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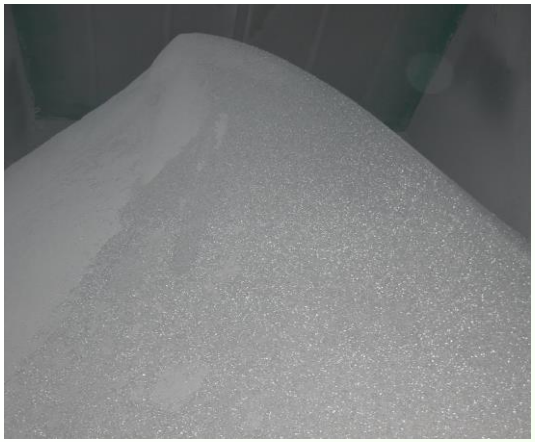
Your partner for energy utilisation from biomass and energy efficiency
Research • Development • Engineering

BIOMASS ASH UTILISATION
Characteristics – processing – utilisation options – references



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Auszeichnung des Landes Steiermark

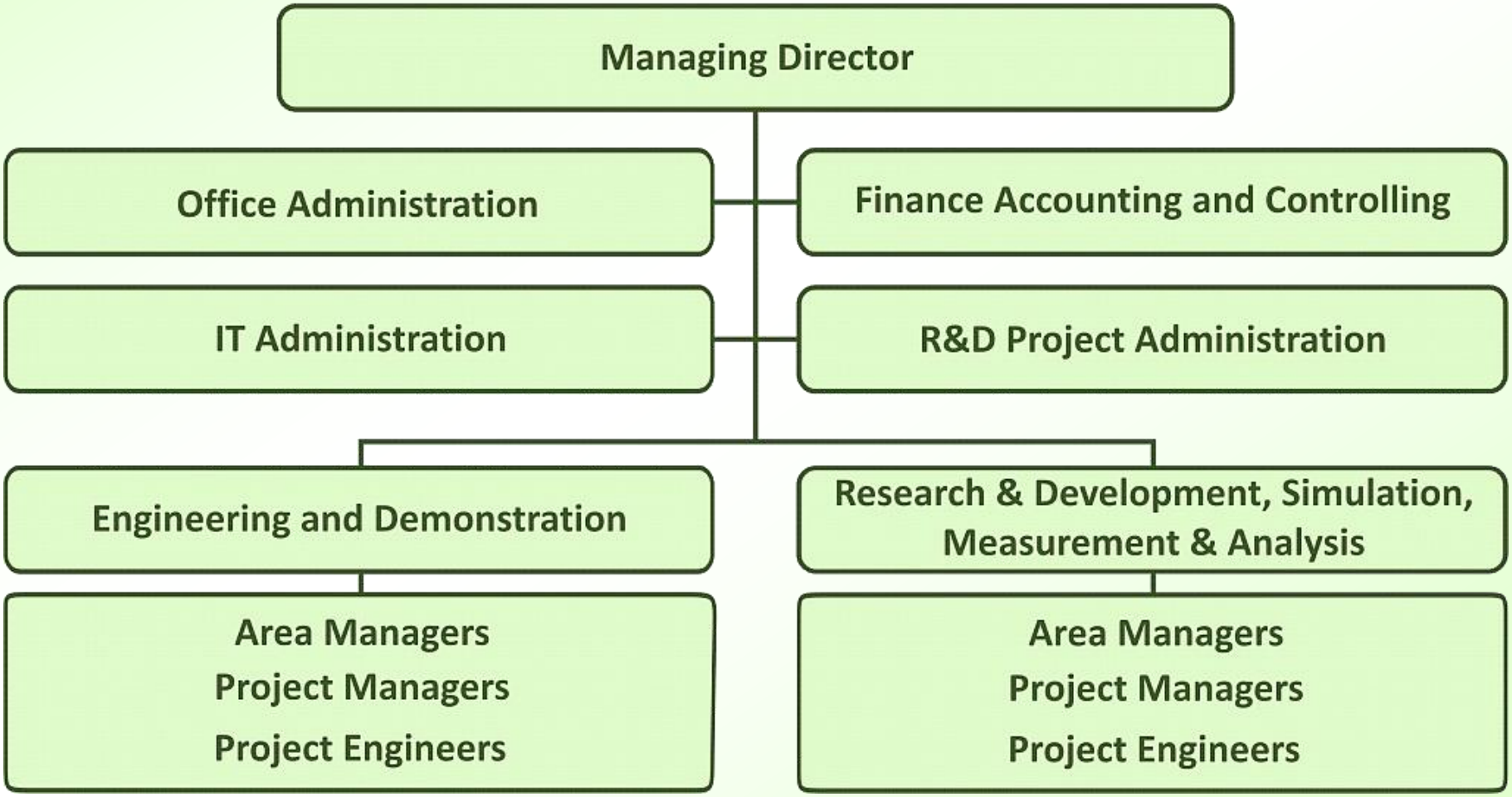
NACHHALTIGE WIRTSCHAFT – ENERGIE BIOMASSE – P Mg Ca K – ASCHE

BIOS BIOENERGIESYSTEME GmbH
Key information

- Founded in 1995 as a spin-off of the Graz University of Technology
  Re-organisation to a limited liability company in 2001
- 2015 opening of the
  BIOS Innovation Centre
- General manager:
  Prof. Dr. Ingwald Obernberger

- Present staff: 25 (21 graduated engineers)
- Annual turnover in 2020: approx. 5.0 Mio €
- Markets: Austria, Germany, Italy, Switzerland but also Belgium, Denmark, Estonia, France, Greece, United Kingdom, Ireland, Croatia, Montenegro, The Netherlands, Norway, Serbia, Slovakia, Spain, Czech Republic, Hungary, Bangladesh, Barbados, Belarus, Chile, Honduras, Canada, Russia, South Africa, Taiwan, USA

ORGANIGRAM of BIOS BIOENERGIESYSTEME GmbH




Contribute to an efficient energy system of the future by our research, development and engineering activities
Be the competitors always at least a step ahead regarding Know How, new developments and new applications

Ash characteristics

Typical ash fractions in biomass combustion systems (I)

- **Bottom or grate ash (BA):** this is the predominantly mineral residue of the biomass used in the furnace of the combustion system. The impurities contained in the fuel (e.g. sand, earth, stones) and parts of the bed material (mostly quartz sand) in the case of fluidized bed furnaces are also found here. In addition - especially when using bark and straw - sintered ash fragments and slag can be contained in the bottom ash.
- **Boiler ash (BoA):** ash particles that accumulate as dust in the boiler are called boiler ash. Boiler ash is either collected separately or mixed with the coarse or cyclone fly ash fraction.

Typical ash fractions in biomass combustion systems (II)

- **Cyclone fly ash or coarse fly ash (CFA):** this is the term for solid, predominantly inorganic fuel constituents carried along as particles in the exhaust gases, which arise as dust in centrifugal separators (cyclones) downstream the boiler.
- **Fine fly ash (FFA):** this is the ash fraction that is precipitated in fabric filters or electrostatic precipitators or as condensate sludge in exhaust gas condensation systems. In the case of combustion systems without such a waste gas cleaning system, the fine fly ash is released into the atmosphere as residual dust.

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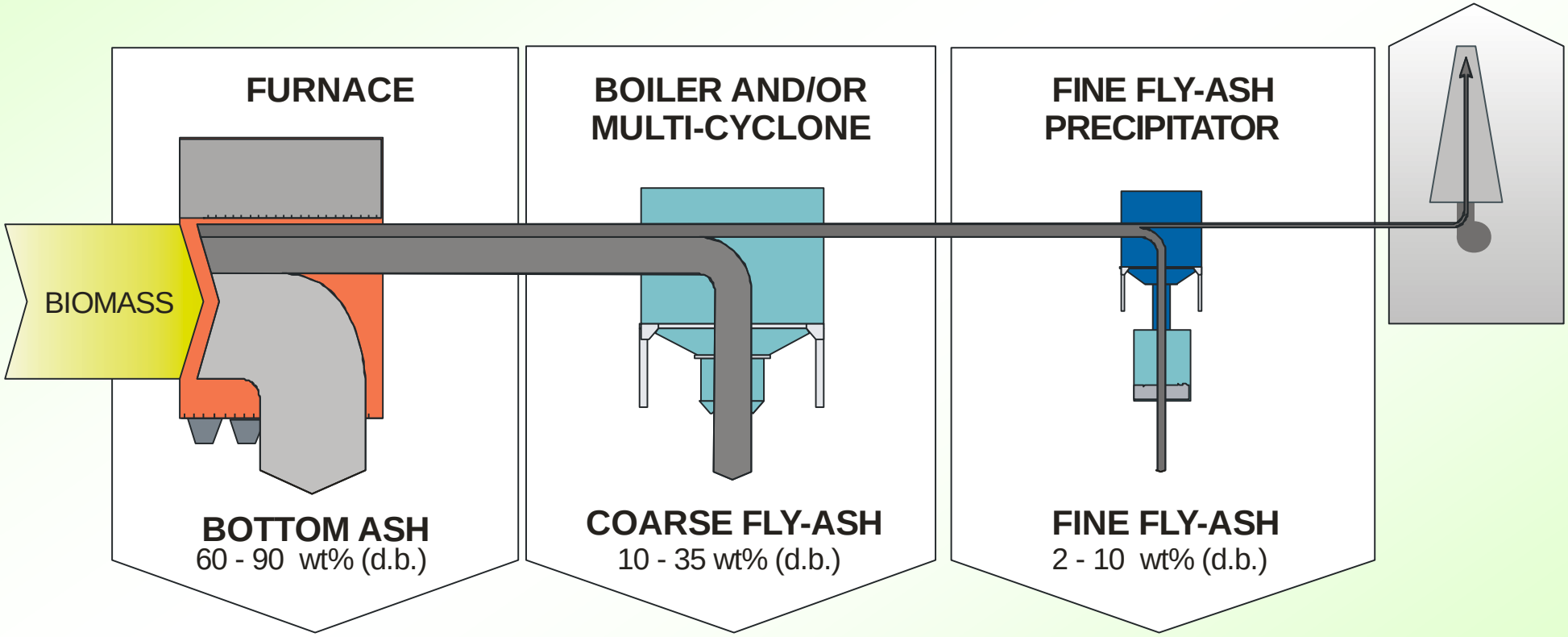
Typical ash fractions in biomass combustion systems (III)



