BAYERISCHE
STAATSFORSTVERWALTUNG

Wood Chip Drying Pilot Study „Wadlhausen“

Ordered by: Polyfelt, Linz, Austria

Conducted by: Bayerische Landesanstalt für Wald und Forstwirtschaft, Freising, Subject Area IV, Mr. Frank Burger

Bayerische Landesanstalt
für Wald und Forstwirtschaft

Initial Situation and Objectives of this Pilot Study

The utilization of wood for the generation of energy helps reduce the dependency on imports of fossil fuels, has a positive impact on climatic protection efforts, and generates new sources of income for agriculture and forestry. Therefore, in all of Europe, support programs and legal provisions encourage the use of wood which, in terms of quantity, constitutes the most important biomass. In view of the growing number of wood chip heating systems and wood-fuelled combined heat and power plants, we are increasingly often confronted with the question of how to store and dry the hogged material cost-efficiently. Even more so, when trees from protected forests have just been felled and need to be stored for several months during the warm season when the heating system is not being used. A cost-efficient way to dry the wood chips is to store them outdoors. Yet, storing them without any cover entails the risk of an unnecessary degradation of the chip quality caused by precipitation in the form of rain or snow. Negative results were already obtained with this type of storage back in 1997 within the scope of the LWF project "Cultivation trials with fast-growing trees in short rotation" (*Anbauversuche mit schnellwachsenden Baumarten im Kurzumtrieb*) in the Northern Oberpfalz region. Half a year after the harvest in March, the wood chips' water content was still high, and they had turned dark and could only be sold for a very low price.

A possible way to remedy this problem would be by covering the pile of wood chips with a commercially available fleece. The TOPTEX fleece used in the present study and manufactured by Polyfelt costs 1.52 euros per m² (not including VAT) and can be used for a period of five years. According to information provided by Polyfelt, this fleece is permeable to air and steam. However, due to its particular consistency, 85% of the precipitation are drained off within the fleece, with a certain inclined position of the pile's crown being required. It was the aim of this "drying pilot study" to determine whether in the climatic conditions of the alpine foothills (*Alpenvorland*) unseasoned wood chips from recently felled trees can be dried during the summer, with the help of this fleece, to a water content of less than 30%. Wood chips having a water content of less than 30% (range of the fiber saturation point of wood) can be considered as conditionally fit for storage.

Methodology

In winter 2004, an energy forest trial area in Beuerberg (Bad Toelz/Wolfratshausen county) was ready to be harvested for the second time. The parcels to be harvested were stocked with various kinds of western balsam poplar and aspen. The harvest took place in January 2004. On April 22, the timber was moved to a storage yard, where it was hogged on April 26. On the same day, the chips were transported to a mobile silo at *Gut Wadlhausen* near Icking, amid Bavaria's alpine foothills.

The harvested quantity totaled 280 stacked cubic meters (m^3), tantamount to a fuel oil equivalent of about 19,600 liters. At *Gut Wadlhausen*, the wood chips were stored in two equally sized piles in a mobile silo having a capacity of 1000 m^3. The two piles were spaced apart by a distance of several meters so as to allow them to dry separately from one another. The longitudinal axis of the mobile silo was disposed roughly in a north-south orientation. The first pile was covered with the TOPTEX fleece made by Polyfelt. The fleece was weighted down with tires (see photo on title page). The second pile was left uncovered to serve as control pile. The piles contained a homogenous mix of wood chips of western balsam poplar (about 70%) and aspen (about 30%). At the onset of the pilot study, six wood chip samples were taken to determine their initial water content by means of drying in the drying oven. At the time of placement into storage, it was exactly 51%. From empirical data obtained in the abovementioned LWF project, water contents of nearly 60% are to be expected in freshly felled western balsam poplar, while the water content of fresh aspen is about 57%. As a result, it could be concluded that the western balsam poplars and aspens of the present drying study had already dried to some extent during the period between harvest and hogging.

To obtain representative samples throughout the drying period, coarse-meshed potato bags were filled with wood chips prior to the onset of the study and placed 80 cm underneath the crown level of the pile (cf. WEIXLER et al., 1999). A cord fastened to the bags permitted the subsequent removal of samples. While it would have been desirable to place the bags at a deeper location in the pile, according to experience gathered by the LWF this would not have permitted the subsequent smooth removal of samples. To document the drying progress, two bags per pile were removed once a month, the wood chips were weighed and dried at 104°C in the drying chamber to a constant-weight state (ÖNORM G 1074). Based on the difference between the weights prior to and after drying, the water content was determined. In addition, the interior temperatures of the piles were measured at regular intervals, using a digital insertion thermometer.

In the course of the study, it turned out that sampling of wood chips with the help of bags failed to achieve the desired objectives. Even after several months in storage, the bags still had very high water contents which even varied randomly. Control samples removed from the front faces of the piles were much drier. Obviously, the samples were taken from the so-called "sweating cone" created in both wood chip piles during the drying phase (cf. WEIXLER et al., 1999). In addition, at least in the case of the non-covered pile, the rainfall during the summer of 2004 also contributed to the increased water content under the piles' surfaces. No samples were taken from deeper locations under the surface, as this would have interfered with the drying process. Therefore, at the end of the study on November 15, both piles were turned around with a wheel loader, and several wood chip samples were taken so as to measure representative water contents at least at the end of the study.

