

FFG collective research project „Development of innovative processes for wood ash recycling“

Project manager: DI (FH) Rainer Handl, Austrian Economic Chamber of the wood industry, Schwarzenbergplatz 4, A-1037 Wien

Scientific project manager: Prof.Univ.-Doz.Dipl.-Ing.Dr. Ingwald Obernberger, BIOS BIOENERGIESYSTEME GmbH, Inffeldgasse 21b A-8010 GRAZ

FACT-SHEET: Intermediate storage of biomass ashes



Editor:

Austrian Economic Chamber of the wood industry
Schwarzenbergplatz 4
A-1037 Wien

Authors:

Ingwald Obernberger, Prof. Univ.-Doz., Dipl.-Ing. Dr. techn.
Klaus Supancic, Dipl.-Ing.

BIOS BIOENERGIESYSTEME GmbH

Inffeldgasse 21b

A-8010 Graz

Tel.: +43 (0)316 481300; Fax: +43 (0)316 481300-4

E-Mail: obernberger@bios-bioenergy.at

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This fact sheet is based on the current state of the art of biomass combustion systems operated in Austria and refers to the Austrian legal framework conditions at the time of printing. For this reason the statements, technical information and recommendations included may not be valid in other countries.

1 Under which circumstances is the intermediate storage of biomass ashes feasible?

Intermediate storage is feasible and necessary if

- there is a longer period of time between the time of ash production and ash utilization and/or
- a specific amount of ash is needed that has to be collected over a longer period of time and/or
- a change in the physical and chemical properties during storage is desired (“ageing” of ashes)

The type of intermediate storage depends on the ash to be stored and in particular from the intended use of the ash. Therefore, the recommended storage conditions are listed below depending on the subsequent use of the biomass ashes.

2 Intermediate storage of biomass ashes for the utilization as a binder in forest road construction and soil stabilization (road construction, dam construction etc.)

The intermediate storage of plant ashes for utilization as a binder is necessary because, for example, for a single (forest) road construction project usually several 100 tons of biomass ash are needed. Therefore, depending on the size of the biomass combustion plants and their ash production, the ash must be collected over several weeks or months in order to provide the amounts required.

In addition, construction activities usually take place only from spring to autumn. If the ashes, which are generated during the main heating season in winter, should be recycled, a temporary storage is necessary as well.

2.1 Recommended storage conditions

Since the utilization of ashes as a binder in forest road construction or soil stabilization requires the highest possible CaO content, the ashes **must be stored dry**.

Depending on the particle size different storage facilities may be used (depending on the yet to be determined limiting values for total concentrations in the ash, it is possible that not all ash fractions listed below are applicable for forest road construction and / or for soil stabilization):

- Untreated bottom ashes from grate furnaces or mixture of untreated bottom ashes with coarse fly ashes as generated in the heating plant and untreated bottom ashes from fluidized bed furnaces:
 - Storage in a closed container or at roofed and paved storage sites (dust emissions have to be minimised by providing appropriate wind protection)
- Crushed bottom ashes from grate furnaces or mixture of crushed bottom ashes with coarse fly ashes as generated in the heating plant and crushed bottom ashes from fluidized bed furnaces:
 - Storage in a closed container or at roofed and paved storage sites (dust emissions have to be minimised by providing appropriate wind protection)

- storage in silos (recommended)
- Fly ashes from fluidized bed furnaces:
 - storage in silos

From a legal point of view, the maximum storage period should not exceed 3 years, otherwise remediation fees according to the Austrian Remediation Act (ALSAG) would be payable (see also section 2.2). From an economic perspective, the storage period should be only as long as necessary to keep the costs of storage facilities as small as possible.

2.2 What are the benefits of the intermediate storage of biomass ashes for users?

- The amount of ash required is promptly available.
- By delivering the amount of ash required from a single biomass plant quality fluctuations of the ashes can be minimized.

2.3 What are the benefits of the intermediate storage of biomass ashes for the heating plant operator?

- Significant improvement of the flexibility in regard of the possible utilization period and any necessary further preparation steps (e.g. crushing of ashes).
- Larger amounts of ash can be provided at a time to a recycler, allowing for simplifications in terms of logistics, permits and project management.