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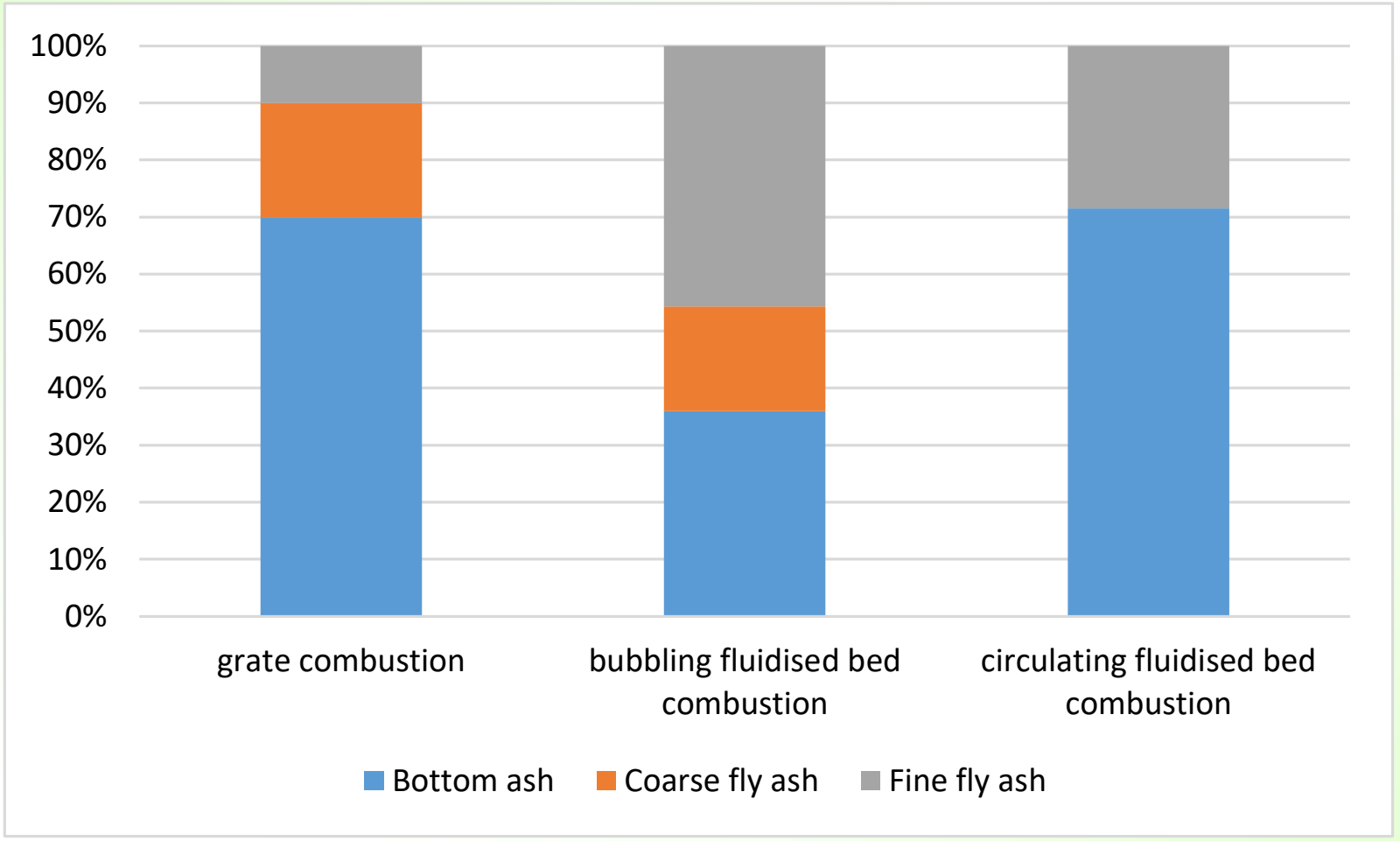
Typical ash fractions in biomass combustion systems (IV)



Ashes from fluidised bed furnaces comprise the ash from the fuel and also certain amounts of bed material (usually SiO_2) that can be usually found in the bottom ash; the share of fly ash is dependent on the type of the fluidised bed technology.

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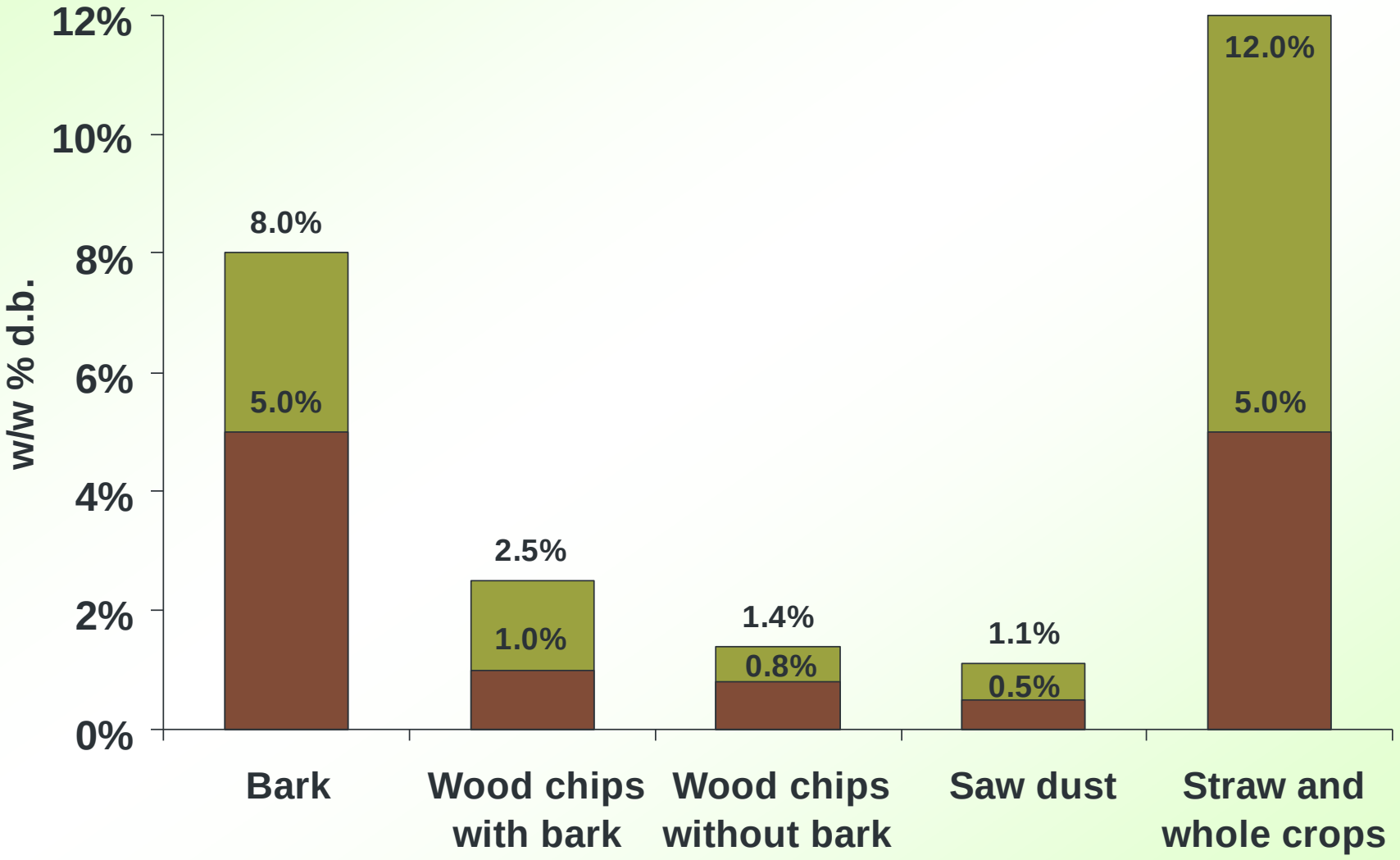
Ash contents of different biomass fuels



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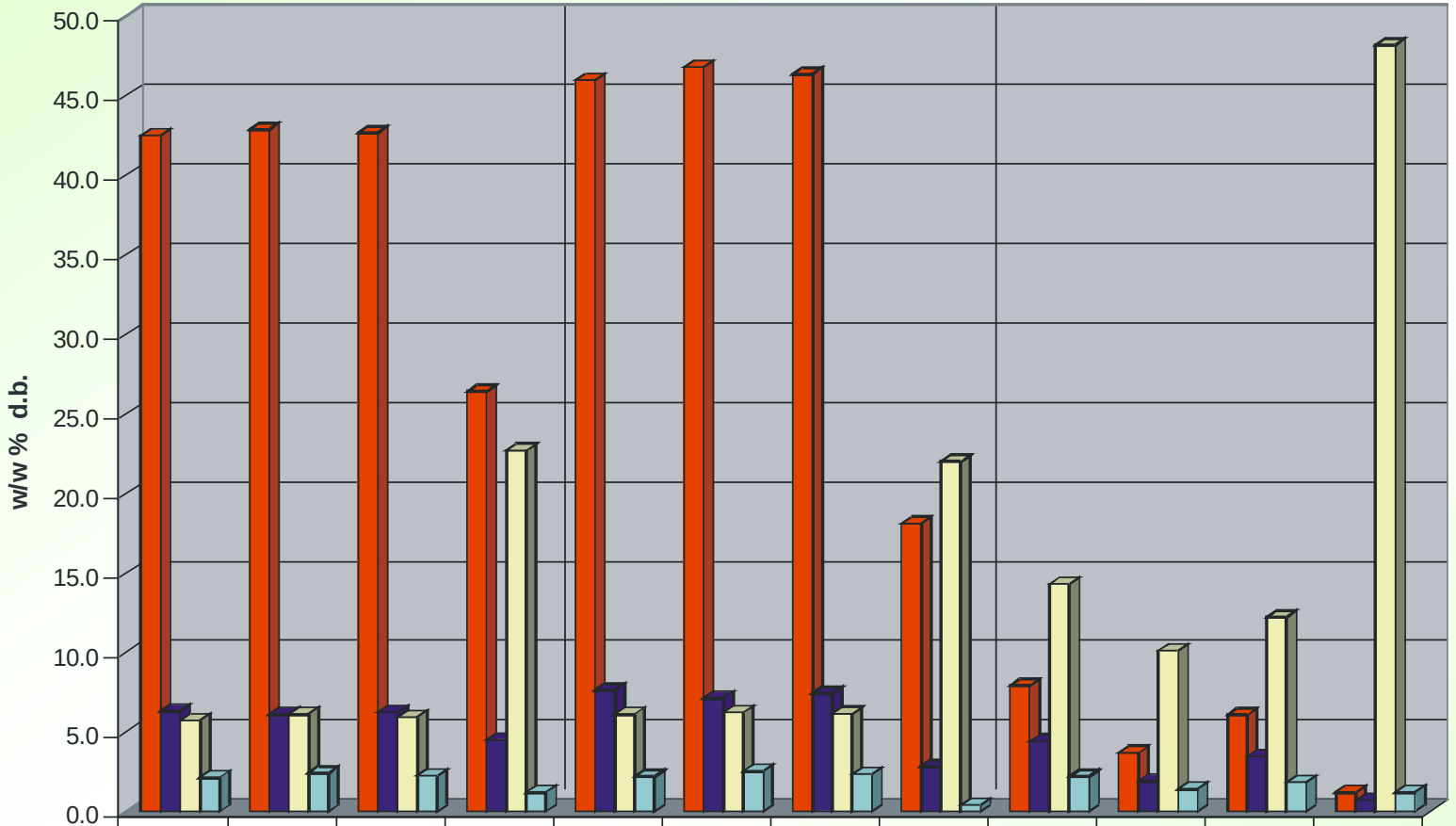
Typical nutrient contents in different ash fractions