Results

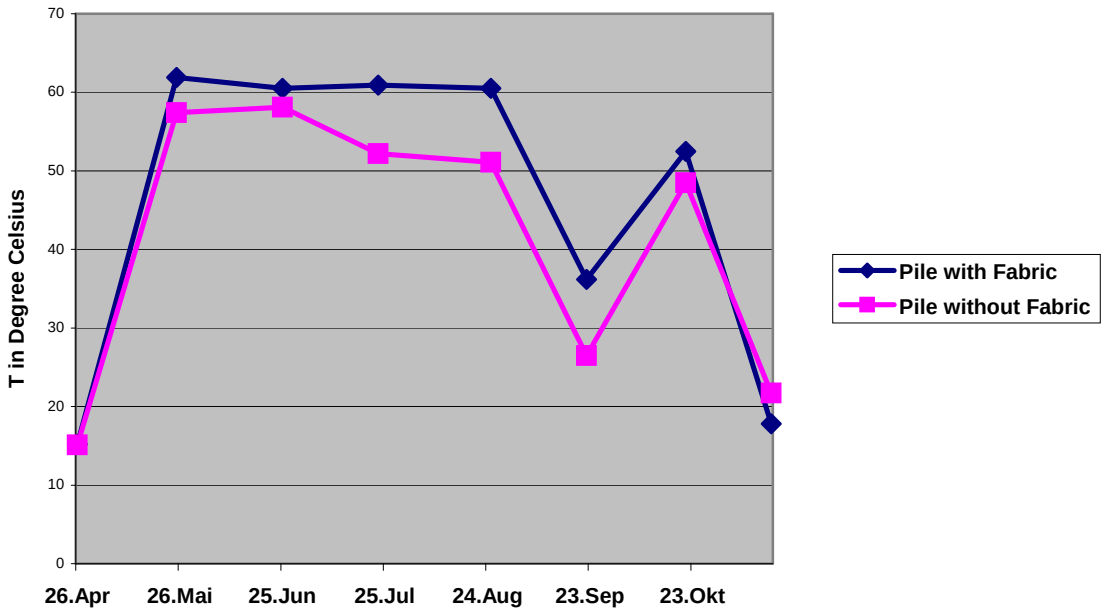
Pictures 1 and 2 clearly show the differences between the covered pile and the control pile. While the covered wood chips in picture 1 still have their original color, the ones stored without fleece cover have turned blackish. On November 15, the covered pile had a water content of 23%.

Picture 1: The pile, which had been covered with the Toptex fleece made by Polyfelt, at the end of the study (after the fleece had been removed) on 15/11/2004.

In the non-covered pile, the water content was 70%, that is even 19% more than at the time the chips were placed in storage in April. Hence, precipitation had caused the water content in the pile to rise. This becomes apparent in picture 2. While a few bright, dried spots can be discerned in the lower portion, the portion close to the crown had turned completely blackish.

Picture 2: The non-covered pile at the end of the study on 15/11/2004

Picture 3 shows the temperature curves for both piles. It can be seen that one month after placement in storage, microbial activity in the piles had fully unfolded. As a consequence of the metabolic processes involved in the growth of fungi, within four weeks the temperature had risen from 15°C at the beginning of storage to about 60°C. Until October, the covered pile always yielded higher temperatures. Only in November did the covered pile become slightly colder. In the light of a water content of 23% achieved by then, this seems quite logical, as microbial activity ceases below 30%.



Picture 3: Temperature curves for both wood chip piles from April 26 to November 15, 2004.

Despite the somewhat higher temperatures for the covered pile, the substance loss due to microbial degradation processes should not be greater than in the control pile. On the one hand, the temperatures of the two piles are for half of the time only slightly different, while on the other hand – and this is crucial – the heated air was able to escape with much greater ease from the non-covered pile so that the estimated substance loss will certainly be greater in the control pile.

Discussion

Western balsam poplar in its fresh state has a water content of 60%; that of aspen is about 57%. Therefore, wood chips made from these tree species are, even though, as in this case, they may have already dried to some extent, difficult to dry as compared to hogged wood from spruce or other common forest tree species having a low water content in its freshly felled state. This is aggravated further by the climatic conditions of Bavaria's Alpine Foothills. The climatic map for Bavaria shows annual precipitation levels of 1200 mm for the region around *Gut Wadlhausen*, way above Bavaria's average of 916 mm (BayFORKLIM, 1996). Under these aspects, the drying effect caused by the composting fleece must be rated as surprisingly good. The large difference over the water content of the control pile was not to be expected. Obviously, the precipitation was drained off effectively by the fleece and was therefore not able to add to the moisture of the wood chips stored underneath it.

The test setup employed by this pilot study should be used again at other locations offering different local conditions so as to be able to derive universally valid recommendations.

Literature:

BayFORKLIM (Bayerischer Klimaforschungsverbund)(1996): Klimaatlas von Bayern, 48 pages + 57 maps, Munich.

ÖNORM M 7133: Holzhackgut für energetische Zwecke, Anforderungen und Prüfbestimmungen. Österreichisches Normungsinstitut, Vienna.

WEIXLER et al. (1999): Teilmechanisierte Bereitstellung, Lagerung und Logistik von Waldhackschnitzeln. Berichte aus der Bayerischen Landesanstalt für Wald und Forstwirtschaft No. 21.