2.4 What is the current status in Austria regarding the legal basis and the implementation in practice?

Legal basis in Austria:

- Currently the Austrian Waste Management Act (AWG 2002), the Austrian landfill ordinance and the Austrian Remediation Act (ALSAG) form the legal basis for intermediate storage of wastes in Austria.
- The intermediate storage can be carried out on the premises of the biomass heating (power) plant or the recycler. Regardless of whether the waste will be passed on by the owner of the biomass plant for recovery or disposal, the storage site for the ash is not considered a treatment facility for intermediate storage of waste. Therefore, a separate authorization under the Waste Management Act (AWG 2002) is not given for storage at the biomass heating plant site. However, these storage facilities are an integral part of the biomass plant and therefore subject to the rules for the biomass plant authorization regime.
- An intermediate storage of waste outside the site where the waste is generated is considered a waste treatment process according to AWG 2002. If the intermediate storage of biomass ashes is carried out by a natural or legal person who operates the intermediate storage facility in combination with a commercial activity, according to § 37, para 2 no. 5 AWG 2002 only an industrial equipment license according to the Industrial Code (GewO) is required. If the intermediate storage facility is operated by a natural or legal person whose occupation is not subject to GewO (e.g. agriculture and forestry), a permit for the intermediate storage facility is necessary according to AWG 2002. A permit according to the AWG 2002 is required in any case when the biomass ashes are not only stored, but also treated (e.g. ageing). In this case, there is also no

exemption from this permit requirement for natural or legal persons operating the intermediate storage facility in combination with a commercial activity.

- Each batch of stored biomass ash may be stored up to one year prior to disposal (landfill) or three years before further utilization. If these periods were exceeded, the intermediate storage site would be considered an inadmissible, because unauthorized, landfill. Compliance with the storage periods is important since according to § 3 para 1 no 1 lit b of the Austrian Remediation Act (AISAG), a more than one-year storage of waste for disposal or a more than three years' storage of wastes destined for further utilization would be considered as landfilling within the meaning of the AISAG and would be therefore subject to remediation fees.
- In case the intermediate storage is carried out on landfills, the provisions of the Austrian Landfill Ordinance apply. It has to be assured that the ash is stored on designated areas and not mixed with other waste in order to avoid contamination by other waste stored at the landfill.

Status in Austria:

- Since up to date (status as of autumn 2015) biomass ashes have not been used yet as a binder in forest road construction or soil stabilization in industrial practice, there is no experience with the intermediate storage of biomass ashes for this purpose.

3 Intermediate storage of biomass ashes for the utilization on agricultural and forest soils

The intermediate storage of biomass ashes for utilization in agriculture and forestry is necessary because fertilizers in general and biomass ashes in particular must not be applied in winter or when the soil is covered with snow. In addition, depending on the local conditions, further time restrictions for ash application may apply. If ashes that are generated during the period of an application ban should be recycled, intermediate storage is necessary.

3.1 Recommended storage conditions

3.1.1 Application on agricultural soils

Since the utilization of ashes as a fertilizing agent on agricultural soils requires the highest possible CaO content, the ashes **must be stored dry**.

Depending on the particle size, different storage facilities are recommended:

- Screened bottom ashes from grate furnaces or mixture of screened bottom ashes with coarse fly ashes as generated in the heating plant and screened bottom ashes from fluidized bed furnaces:
 - Storage in a closed container or at roofed and paved storage sites (dust emissions have to be minimised by providing appropriate wind protection)
- Crushed bottom ashes from grate furnaces or mixture of crushed bottom ashes with coarse fly ashes as generated in the heating plant and crushed bottom ashes from fluidized bed furnaces:
 - Storage in a closed container or at roofed and paved storage sites (dust emissions have to be minimised by providing appropriate wind protection)

- storage in silos (recommended)
- Fly ashes from fluidized bed furnaces:
 - storage in silos

From a legal point of view, the maximum storage period should not exceed 3 years, otherwise remediation fees according to the Austrian Remediation Act (AISAG) would be payable (see also section 2.2). From practical perspective, the stored ashes should be applied within a year.

3.1.2 Application on forest soils or on grasslands

Since the utilization of ashes as a fertilizing agent on forest soils or grasslands requires a high CaCO_3 content, an ageing of the ashes by adding water during storage is a feasible option.