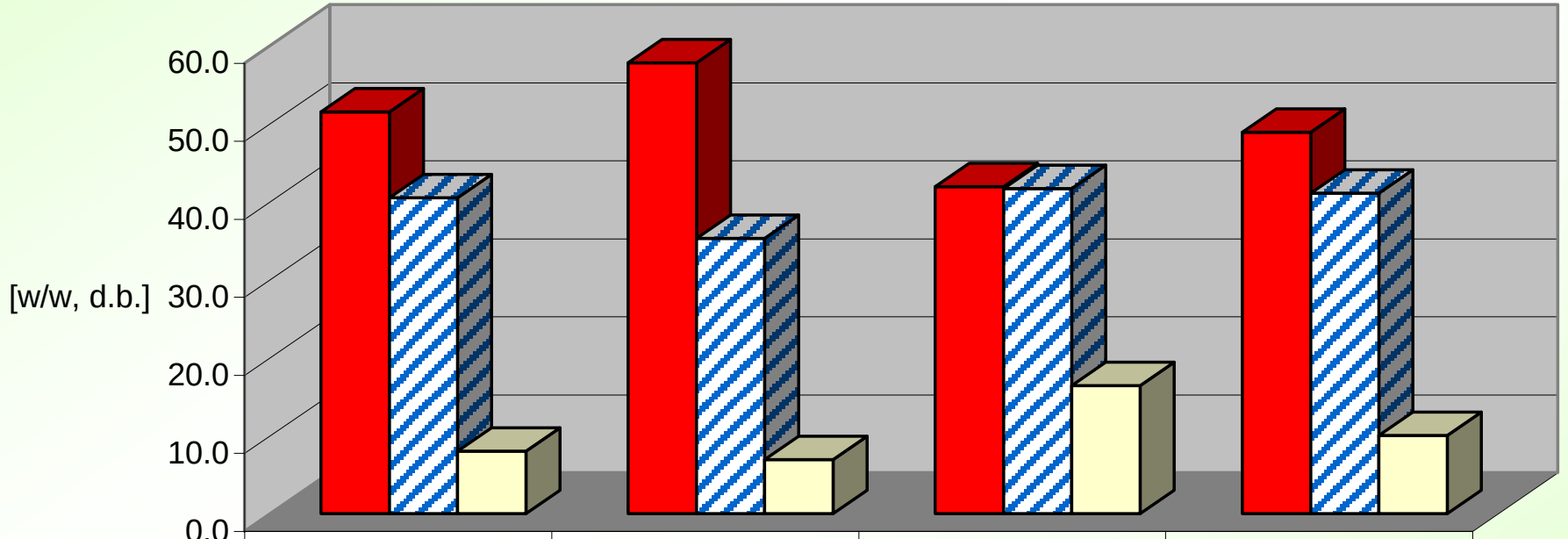


	Bark				Wood chips				Straw			
	BA	CFA	BA+CFA	FFA	BA	CFA	BA+CFA	FFA	BA	CFA	BA+CFA	FFA
CaO	42.5	42.9	42.7	26.4	46.0	46.8	46.4	18.1	7.9	3.7	6.1	1.2
MgO	6.3	6.1	6.2	4.5	7.6	7.1	7.4	2.8	4.4	1.9	3.5	0.7
K2O	5.7	6.1	5.9	22.7	6.1	6.2	6.1	22.0	14.3	10.1	12.2	48.2
P2O5	2.1	2.4	2.2	1.2	2.2	2.5	2.3	0.4	2.2	1.4	1.8	1.2

Explanations: BA … bottom ash, CFA … cyclone fly ash, BA + ZFA … bottom + cyclone fly ash as generated

Share of nutrients in the different ash fractions

Bark or wood chip-fired grate furnaces



	Ca	Mg	K	P
Bottom ash	51.5	57.8	41.9	48.9
Coarse fly ash	40.5	35.3	41.7	41.1
Fine fly ash	8.0	6.9	16.4	10.0

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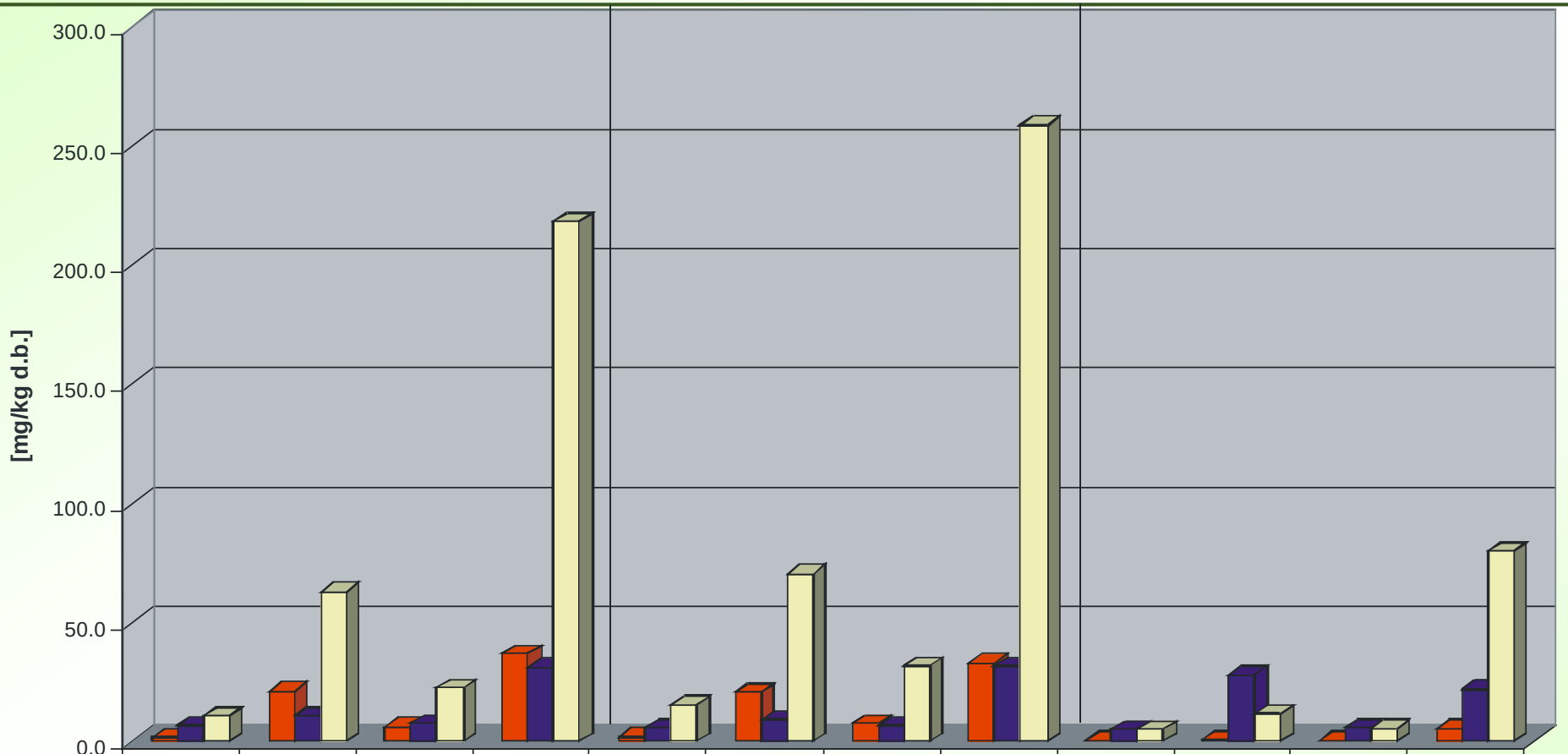
Typical contents of volatile heavy metals in biomass ashes (I)



	Bark				Wood chips				Straw			
	BA	CFA	BA+CFA	FFA	BA	CFA	BA+CFA	FFA	BA	CFA	BA+CFA	FFA
Cd	1.8	21.3	6.0	36.7	2.0	20.9	7.6	32.9	0.,2	0.8	0.2	5.2
As	6.4	10.6	7.3	31.2	5.8	9.2	6.8	31.5	5.0	27.9	5.9	22.0
Pb	10.9	62.7	22.3	218.5	15.4	70.5	31.8	258.8	5.1	11.4	5.4	80.0

Explanations: BA … bottom ash, CFA … cyclone fly ash, BA + ZFA … bottom + cyclone fly ash as generated

