

HANDBOOK

BURNING WOOD
IN A HOTTUB STOVE WITH AN
ABCAT[®] HOTTUB
IN THE CHIMNEY

Your dealer:

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1 FUEL

1.1 Suitable / unsuitable

Suitable fuel for use in a wood stove without or with ABCAT® HOTTUB are:

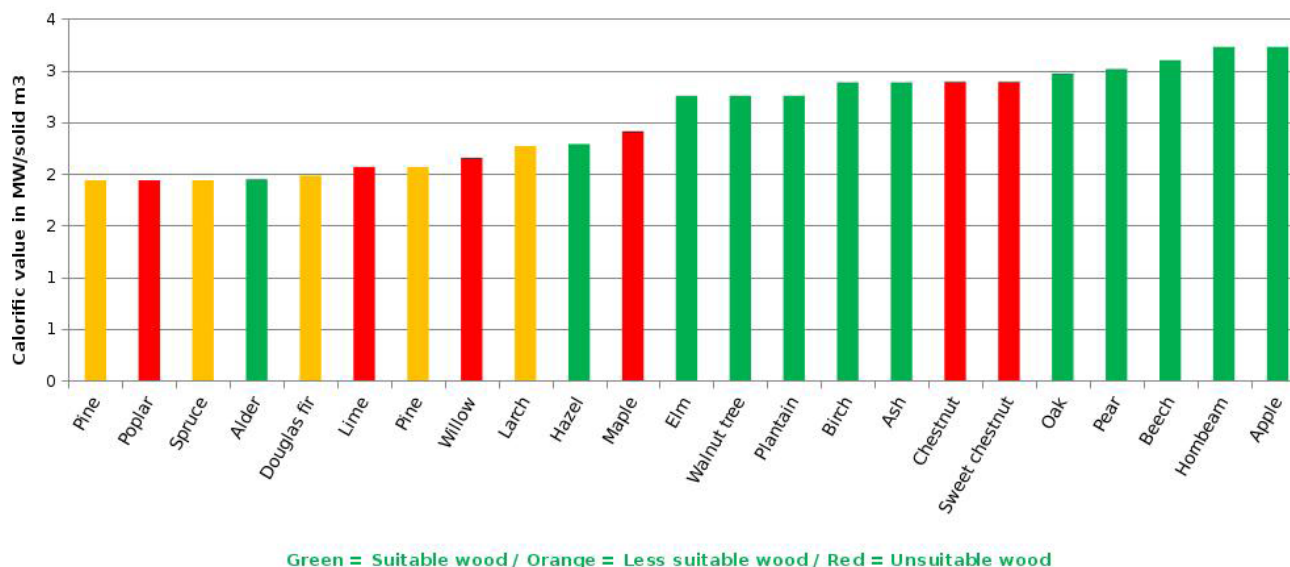
- fire wood with a circumference of max. 30cm, 12-15% moisture (see Ch. 1.6)
- briquettes of compacted, clean wood without additions (such as glue)

Unsuitable for wood stoves (with an ABCAT® HOTTUB) are:

- coal (because of calcium containing components)
- lignite (because of sulfuric odor)
- pellets (because of a relative high fly ash content)
- treated wood (preserved, glued, painted, etc)
- wood with nails, screws or other types of metal

1.2 Types of wood

Energy from native wood: overview of caloric value and odor impact
(the caloric value is the amount of heat that is released when the wood is completely combusted)



Explanation: the **red** colored wood types are classified as unsuitable because of the high concentration of odor which is released upon combustion and which are generally considered to have an unpleasant smell. The wood types indicated with either **red** or **orange** are classified as not or less suitable because:

- of the relatively high ash content and particulate emission;
- they gasify too fast in the stove with an increased risk of emitting unburnt wood gas;
- they contain much resin which produces relatively much soot-forming components;
- they produce much odor which is generally considered to have an unpleasant smell upon combustion.

Exotic types of wood (eg. tropical hard wood) produce a different (exotic) wood smoke odor. These types of wood can contain resin which, upon combustion, produces an irritating and annoying odor.

Small pieces of pine wood are very suitable to start a fire with. They burn easy and fast. However, pine is unsuitable to use as main fire wood because of this rapid combustion. Most wood stoves are not designed to cope with this rapid combustion and will have a significantly increased emission.

1.3 Moisture

Fresh wood contains about 50-75% moisture. This is both free and fixed water. Air dry wood has a moisture content of about 12-15%. This is the fixed (cell- and chemically bound water) water content. This fixed moisture can only be removed by exposing the wood to very high temperatures, such as in a fire.

Wood which is suitable for burning has a moisture content of about 12-15%.