The following procedure is recommended:

- Intermediate storage at landfills:
 - Determination of the amount of water to be added based on the Ca content: the amount of water to be added shall be sufficient to enable the full conversion of CaO to Ca(OH)_2 (one Mol water is required per Mol of Ca, that is, per g of Ca in the ash 0,45 g of water are required). Example: Ca content: 0.3 kg/kg dry basis → water admixing ratio: $0.3 * 0.45 = 0.135$ kg of water per kg of ash (dry substance).
 - Admixing of water by a suitable mixing unit (e.g. cement mixer or universal mixer).
 - The ashes shall be stored in heaps. In order to allow for a uniform ageing process and a processible grain size of the ashes during storage, the ashes shall be turned (similar to compost) several times during storage. During very long periods (> 4 weeks) without rain the ash shall be moistened on the surface to avoid dust formation. In case of regular precipitation no moistening is necessary.
 - After storage a screening of the ash to a particle size < 1.0 cm is recommended followed by a direct filling of the transport vehicle by a wheel loader or similar device. Alternatively, the ash can be filled in big bags, if the respective infrastructure (filling station) is available.
- Intermediate storage at the end user:
 - If the ash is to be stored at the end user, the legal framework conditions that apply have to be considered. Basically, intermediate storage is allowed at the end user, if the ash stored is used within a growing season.
 - Admixing ratios and admixing procedure as described for the storage at landfills
 - The ashes shall be stored in heaps. In order to allow for a uniform ageing process and a processible grain size of the ashes during storage, the ashes shall be turned (similar to compost) several times during storage. In order to avoid leaching of the ashes the heaps shall be covered with breathable but water tight sheets.
 - After storage a screening of the ash to a particle size < 1.0 cm is recommended followed by a direct filling of the spreading device or the transport vehicle by a

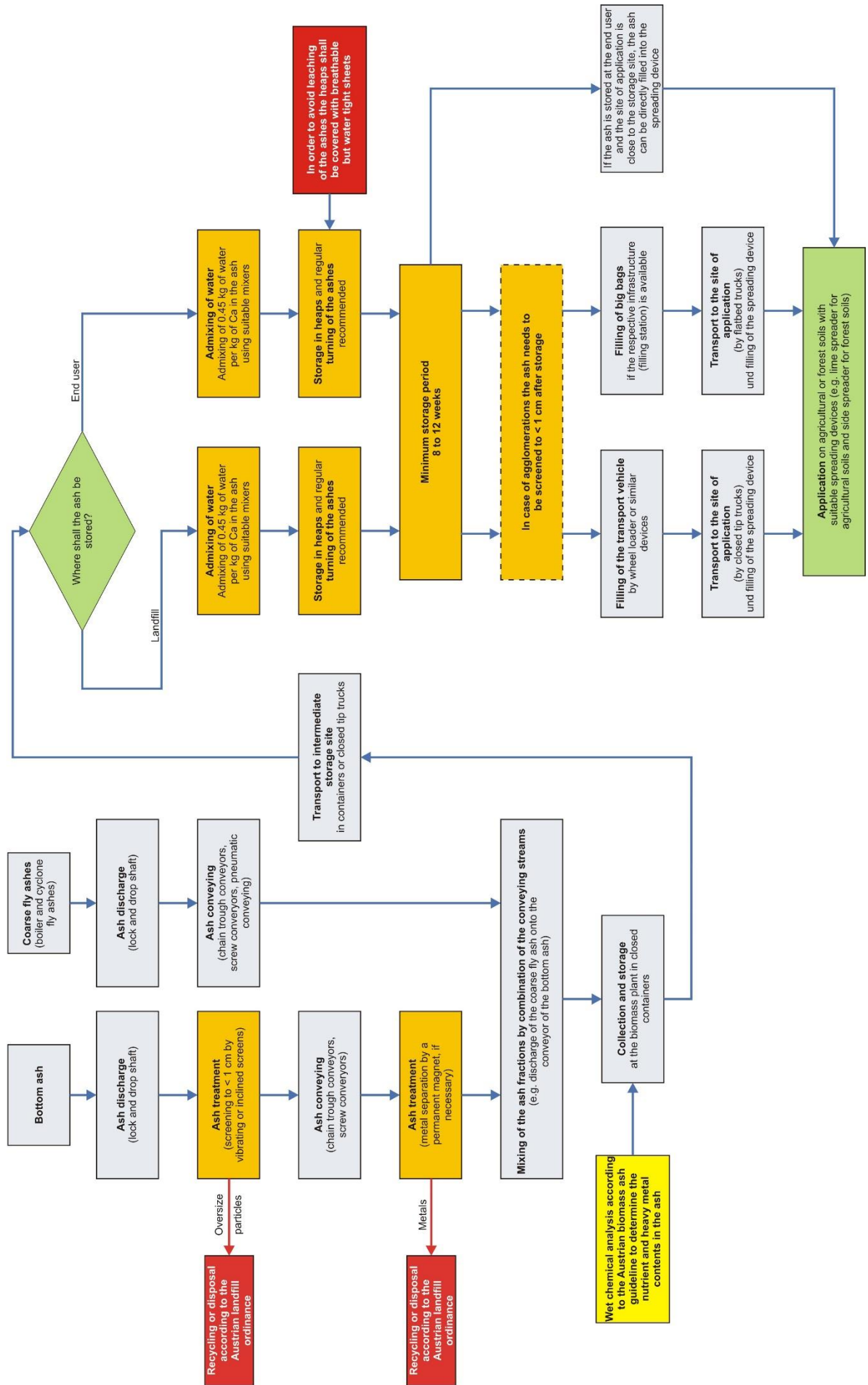
suitable device. Alternatively, the ash can be filled in big bags, if the respective infrastructure (filling station) is available.