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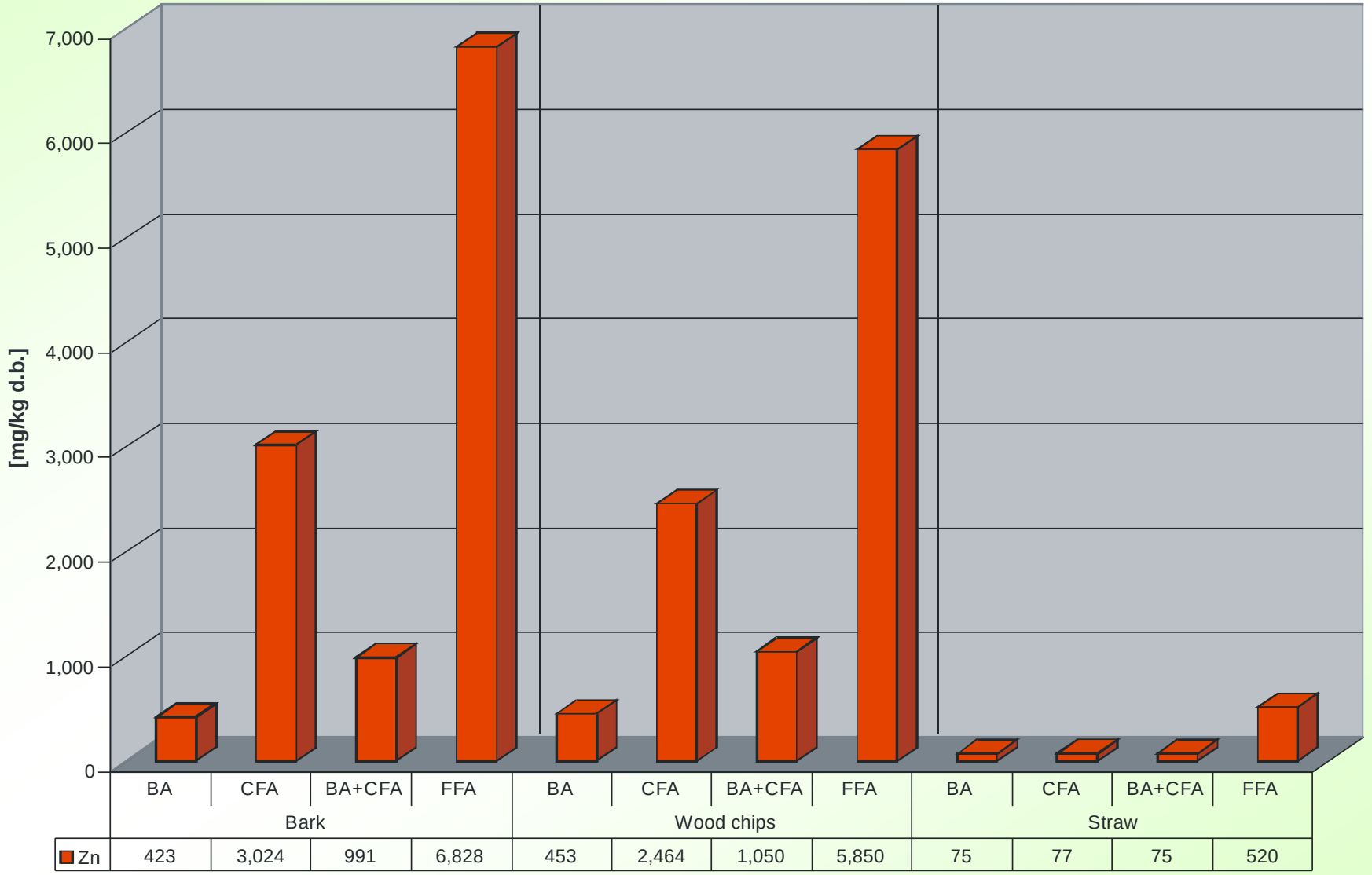
Typical contents of volatile heavy metals in biomass ashes (II)



Explanations: BA … bottom ash, CFA … cyclone fly ash, BA + ZFA … bottom + cyclone fly ash as generated

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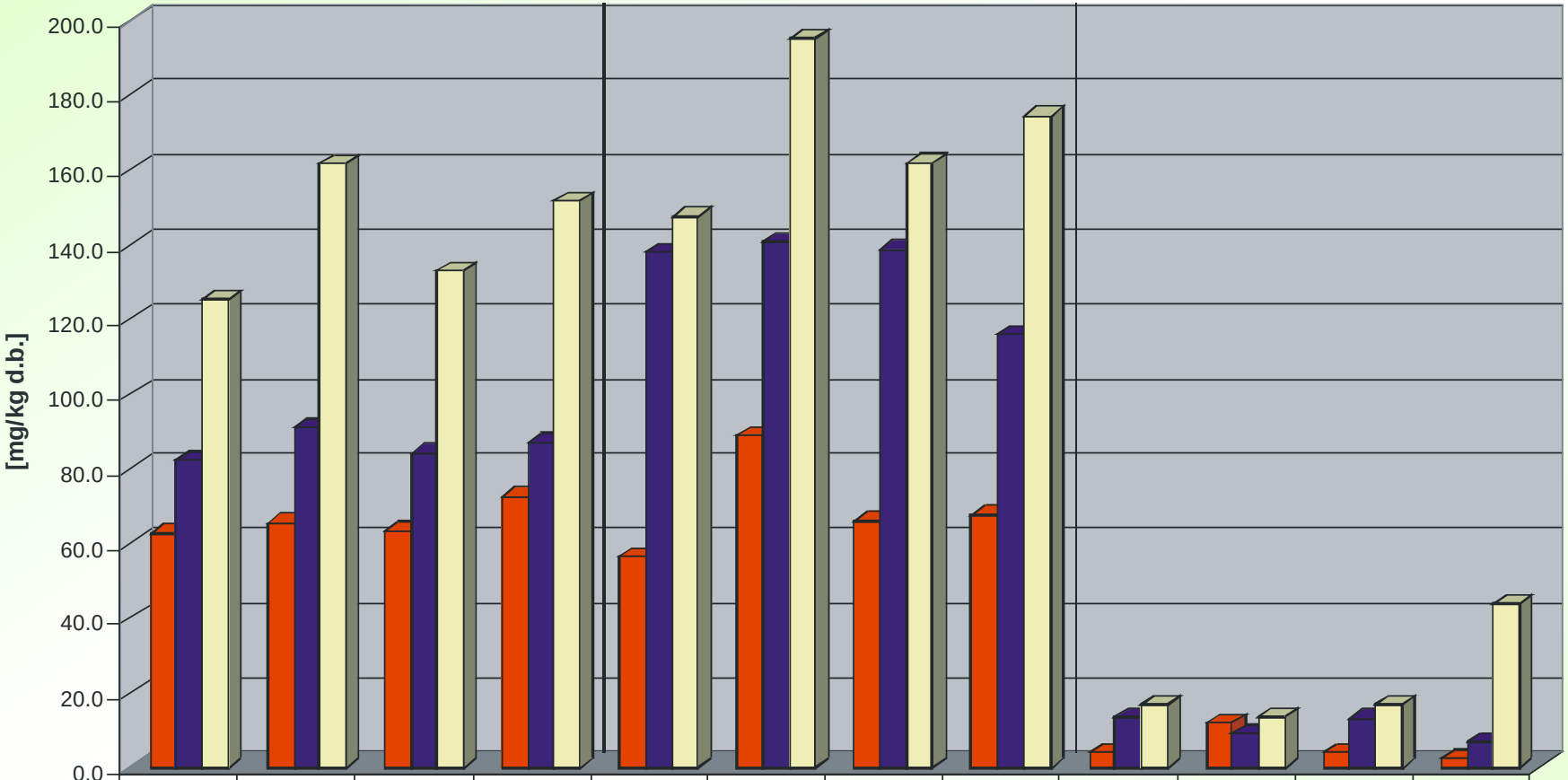
Typical contents of semi- and non-volatile heavy metals in biomass ashes

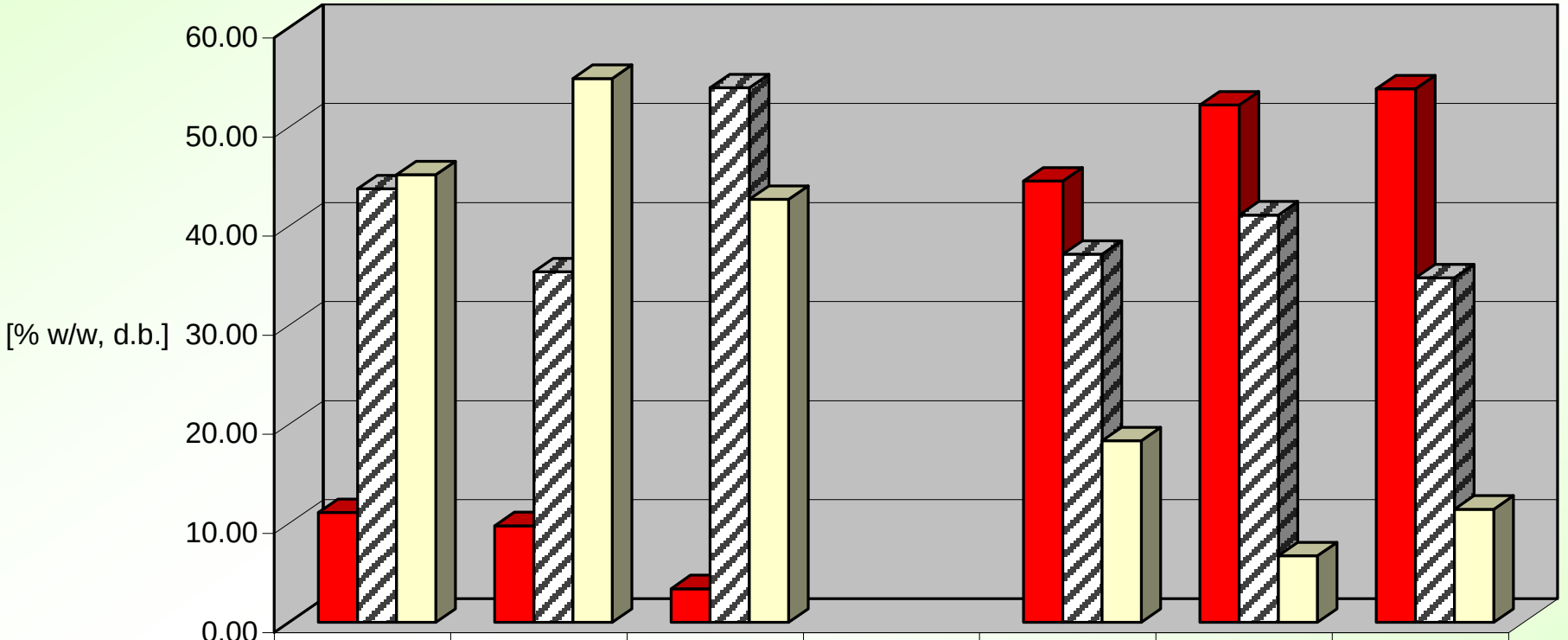


	Bark				Wood chips				Straw			
	BA	CFA	BA+CFA	FFA	BA	CFA	BA+CFA	FFA	BA	CFA	BA+CFA	FFA
Ni	62.8	65.6	63.4	72.7	56.6	89.1	66.2	67.8	4.0	11.9	4.3	2.5
Cr	82.4	91.2	84.3	87.1	138.0	140.7	138.8	116.0	13.5	9.1	13.3	6.8
Cu	125.3	161.6	133.2	151.9	147.7	195.4	161.9	174.6	17.0	13.6	16.9	44.0