As an example: 600 gr beech with 15% moisture contains 90 grams of water. See the picture to the right.

In heavier types of wood the moisture content of the living tree is lower than in lighter types of wood.

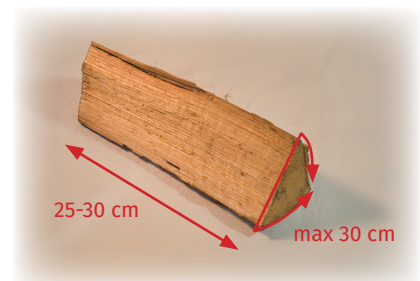
Evaporating water requires energy and therefore takes away some efficiency. Water vapor in the stove reduces the fire-temperature, causes a poor combustion, condensate in the chimney and a lot of mission of smoke and odor. Therefore it is important to use fire wood with a moisture content of 12-15%.



90 ml moisture in 600 gr beech
(15% moisture)

1.4 Wood splitting

Wood can be split easiest when it is still fresh. Wood should be split into pieces with a circumference of maximum 30 cm. A good length for fire wood is about 25-30 cm.



Split wood

1.5 Drying and storing wood

Wood dries at the cut of (front and back) side. The moisture moves through the small channels in the wood slowly to evaporate. Shorter cut wood dries faster since there is less distance for the moisture to cover before reaching the front or back side. The thickness of the wood barely influences the time required for drying.

Sufficiently dried wood has a moisture content of about 12-15%. The moisture content can be determined by measuring with a wood moisture meter. Using this meter correctly is important, since otherwise incorrect values can be measured. The next page shows, how to use a moisture meter correctly.

There is a general misconception that fire wood is suitable to burn after 2 years of drying. The only correct way to determine if the wood is ready for use in the stove, is by measuring the moisture content. In some drying setups wood can be dried sufficiently within one year. However, if the setup is wrong, wood can still be too moist to use in the stove after several years. Furthermore, if drying takes a long time, mold and fungi can develop which can pose a health risk.

Fresh or moist wood should always be stored outside, preferably under a roof to protect it from rain. Never store fresh or moist wood indoors, for example in a closed garage. The wood can not dry properly and the aforementioned mold can develop and cause a health risk. Sufficiently dry wood (12-15% moisture) can be stored indoors without any problems.

The moisture that evaporates from the wood makes the air more moist. Moist air is heavier than dry air. Moist air will fall to the bottom of the wood stack. It is important that this moist air can then be carried away by the wind. This functions best when there is space between the stacks of wood and when the base of the wood stack is lifted about 30 cm of the ground. Wood dries by wind and not by sun!

Below an example of a suitable drying setup for fire wood.



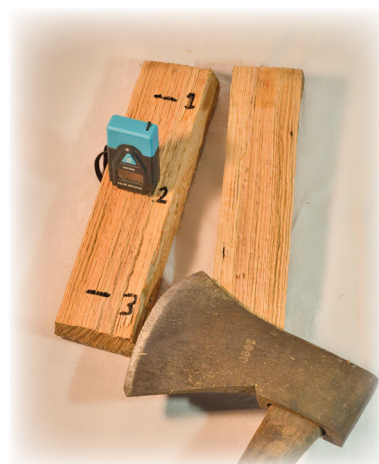
Drying setup, lifted approx. 30 cm of the ground with space between the rows of wood

1.6 Measuring moisture content

To determine the average moisture content of a piece of firewood, first, the wood has to be split in two. The moisture content should then be measured on the depicted three locations, crosswise to the grain of the wood. Sum up the three percentages and divide by three. The result is the average moisture content of the piece of wood. When the average moisture content is 12-15%, the wood is suited for use in a wood burning stove



Split wood trough the middle



Measure moisture content of the fresh split surface, crosswise to the grain, at these points

*sum up % of points 1, 2 and 3, then divide
by 3
= average moisture content of piece of fire
wood*

2. STOVE

2.1 Requirements for using an ABCAT® HOTTUB

- The stove must be fitted with a door that can be used to close off the combustion chamber, while ensuring the supply of sufficient combustion air to the fire.
- The stove must be fitted with a baffle plate. This prevents flames from the fire from coming directly into the chimney.
- A **minimum of 2 meters** of flue pipe going straight up after the ABCAT® HOTTUB must be installed.
- The chimney exhaust must be free. This means that flue gases from the chimney can easily be carried away by the wind. For example: A chimney exhaust next to a wall is NOT free.
- The stove must be fired in accordance with the regulations in chapters 3 and 4 of this manual.