The storage period shall be between 8 to 12 weeks, if relevant changes in the chemical properties of the ashes (reduction of the leaching of Ca, reduction of the pH-value and the electric conductivity) are desired.

From a legal perspective, biomass ashes may not be stored longer at the end user as needed (e.g. optimal application period). If the ashes are stored on landfills, no limitations regarding the storage period are given (see also chapter 2.2).

Following, the complete process flow chart for ashes from grate furnaces used on agricultural or forest soils is presented.

Process chain recommended for ashes from grate furnaces



For which type of ashes intermediate storage with ageing is feasible?

- Bottom ashes and mixtures of bottom ashes and coarse fly ashes as generated in grate furnaces show positive changes of the chemical and physical properties
- Coarse fly ashes from fluidized bed furnaces show only minor changes in their chemical and physical properties by ageing. Thus, the additional efforts for water admixing and turning of the ash heaps seems to be not feasible.
- Based on the results of the laboratory and field tests performed within the scope of the project the **specific ageing of biomass ashes during intermediate storage can be only recommended for bottom ashes and mixtures of bottom and coarse fly ashes as generated in grate furnaces.**

3.2 What are the benefits of the intermediate storage of biomass ashes for users?

3.2.1 General

- The amount of ash required is promptly available.

3.2.2 Intermediate storage with specific ageing

- The intermediate storage with specific ageing allows for a pre-treatment of the ashes to be applied on forest soils or grasslands for liming and fertilizing purposes and enables a significant reduction of dust formation during the application process, since the ash is mixed with water at the beginning of the storage period.
- Slight decrease of the pH-value of the ash if the ash is stored between 8 and 12 weeks → the ash becomes more biocompatible for organisms sensitive to high pH-values.
- Reduction of the solubility of Ca → longer lasting liming effect (relevant for application on forest soils or grasslands)

3.3 What are the benefits of the intermediate storage of biomass ashes for the heating plant operator?

- Significant improvement of the flexibility in regard of the possible utilization period and increase of the amount of ash to be utilized per year (ash which is generated during winter can be utilized in spring or summer).
- An intermediate storage is economically and technically feasible, if it enables the utilization of biomass ashes generated in winter, which, due to the ban on application which does not allow an application before spring, are usually landfilled. If the costs for ash treatment, intermediate storage and transport to the site of application are lower than the costs for landfilling (including transport costs), an intermediate storage is economically feasible.

3.4 What is the current status in Austria regarding the legal basis and the implementation in practice?

Legal basis in Austria:

- See chapter 2.4.
- Intermediate storage in forests is prohibited by law (any deposition of waste in the forest is considered as forest devastation).

Status in Austria:

- The process of ageing during intermediate storage was tested within the scope of the Austrian collective research project „Development of innovative processes for wood ash recycling“ in laboratory and field tests (in Lower Austria). An implementation in practice is still pending (status as of autumn 2015).
- Intermediate storage of biomass ashes without specific ageing is already implemented in practice in Austria.