Explanations: BA … bottom ash, CFA … cyclone fly ash, BA + ZFA … bottom + cyclone fly ash as generated

Distribution of heavy metals to the individual ash fractions

Bark or wood chip-fired grate furnaces



	Zn	Pb	Cd		Cu	Ni	Cr
Bottom ash	11.1	9.7	3.4		44.5	52.2	53.8
Coarse fly ash	43.7	35.4	53.9		37.1	41.1	34.8
Fine fly ash	45.2	54.9	42.7		18.3	6.7	11.4

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Comparison of typical heavy metal contents in biomass ashes with the limiting values of the Austrian biomass ash guideline*

Parameter	Bark				Wood chips				Straw				Guideline *	
	BA	CFA	BA+CFA	FFA	BA	CFA	BA+CFA	FFA	BA	CFA	BA+CFA	FFA	Class A	Class B
As	6.4	10.6	7.3	31.2	5.8	9.2	6.8	31.5	5.0	27.9	5.9	22.0	20	20
Cd	1.8	21.3	6.0	36.7	2.0	20.9	7.6	32.9	0.2	0.8	0.2	5.2	5	8
Cr	82.4	91.2	84.3	87.1	138.0	140.7	138.8	116.0	13.5	9.1	13.3	6.8	150	250
Cu	125.3	161.6	133.2	151.9	147.7	195.4	161.9	174.6	17.0	13.6	16.9	44.0	200	250
Ni	62.8	65.6	63.4	72.7	56.6	89.1	66.2	67.8	4.0	11.9	4.3	2.5	150	200
Pb	10.9	62.7	22.3	218.5	15.4	70.5	31.8	258.8	5.1	11.4	5.4	80.0	100	200
Zn	422.5	3,024.1	991.3	6,828.3	452.9	2,464.3	1,049.7	5,849.8	75.0	77.0	75.1	520.0	1,200	1,500

- The values in the table represent typical heavy metal contents of ashes from grate combustion. Due to the natural fluctuation range of the fuels used, the contents can in some cases be lower, so that mixtures of coarse and cyclone fly ash from wood chip and bark furnaces can also comply with the class A limit values of the Austrian biomass ash guideline *.

- Ashes from fluidized bed combustion show a tendency towards lower heavy metal contents due to the dilution with bed material (mostly quartz sand, SiO_2).

* Bundesministerium für Land- und Forstwirtschaft, Umwelt und Wasserwirtschaft, Fachbeirat für Bodenfruchtbarkeit und Bodenschutz, 2017: Richtlinie für den sachgerechten Einsatz von Pflanzenaschen zur Verwertung auf land- und forstwirtschaftlich genutzten Flächen (Grenzwerte für Flusssäureaufschluss)
Explanations: BA … bottom ash, CFA … cyclone fly ash, BA + ZFA … bottom + cyclone fly ash as generated, FFA … fine fly ash

Cr VI in biomass ashes (I)

- According to the applicable national fertilizer law as well as the new EU Fertilizer Regulation, the limit value for Cr VI of 2 mg / kg d.b. must be observed for the use of ashes as fertilizer. For this reason, this limit was also added to the Austrian biomass ash guideline in 2017.
- Since then, this limit value has led to problems for several operators of biomass heating (power) plants, as the ashes often have excessively high Cr VI values. Cr VI values in wood ashes can be between <1 mg / kg (own analyzes) and well above 10 mg / kg. No data are available for straw ashes.
- There is no correlation between the total Cr content and the Cr (VI) content in the ashes.
- It is practically not possible to influence the Cr VI content by means of appropriate combustion-related measures, so only measures for ash treatment are possible.

Cr VI in biomass ashes (II)

- In principle, the aging of the ash with the addition of water, i.e. the naturally occurring reduction processes (converting the quicklime content with water + carbonation → lowering the pH → reducing Cr VI to Cr III) should enable a reduction in the Cr VI content. However, this requires sufficient storage capacity, because this process takes space and time.
- Investigations in the course of intermediate storage tests (see section "Intermediate storage") showed Cr VI contents in the untreated ashes below the limit value, but a significant reduction in the Cr VI content in the ashes could not be observed over a storage period of 24 weeks.
- The addition of reducing agents such as iron (II) sulfate can accelerate the reduction of Cr VI to Cr III.

Organic pollutants (I)

- PCDD / PCDF‘s (polychlorinated dibenzo-p-dioxins and dibenzofurans) and PAK‘s (polycyclic aromatic hydrocarbons) were considered as organic pollutants in plant ashes.
- Even small amounts of PCDD / PCDF‘s can promote the development of cancer from previously damaged cells and are hardly broken down in the environment.
- Almost all polycyclic aromatic hydrocarbons that consist of more than four benzene rings, including benzo- [a] -pyrene, have been shown to be carcinogenic.
- Unburned carbon (C_{org}) itself is not a pollutant, but it is an indicator of incomplete burnout of the fuel.
- The content of unburned C_{org} in wood ashes typically correlates well with the content of organic pollutants.

Organic pollutants (II)

- In general, the most complete burnout possible (<5% C_{org}) should be aimed for, as this automatically minimizes the formation of organic pollutants → accordingly, according to the Austrian biomass ash guideline with a C_{org} content of <5%, no organic pollutant analysis is required the ashes required.

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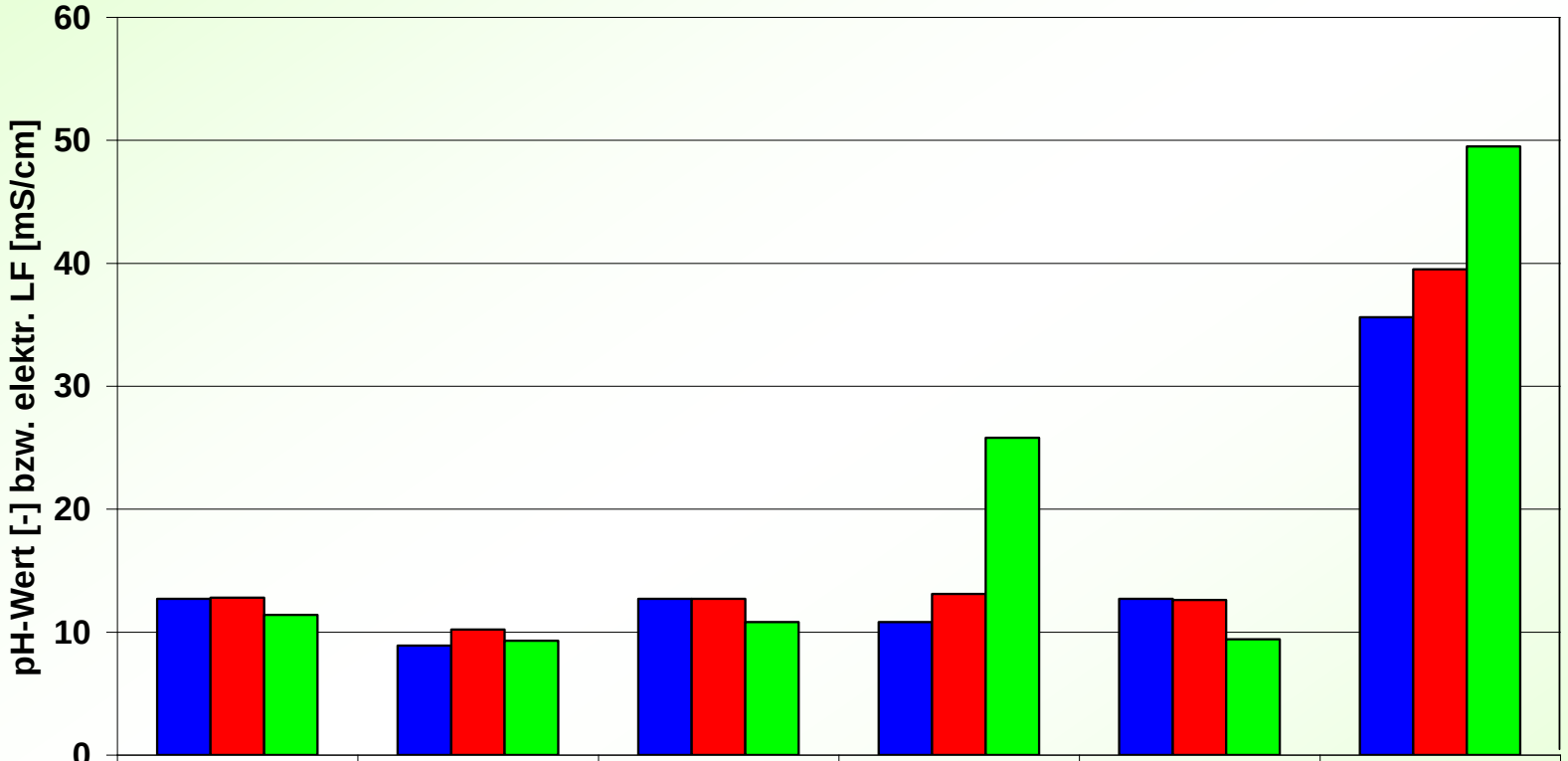
pH-value and electric conductivity of biomass ashes



	Grobasche		Zyklonasche		Feinstflugasche	
	pH-Wert	elektr. LF	pH-Wert	elektr. LF	pH-Wert	elektr. LF
Rinde	12,7	8,9	12,7	10,8	12,7	35,6
Hackgut	12,8	10,2	12,7	13,1	12,6	39,5
Stroh	11,4	9,3	10,8	25,8	9,4	49,5

Methodology: pH-value according to EN ISO 10390, el. conductivity with water extraction 1:10, measurement according to ÖNORM M 5883

Legal framework conditions for landfilling of biomass ashes in Austria

- When dumping biomass ashes, the applicable Austrian Landfill Ordinance must be observed.
- For biomass ashes, landfills for residues (“Reststoffdeponie”) or bulk waste (Massenabfalldeponie”) are usually possible.
- In the case of landfills for residues, a limit value for the pH value of 12 generally applies. However, according to Section 9 of the Landfill Ordinance, biomass ash and other alkaline residues from thermal processes may be deposited up to a pH value of 13 if the prescribed framework conditions are complied with.
- In the case of bulk waste landfills, the limit values for heavy metal content must be observed (in particular for Cd and Zn in fly ash from bark and wood chip firing).

