Alexander Höldrich and Hans Hartmann, Straubing

Storage and drying progress of wood logs

For energetic use in wood log furnaces, the moisture content of wood logs must be below 20%. The logs are generally dried during a longer period of storage. The storage trials carried out here with 37 cubic metres of piled wood over two years, during which the cordwood log bundles were weighed every month, show that the required water content of up to 20% is reached even after a storage period of one year if the storage conditions are good. This applies to beech- and spruce wood as well as split and unsplit wood with or without covers in the open or in airy storage sheds. The results were verified at two different locations and during two storage periods in the years 2003 and 2004.

Between December 2002 and November 2004, a total of 37 cubic metres of freshly cut cordwood logs of the tree species spruce (*picea abies*), beech (*fagus sylvatica*), and pine (*pinus sylvestris*) were stored in order to study the progress of drying. This study was carried out at two relatively different locations in Bavaria: in drier and warmer Freising (precipitation: 757 mm, average temperature from 12/2003 until 11/2004: 8.2°C) and in Kempten, where the climate is more humid (1,118 mm, 7.7°C). The wood used was split and unsplit wood corded up into round 0.5 cubic metre bundles. The wood was stored outdoors with and without covers (plastic film) and in a well-ventilated machine hall, which was open on one side. The gaps between the bundles, which were stacked to a height of 2 m (in three layers), were filled with loose single logs. Each bundle was weighed with an accuracy of ~ 50 g at the storage place once per month using a Flintec strain gauge weighing cell (UB6 C3).

At the beginning and at the end of the one- or two-year storage period, the water content was measured according to the drying chamber method at 105 °C over a drying period of 48 h using 3 to 4 cm thick log sections. In order to determine the dry matter losses, the initial water content was measured using samples from 15 logs per tree species. For the measurement of the final water content, samples from four logs per bundle were taken (total: 188 logs). Since it is not practicable to determine the water content of whole logs, approximately 4 cm thick sample discs were sawed at the log positions 0 cm, 50 cm, and 90 cm. The following equation shows the weighting of three samples taken at different positions of one log in the average value calculation of the water content (W_{tot}):

$$W_{tot} = 0.092\ W_{0cm} + 0.136\ W_{50cm} + 0.773\ W_{90cm}$$

This weighting was determined in extensive previous studies of a total of 30 logs, whose moisture content was different.

The final water content was used as a reference value for the development of the water content determined through the monthly intermediate weighings because the final water content was able to be determined more reliably than the significantly more variable initial water content. The average dry matter loss over the storage period was determined as well (cf. below) and used as a corrective value for the development of the water content by distributing the losses linearly over the 12- or 24-month storage period.

Drying progress

The question of when the moisture content of the wood falls below the maximum of 20% required for energetic use rather depends on the initial water content than on the storage climate. This results from the only slight differences in drying progress between the rather dry location Freising and comparatively cool and moist Kempten. Therefore, only results from one location (Freising) are presented below.

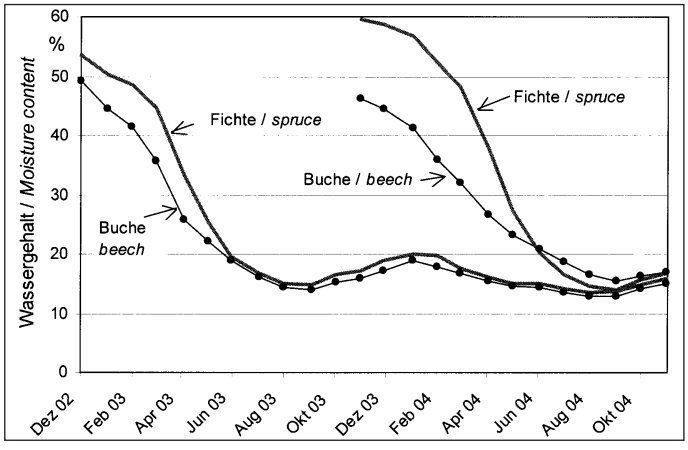

Fig. 1: Moisture content decline during wood log storage. Storage type: outdoor, split wood, covered. Location: Freising

Dr. Hans Hartmann is director of the Department of Biogenous Solid Fuels of the Technology- and Support Center in the Competence Centre for Renewable Raw Materials. Mr. Alexander Höldrich works in the same department. Adress: Schulgasse 18, D-94315 Straubing; e-mail: *Hans.Hartmann@tfz.bayern.de.*

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Keywords

Wood fuel, wood logs, storage, drying, moisture content

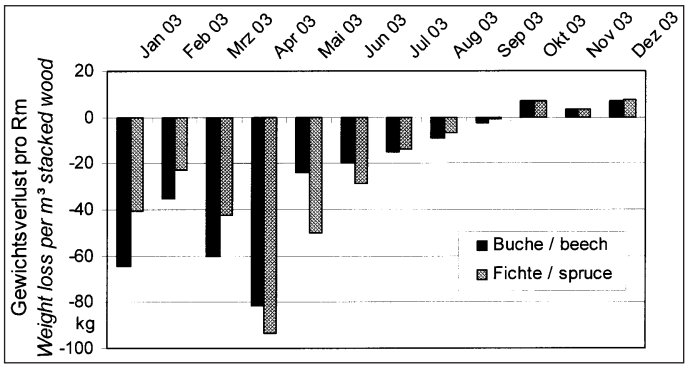

Fig. 2: Monthly drying rate of freshly stored split 1-m wood logs at a covered outdoor location in Freising