3. STARTING THE FIRE

3.1 How does wood burn?

In a fire it is not the wood that burns but rather it is the wood gas that burns. Wood gas is produced when wood is heated. The wood gas burns because it reacts with oxygen from the combustion air that is sucked into the stove. This process is very visible, since it produces the flame that can be seen in the stove. Aside from oxygen, this reaction also requires a sufficiently high temperature.

3.2 Top down fire starting

The best way to start a fire is using the top down method. This method is also known as the Swiss or upside down method. This way of lighting the fire is called upside down because the fire burns from top to bottom. The hot wood gas does not collide with cold firewood on top of the flame, as is the case with lighting the fire from the bottom. Since the wood gas does not cool down because of any contact with cold wood, the flame can burn freely; most wood gas passes through the flame and burns up. When the heat of the fire on top has heated the wood beneath and wood gas is produced, these pieces of wood will also start to burn. So, the wood only starts to burn when it is ready to do so.

Another advantage of this way of lighting the fire is that the stove and chimney can heat up slowly. In particular the chimney needs heat to produce draft and suck in combustion air to the stove. The amount of combustion air required increases as the fire grows. Simultaneously the chimney heats up and produces more draft. There is a balance in these factors that is respected using the upside down firing method.

When a fire is lighted from the bottom the hot wood gas will cool down upon contact with the cold pieces of wood on top. The combustion will stop at that point since there is insufficient temperature for the combustion reaction. As a result the emission of wood gas and other unburned components increases. This leads to more condensation in the chimney and a higher emission of harmful components, leading to a higher impact on health and environment. Basically the stove is required to start of full throttle while everything is still cold, the chimney produces close to no draft and there is insufficient combustion air sucked into the stove. This leads to a higher emission.

To light the fire upside down a fire starter or wood-wool fire starters. Do not use newspapers, starter liquids, etc.



RIGHT
Upside down lighting with a fire starter on top



WRONG
Bottom up lighting produces much smoke and emission

4. FIRE MAINTENANCE

4.1 Adding fire wood

The right moment to add fire wood to the stove, is when the last small flames are about to extinguish and there is a nice glowing bed of embers. You can now refill with 3 to 4 pieces of wood as described in Chapter 1 of this manual.

If the fire is difficult or impossible to see, the smoke from the chimney can also be relied upon; When it regains its scent and color, the combustion (and thus the temperature) decreases and new wood can be added. In that case, add 1 or 2 pieces of fire wood as described in Chapter 1 of this manual.

Do not fill the stove with too much wood! Use a maximum of 2 kg of wood per half hour. This corresponds to 3 to 4 pieces of wood as described in Chapter 1. Make sure that the combustion chamber is filled with wood no more than half its height, so that the flames remain within the combustion chamber and there is sufficient space above the flames. If the stove is overfilled and the flames disappear behind the baffle plate, too much wood has been placed in the stove. This leads to extra emissions and loss of efficiency. In that case, use less wood for a subsequent filling.

When adding fire wood, it is important that the combustion air can reach the fuel. Therefore always lay wood in such a way that the combustion air can flow properly around the logs.

The combustion air must always be fully open. After all, both the fire and the ABCAT® HOTTUB need air, and the stove is fired at a considerable capacity.

Below examples of how wood should and should not be added:



RIGHT
Combustion air can flow properly between the pieces of wood



WRONG
*Too big, not split wood
The big block ignites difficult and suffocates the fire*



WRONG
*Stacked too close together
The wood suffocates the fire*

5. CATALYST

5.1 ABCAT® HOTTUB

The ABCAT® HOTTUB has been developed to reduce the emission of wood smoke from the chimney of hottub stoves. Particular attention has been given to reducing the odor of the wood smoke. The ABCAT® HOTTUB is placed directly on top of the hottub stove.

The ABCAT® HOTTUB contains a mixed bed palladium/platinum (precious metal) catalyst and is fully constructed from stainless steel. The ABCAT® is robust and operation and maintenance are easy.

The ABCAT® HOTTUB is not a tool to compensate an inferior installation or poor operation! Of great importance is that the whole firing process satisfies the aspects addressed in this handbook. Only then the ABCAT® HOTTUB can optimally contribute to reducing the emission. After all, a poorly maintained car with a badly running engine does not turn into a perfect car by only installing a filter in the exhaust.

5.2 Functioning

A simple description of what the ABCAT® HOTTUB does: What did not combust in the stove gets a second chance in the ABCAT® HOTTUB to combust. The filter in the ABCAT® HOTTUB consists of a palladium/ platinum catalytic converter. The catalyst material is enclosed in a round module. The the wood smoke goes through the catalyst. The catalyst cracks components that did not burn in the flames, such as hydrocarbons. These components give the color and odor to the wood smoke. Next to the catalytic function, the catalyst also acts like a mechanical filter, filtering out part of the particulates (fly-ash).