Impact factors on ash quality

Impact factors on ash quality and quality assurance

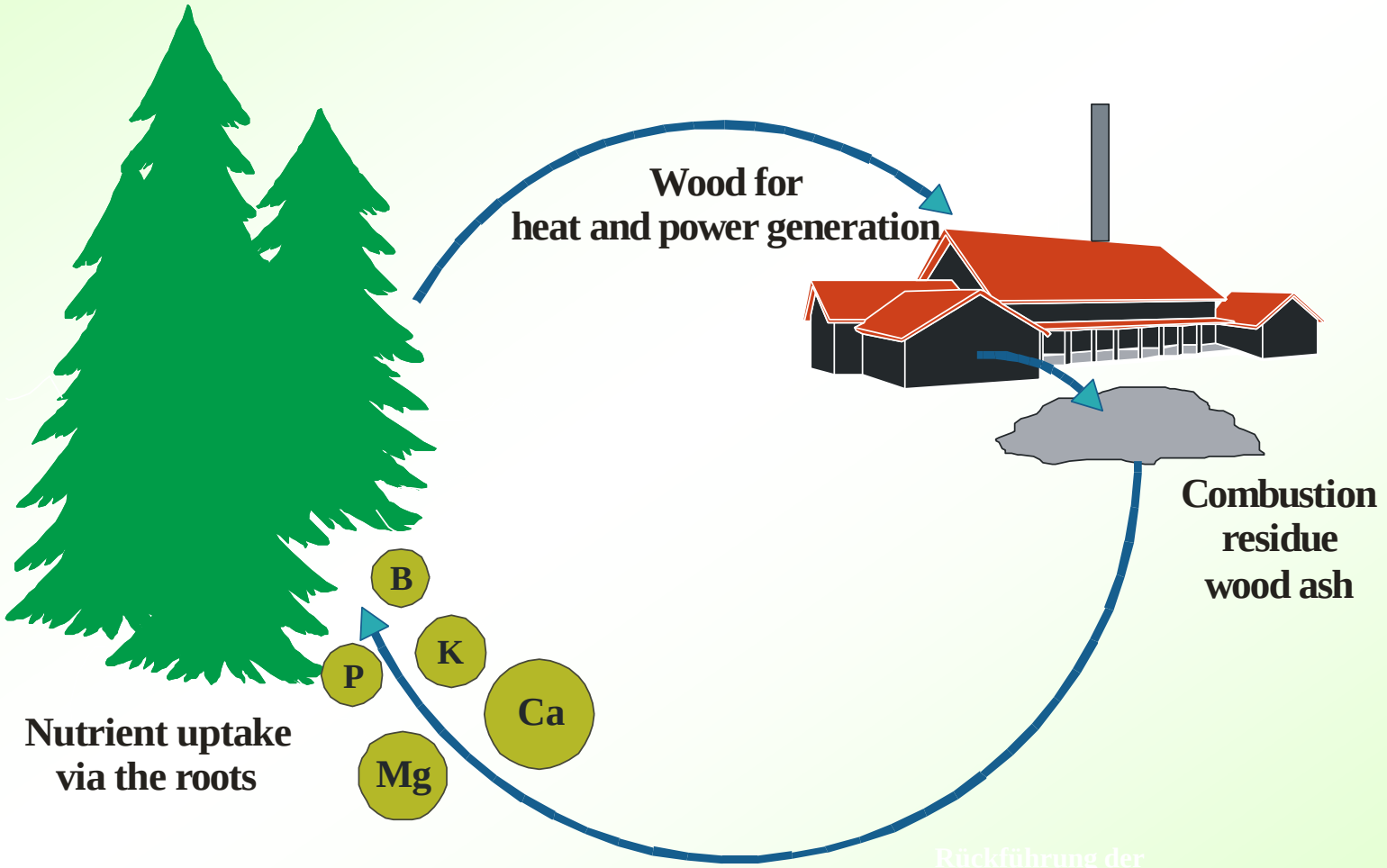
- **Incoming inspection of the fuels or appropriate fuel selection**
  - The chemical composition of the fuel forms the basis for the chemical composition of the ash fractions arising from the fuel.
  - **Only biomass ashes from the incineration of chemically untreated material may be used for recycling on agricultural and forest areas!**
- **Firing technology, plant control and flue gas cleaning technology influence the amount and chemical composition of the ash fractions.**
- **Monitoring the ash composition for key parameters (e.g. C_{org}) and checking the ash quantities.**

Measures to improve the quality of the ash

- **Use of appropriate firing and dust separation technologies:**
  - Ensuring as complete a combustion as possible (keep the C_{org} content in the ash low)
  - Appropriate design of the grate and combustion chamber to keep fly ash discharge as low as possible (for fixed bed combustion systems)
  - Sub stoichiometric mode of operation (λ <1) in the primary combustion zone (appropriate air staging)
  - Return of the boiler ash or the cyclone fly ash to the grate (especially in the case of burnout problems)
  - Separate collection of coarse and fine fly ash
  - Wet ash removal to reduce the dust problem

