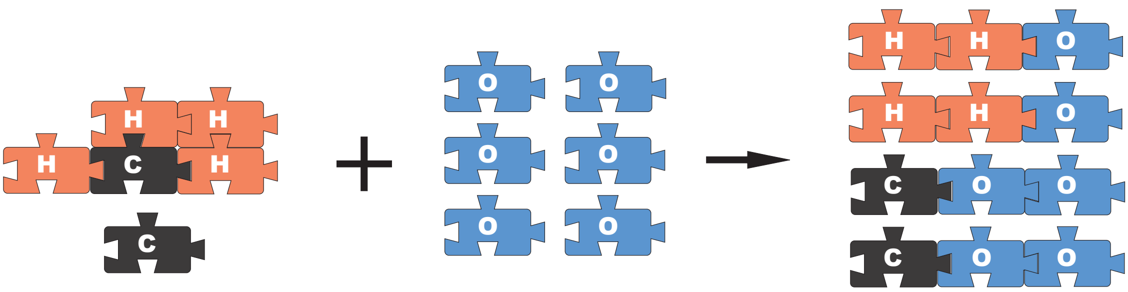


The tree breaks the bricks apart, puts the oxygen back into the atmosphere and retains the carbon. The tree absorbs water, which is two hydrogen bricks linked to one oxygen brick, and the bricks are broken apart with the hydrogen brick being retained and the oxygen bricks returned to the atmosphere.



The tree joins chains of carbon bricks to form the “skeleton” of wood and for combustion is referred to as the fixed carbon. It joins hydrogen and carbon bricks to form the hydrocarbons, the complex filling and padding of the skeleton, and these hydrocarbons are referred to as the volatiles

Having formed our wood the vital ingredient necessary for its combustion is the oxygen the tree discarded into the atmosphere, because combustion is simply knocking apart the structures of bricks made by the tree and putting back the oxygen bricks to form the original groups which were water and carbon dioxide.



Burning wood is simply reversing the actions of the tree growth with the heat released being the energy originally put into the tree by the sun. Perhaps with the trend towards new descriptions of everything we should refer to trees as the original solar heating battery, with the added bonus of being self-constructing, and re-generating, and then their use as a fuel might then be given the respect it deserves.