A catalyst needs temperature and oxygen from the wood smoke to crack and burn (oxidize) chemical components. The wood smoke temperature needs to be more than 300°C for an optimal functioning of the ABCAT® HOTTUB. For this reason the ABCAT® HOTTUB is installed directly after the stove. However, the catalyst must not become too hot either, from temperatures of more than 700°C the catalytic converter will be irreparably damaged. Too high a temperature is prevented by not overloading the stove with firewood and by ensuring that the flames do not come into contact with the catalytic converter.

5.3 Installing ABCAT® HOTTUB

De basissituatie zoals omschreven in de randvoorwaarden dient gewaarborgd te zijn. Samengevat betekent dit dat de kachel, schoorsteen, brandstof en bediening moeten kloppen. Alleen dan kan de ABCAT® HOTTUB goed functioneren. Wanneer deze basissituatie niet gewaarborgd is, kan de producent niet aansprakelijk worden gesteld. De ABCAT® HOTTUB dient vakkundig geïnstalleerd te worden.

- **The ABCAT® HOTTUB may only be used on stoves that are installed outside. Use in an enclosed space, for example a sauna, is not permitted!** This is due to the risk of smoke backfire.
- The ABCAT® HOTTUB must remain accessible for regular inspection and maintenance. The ABCAT® HOTTUB may not be built in.
- The ABCAT® HOTTUB must be fitted with suitable connections to the stove. In other words, the ABCAT® HOTTUB must be installed tightly on the stove without adapters. The flue after the ABCAT® HOTTUB must be stable and should be secured if necessary.
- The ABCAT® HOTTUB is placed directly on the the stove.
- The ABCAT® HOTTUB may only be used in a vertical position.

5.4 Using and cleaning the ABCAT® HOTTUB

Check the product prior to installation. Pay special attention to damages or abnormalities that hinder a safe use of the ABCAT® HOTTUB.

When the ABCAT® HOTTUB is installed the following has to be taken into account:

- **BE CAREFUL: The ABCAT® HOTTUB can get hot while using the stove!**
- The ABCAT® HOTTUB may only be removed and serviced when the stove is not burning and cold.
- Never use the ABCAT® HOTTUB in combination with a chimney cleaner or similar products!
- When lighting and burning the fire, the air inlets to the stove must be fully open. The fire and the ABCAT® HOTTUB both need oxygen.
- Light the fire top down and always use suitable fire wood (see Chapter 1).
- The ABCAT® HOTTUB should not be exposed to temperatures above 700°C. Flames must be prevented from reaching the catalytic converter. The temperature can be monitored with a bi-metal insert thermometer.
- The ABCAT® HOTTUB can get covered with soot during the lighting phase, or when the flue gas temperature drops. This soot is cracked and burnt when the ABCAT® HOTTUB reaches its operational temperature. From this temperature upwards the catalyst is self-cleaning for soot and other carbon-containing components.
- A part of the incombustible (mineral) components in wood smoke remain in the ABCAT® HOTTUB. A part of this ash can fall below the ABCAT® HOTTUB.
- The ABCAT® HOTTUB needs to be cleaned periodically to remove the ash that remains inside the catalyst. When the ABCAT® HOTTUB regularly reaches its operating temperature, this ash is mainly mineral ash. This ash can also be found on the bottom of the stove. To clean the ABCAT® HOTTUB, the chimney is removed from the stove. Then the ABCAT® HOTTUB is removed from the stove. The catalyst is then rinsed with warm or hot water.

The frequency of cleaning depends on many aspects, such as the use of the stove, the type of wood and the stove- and chimney design. **Cleaning should at least be done when ash is removed from the stove.** It is recommended to inspect and clean the ABCAT® HOTTUB regularly after installation. Based on the amount of ash that is removed from the catalyst, the cleaning frequency for the specific situation can be assessed.

5.5 Warranty and replacement

The warranty on the construction of the ABCAT® HOTTUB is 2 years. The functionality of the catalytic converter is guaranteed upon delivery, however, since the lifetime fully depends on the use of the catalyst, no warranty can be given on the catalytic converter itself. With good use and respect for the user conditions, the catalyst will last many thousand hours. The lifetime of the catalyst strongly depends on the combustion quality and the wood smoke temperature. Contaminated fuel and catalyst temperatures over 700°C have a negative impact on catalyst lifetime.

An indication that the module needs replacement, is when the ABCAT® HOTTUB is not self-cleaning any more although the temperature is sufficient and all previously mentioned conditions are met.

An additional indicator is when the metal chips inside the module have become rusty due to overheating or bad fuel. In these cases the ABCAT® HOTTUB needs to be replaced.