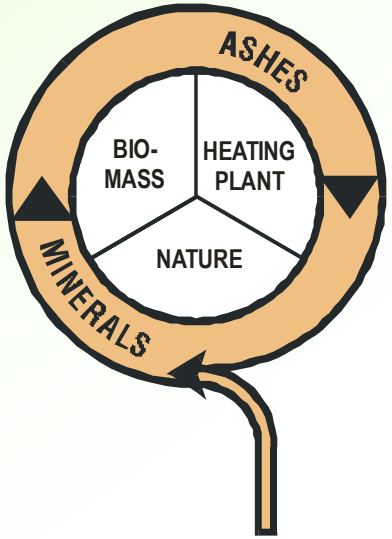
Possible paths of ash utilisation

Ideal ash cycle



Stable and unstable ash recycling system

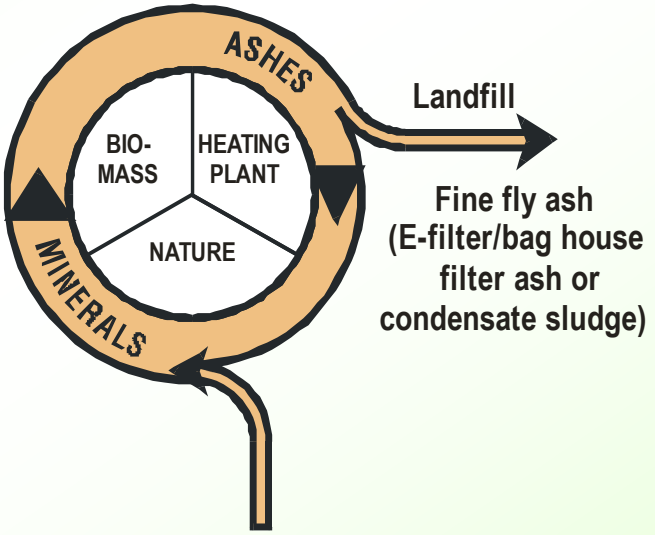
UNSUSTAINABLE
UNSTABLE CYCLE DUE TO ACCUMULATION OF POLLUTANTS



Wet and dry deposition
of heavy metals from air and rain

**DISRUPTION
OF THE NATURAL CYCLE
THROUGH POLLUTION**

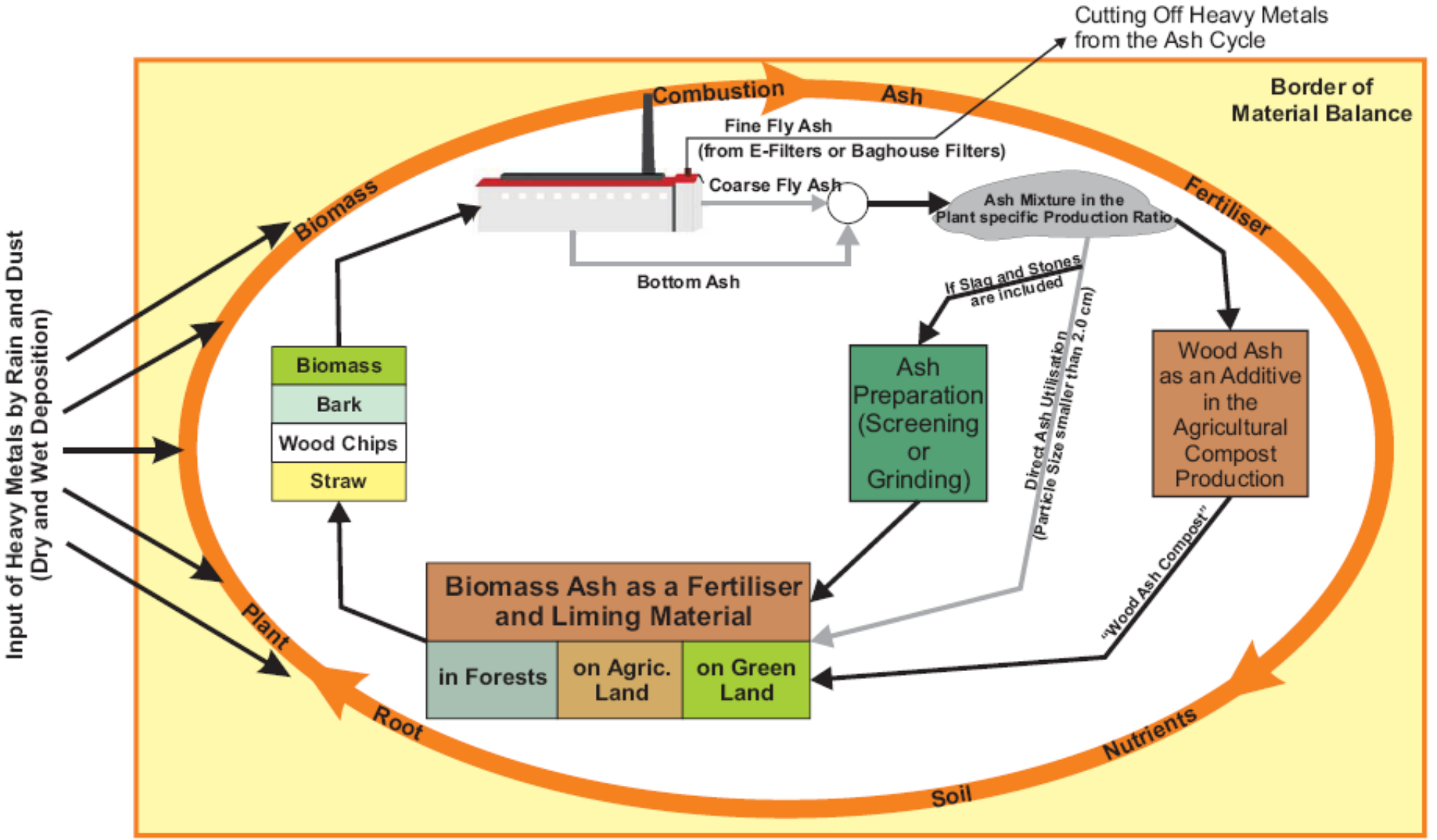
SUSTAINABLE
STABLE CIRCULATION



Wet and dry deposition
of heavy metals from air and rain

**STABILISATION
BY REMOVING A SIDE STREAM
ENRICHED WITH HEAVY METALS**

Sustainable economy with the secondary raw material biomass ash



Ash processing - logistics

- Recycling of bottom ash or mixtures of bottom and coarse fly ash as generated in the biomass combustion plant, if they are mixed within the ash conveying system and the individual fractions comply with the limit values.
- Ash manipulation as dust-free as possible.
- Sufficient dimensions of the ash storage in the heating (power) plant (ash utilization in spring / summer, accumulation all year round → correspondingly large storage capacities necessary) or alternatively intermediate storage in external storage locations (see next slides).
- Providing the ash in a spreadable state (i.e. free from metal pieces, slag and stone fractions with grain sizes over 1.0 cm) → Processing (sieving) necessary.
- Decision between direct (e.g. using a screw spreader or blowing device) or indirect ash recycling (composting)

Intermediate storage of ashes - Background

- 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 intermediate storage of wood ash was evaluated in detail within the course of the R&D project (funded by the Austrian Research Promotion Agency (FFG)), „Development of innovative processes for wood ash utilisation“, (project leader: Fachverband der Holzindustrie; scientific project manager: BIOS BIOENERGIESYSTEME GmbH).

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Intermediate storage of ashes – recommended storage conditions (I)

- The type of intermediate storage depends on the ash to be stored and in particular on the intended use of the ash.
- Together with the Association of the Wood Industry and other project partners, BIOS has created a factsheet on this topic as part of the research project mentioned above, in which both technical questions and the current legal status in Austria are explained.
- The factsheet can be downloaded from the BIOS homepage.

Intermediate storage of ashes – recommended storage conditions (II)

- Utilisation in agriculture and forests
  - Agricultural areas (high CaO content desirable, no aging required, dry intermediate storage in a container, silo or in piles)
  - Forests and grassland areas (high CaCO3 content desirable, aging by water addition during intermediate storage meaningful, storage in piles)
- Utilisation as a binder in soil stabilization (e.g. for road construction → potential future utilization path)
  - high CaO content desirable, no aging required, dry intermediate storage in a container, silo or in piles

Intermediate storage of ashes – recommended storage conditions (III)

- If an ageing of the ash is desired, the following procedure is recommended:
  - 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.
  - 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 composting) several times during storage.
  - In order to avoid leaching of the ashes the heaps shall be covered with breathable but water tight sheets.
  - Dosed addition of water at the beginning of storage based on the Ca content of the ashes

Intermediate storage of ashes – recommended storage conditions selection of ashes

- **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 the combustion plant 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.

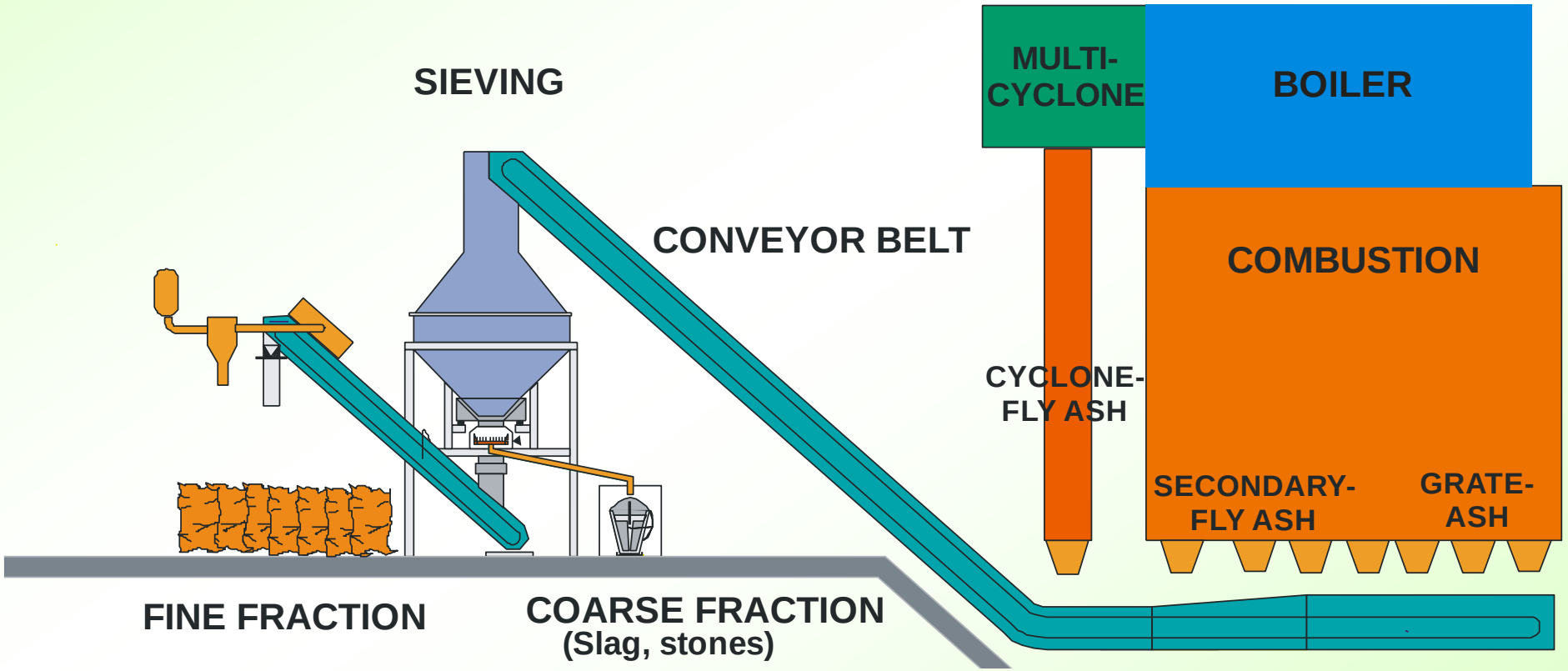
→ Based on the results of the laboratory and field tests performed within the scope of the project the specific ageing of biomass ashes during intermediate storage can be only recommended for bottom ashes and mixtures of bottom and coarse fly ashes as generated in grate furnaces.

Ash processing – appropriate technology (I)

Usually necessary process steps for direct ash application

- Sieving (throwing power is only given for grain sizes up to 1 cm)
- Metal separation (problems with application, endangerment of wild animals during application on agricultural and forestry areas)

Ash processing – appropriate technology (II)



Possible sustainable paths of ash utilization (I)

- **Use as a secondary raw material with fertilizing and soil-improving effects in agriculture and forestry (including short rotation areas)**
  - Direct application via lime, fertilizer or compost spreaders or alternative application technologies (e.g. helicopter)
  - Indirect application via use as an aggregate for composting
- **Use as a raw material for the production of fertilizers**
  - Since the 2017 amendment to the Austrian Fertilizer Act, combustion residues are no longer generally excluded from the fertilizer sector. This enables fertilizer products with ash as the starting material to be placed on the market after obtaining individual approval in accordance with the Austrian Fertilizer Act.

Possible sustainable paths of ash utilization (II)

- **Use as a raw material for the production of fertilizers (cont.)**
  - On July 16, 2019, the new EU fertilizer regulation ((EU) 2019/1009) came into force (national implementation by July 16, 2022). On the basis of the regulation, the Commission can include biomass ash and other potential raw materials (e.g. struvite, a phosphate-containing mineral recovered from wastewater, or biochar) as permitted raw materials for fertilizers (listed in Annex II of the regulation) within the framework of delegated acts. The delegated acts for biomass ash, struvite and biochar were presented to the fertilizer expert group in the Commission in autumn 2019.
  - In summer 2021, the EU Commission adopted a delegated act ((EU) 2021/2087) on the new EU Fertiliser Products Regulation 2019/1009, which regulates the use of "materials from thermal oxidation" for the production of EU fertiliser products. The annexes to the delegated act regulate the feedstocks, quality requirements (heavy metals, organic pollutants, etc.) and process requirements such as combustion temperature, which must be met by biomass ashes, among others.

Utilisation on agricultural areas and in forests (I)

- Application recommendations from the federal government (for arable land, grassland, forest), published by the Advisory Board for Soil Fertility and Soil Protection at the Federal Ministry for Agriculture, Forestry, Environment and Water Management, are available, but no statutory guideline:

  Guideline for the appropriate use of biomass ashes for recycling on areas used for agriculture and forestry

  - The guideline contains limit values for the ashes, as well as maximum application rates on the individual areas
  - All ash fractions with the exception of fine fly ash can be used, provided that the limit values according to the guideline can be complied with
  - Addition 2015 (limit values also for aqua regia digestion)
  - Addition 2017 (Cr VI limit value added)

Utilisation on agricultural areas and in forests (II)

- Together with the Austrian Association of the Wood Industry and other project partners, BIOS has created a factsheet on this topic as part of the research project mentioned above, in which both technical questions and the current legal status in Austria are explained.
- The factsheet can be downloaded from the BIOS homepage.


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: Proper utilization of biomass ash on agricultural and forest soils

Direct ash application on agricultural and grass land

- **The spreading of biomass ashes on agriculturally used soils (also short rotation areas) can be done with conventional spreaders suitable for lime or with compost spreaders**

  - Auger spreaders (see picture) or pendulum spreaders with dust protection have proven to be suitable spreading devices
    - \+ Relatively little dust generation
    - \+ Good distribution accuracy

  - Compost spreaders (see picture) are also suitable for spreading wood ash
    - \+ moderate dust development
    - \+ simple operation, few wearing parts

Direct ash application on forest land

- Side spreaders (see picture) can be used for spreading plant ash in the forest
  - + Robust construction, throwing distances up to 25 m
  - – Application on one side only
  - – Dust generation

- Helicopters (see picture) are mainly used in Germany and Sweden
  - + Great flexibility (with poor accessibility, steep slopes)
  - – Relatively high cost
  - – Relatively poor distribution accuracy

- Blowing devices can also be used, but show a very high level of dust generation and poor distribution accuracy.