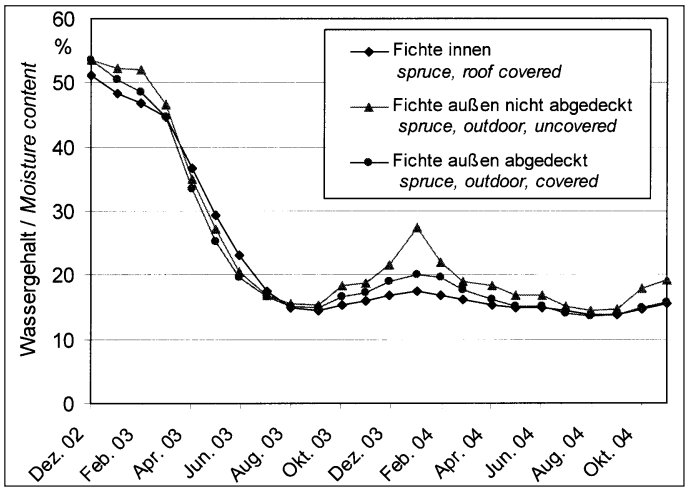

Fig. 3: Drying progress of freshly split 1-m wood logs (spruce) under the conditions of different storage types

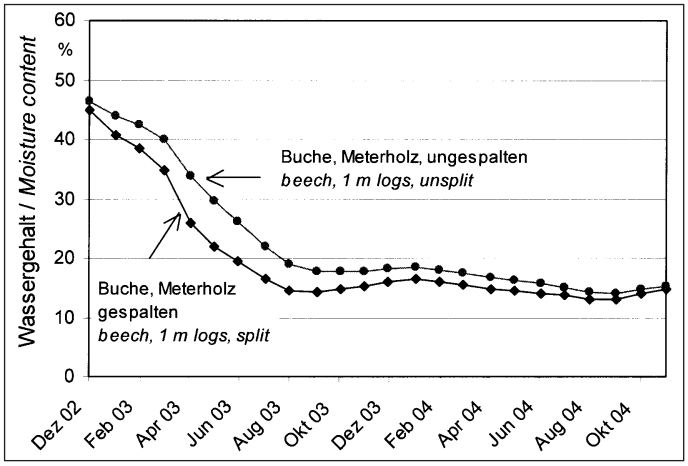

Fig. 4: Drying progress of freshly split and unsplit 1-m wood logs. Location: Freising, roof-covered store

With the beginning of storage, freshly cut wood starts to dry immediately even in the winter months. As of March, maximum monthly drying rates increase to up to 10% of water content. In a dry summer like in 2003 and given favourable storage conditions, the point where the moisture content of wood falls below the maximum of 20% required for combustion in wood log furnaces is already reached in June (*Fig. 1*). As compared with a moister summer (here: 2004), however, the differences are rather small because the wood needed only approximately one more month to reach the 20% limit in the following year.

As of May, spruce wood dries faster than beech wood, but up to this time beech wood is still ahead because it has a lower initial water content than spruce wood and dries slightly faster at the beginning. Despite greater green density, the 20% limit is ultimately reached at approximately the same time.

Drying rates

Figure 2 shows that beech wood loses more moisture in the winter months than spruce wood. In April, the water loss reaches its maximum at values of about 90 l/m^3. As of September, the wood absorbs more moisture from the ambient air and due to precipitation. As a result, the moisture content increases by approximately 5 l/m^3 between October and December.

Kinds of storage

In the winter months, covered wood first dries slightly faster. In the summer months, however, uncovered wood can catch up (*Fig. 3*). Nevertheless, covering is useful for protection against precipitation, in particular at rainy locations. As of September, this also allows the increase in moisture content, which is observed during the winter, to be reduced (*Fig. 3*). Under this aspect, storage in a roof-covered store is best suitable. However, the fast drying in a roof-covered store described here can only be achieved if the conditions in practice are similarly optimal (here: half-open shed with outer walls which allow the wind to pass).

As compared with split wood, unsplit wood must dry for about two more (summer) months in order to reach a water content of less than 20% (*Fig. 4*). For the 20% target to be reached more reliably by autumn, those logs which have a diameter of more than 10 cm should therefore be split before they are stored.

Dry matter losses

A comparison of the total dry matter at the beginning and the end of storage enables the dry matter losses over the entire storage period of 24 months to be estimated. In one-metre logs stored indoors, the average loss was 2.6% (for two years) and thus lower than in logs stored outdoors (5.7%). These values were also used for the above-mentioned linear correction of the weight development of the wood bundles. No additional differentiation is possible for the individual kind of preparation (split/unsplit) and the different kinds of wood (beech/spruce). Since the individual values straggle significantly, the loss data are not secured statistically.

Conclusions

Under good storage conditions, split wood logs, which were cut and split in the winter, can be dried to the degree required for combustion by the late summer after a storage period of 9 months. However, this requires the choice of a dry, windy storage location with sufficient distance of the wood stacks from one another and from the house walls. If wood is stored in the forest, for example, these conditions are not given. In order to keep the increase in moisture content during the winter months small, wood should be covered or stored in a roof-covered store at the latest by September. Under these conditions, differences in drying progress between the different kinds of wood examined here (beech, spruce, pine) are negligible. For accelerated drying, wood should be split when stored.