Indirect ash utilisation via composting (I)

- **Besides direct ash application biomass ash can also be used as an additive in compost production (indirect ash application)**

- **Advantages compared to direct ash application:**
  - No problems of dust formation
  - No pre-treatment necessary → impurities are sorted out during the composting process
  - The addition of ash can reduce the time required for the composting process and can improve the compost structure
  - Reduction of the pH-level of the ash due to carbonation

Indirect ash utilisation via composting (II)

- Research results from the FFG industry project mentioned above show that additions of up to 8 wt% (wet basis) are ecologically sensible.
- According to the current Austrian Compost Ordinance, only an additional amount of 2 wt% (wet basis) is allowed.
- An amendment to the Compost Ordinance has been in the works since 2020. The amendment is currently under review. The inclusion of ash as a permitted raw material for the production of fertilisers ((EU) 2021/2087) in the EU Fertiliser Regulation ((EU) 2019/1009), which has already been decided at EU level in 2021, would then also have to be taken into account in an amendment to the Compost Ordinance.

Outlook for potential utilisation paths in the future

Outlook for potential utilisation paths in the future

- **In addition to already established processes for the use of wood ash in agriculture and forestry, innovative wood ash recycling methods were also examined as part of the aforementioned FFG industry R&D-project on wood ash utilization, which should expand the possibilities for wood ash recycling in the future.**
- **Due to the Ca content of the wood ashes, the admixture as a binding agent to the subsoil material for soil stabilization is of particular interest.**
- **The following recycling options were specifically examined:**
  - Use in forest road construction
  - Use in road construction for soil stabilization

Utilisation in soil stabilisation (e.g. road construction) – relevant results

- In the correct dosage, both grate ash and mixtures of grate and cyclone fly ash from grate furnaces and fly ash mixtures from fluidized bed furnaces represent a very good alternative to lime as a binding agent.
- Mixing rates in the range of 10 to 15% by weight based on the dry soil mass can be given as a guideline (tests in the laboratory based on ÖNORM B 4710-1 to determine the ideal mixing rate are recommended before using the ashes).
- When using bottom ash or mixtures of bottom and coarse fly ash from grate furnaces and fly ash from fluidized bed furnaces, there is no risk to the groundwater if the recommended mixing rates are used.

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Utilisation in soil stabilisation (e.g. road construction) – technical application

Fly ash from fluidised bed combustion (road construction)

Mixture of bottom and coarse fly ash from fixed bed combustion (road construction)

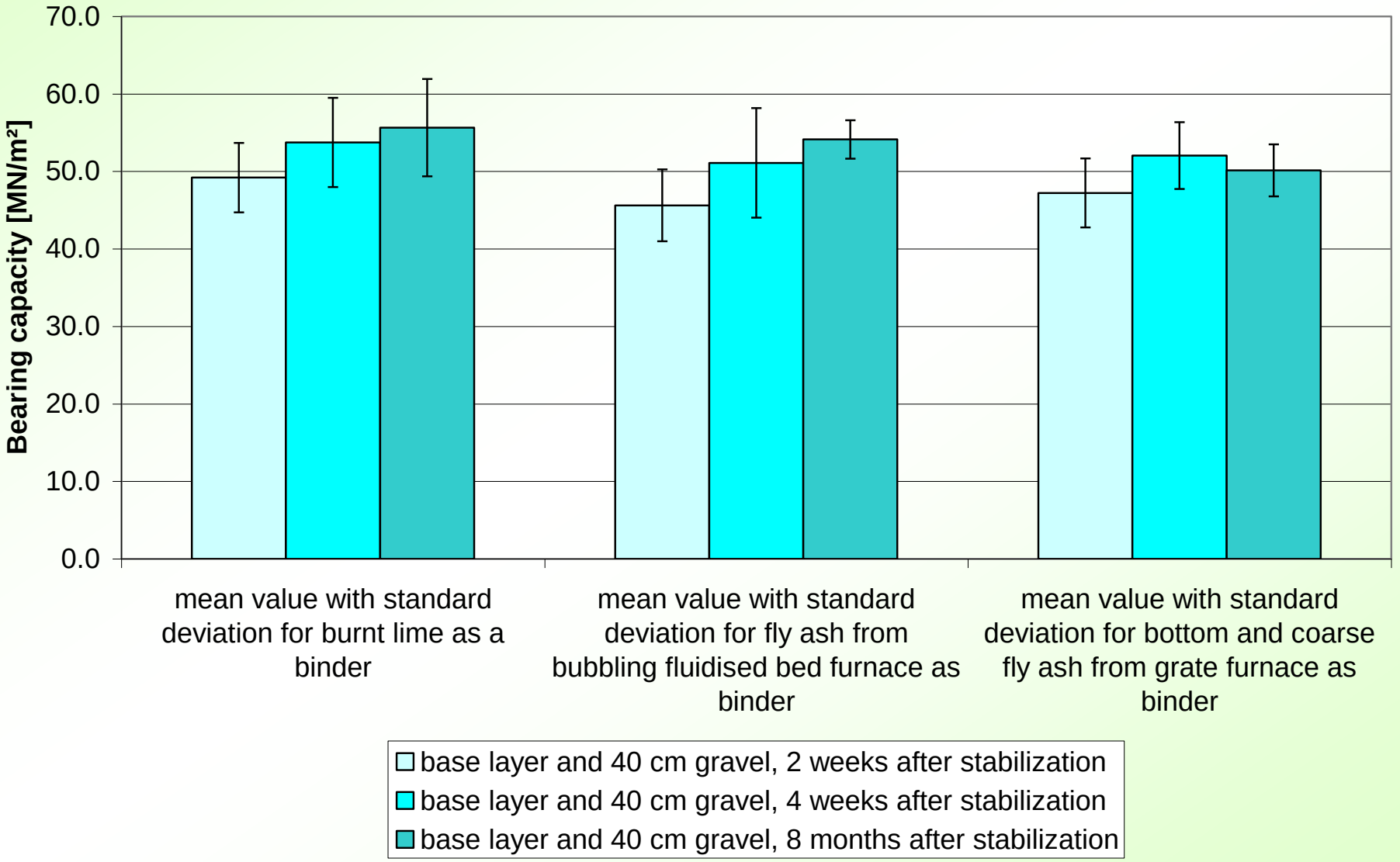
Bottom ash (forest road construction)








Utilisation in road construction – results of the field test



Utilisation in soil stabilisation (e.g. road construction) – suitable ash fractions

- **Ash fractions:**
  - bottom ash or mixtures of bottom and coarse fly ash from grate furnaces
  - fly ash from fluidized bed furnaces
- **Physical properties:**
  - Particle size < 1mm (grinding of bottom ashes necessary) if used in road construction, no limits for forest road construction
  - Dry!
- **Chemical properties:**
  - Ca content of the ash > 15 wt% dry basis → bottom ash from fluidised bed furnaces are not suitable as it is diluted with bed material
  - Limited contents of heavy metals allowed based on the results of the environmental impact assessment (critical parameters: Zn, Pb und Cd) → fine fly ash from fixed bed combustion is not suitable

Utilisation in soil stabilisation (e.g. road construction) – ecological benefits

- **Saving of CO2 emissions**
  - The production of one ton of quicklime releases 990 kg of CO_2
- **Conservation of non-renewable resources**
  - Reduction of limestone mining
    - Reduction of dust emissions
    - Reduction of the loss of fertile surface

Utilisation in soil stabilisation (e.g. road construction) – legal status (I)

- **Legal status**
  - There is currently no specific legal basis for the use of ash as a binding agent for soil stabilization.
  - An AlSAG (federal law on the financing and implementation of the remediation of contaminated sites) tax obligation can be excluded on the basis of the legal opinion available.
  - **Implementation in industrial practice is therefore currently not possible without a lengthy administrative procedure.**

Utilisation in soil stabilisation (e.g. road construction) – legal status (II)

- **Legal status (cont.):**
  - Together with the Austrian Association of the Wood Industry and other project partners, BIOS has created two fact sheets on this topic as part of the wood ash research project mentioned above, in which both technical questions and the current legal status in Austria are explained.
  - The factsheets can be downloaded from the BIOS homepage.


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: Utilisation of wood ash as a binder for soil stabilisation e.g. in road construction


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: Utilization of wood ash in forest road construction

Utilisation in soil stabilisation (e.g. road construction) – further procedure

- **Further procedure:**
  - **Preparation of a guideline** in which the technical, ecological and legal framework conditions for the proper use of wood ash as a binding agent in road construction are defined.
  - **Objective:** Creation of a uniform procedure for heating plant operators and recyclers, coordinated with the authorities, rapid approval and end of the term waste for the wood ash used as a binding agent.

Summary and conclusions

Summary and conclusions (I)

- Plant ashes contain important plant nutrients but also heavy metals, which do not allow uncontrolled use of the ashes.
- In order to keep the mineral cycle of nature largely stable in the course of thermal biomass utilisation, the smallest possible and pollutant-rich partial flow should be discharged from the process, the rest should be returned to the soil in a controlled manner in the sense of a sustainable circular economy.
- Only ash from the combustion of chemically untreated biomass can be used for return to agricultural and forestry areas.

Summary and conclusions (II)

- In principle, direct application to the soil or indirect use via composting is possible.
- Appropriate monitoring and analyzes are required in accordance with existing guidelines or ordinances / laws in Austria.
- Cr VI is partly a problem for direct application on soils, which can make post-treatment of the ash necessary
- There is currently no legal framework in Austria for alternative recycling routes, above all the use as a lime substitute for soil stabilization

Summary and conclusions (III)

- In most cases, the ash needs to be processed; The minimum requirements are sieving and metal separation → this does not apply to indirect use via composting, where appropriate processing steps are carried out as part of the composting process.
- Concerning logistics, it is important to provide appropriate intermediate storage facilities for the ash, as the ash may not be utilised all year round. In this context, it can make sense to age the ash during storage by adding targeted water to improve the chemical and physical properties of the wood ashes when used on forest and green areas.

Summary and conclusions (IV)

- Current research results show that wood ash can also be used as a binding agent in forestry and road construction for soil stabilization.
- Results from the field tests carried out with accompanying measurements and analyzes show that when using the correct aggregate amounts (10 to 15% by weight based on the dry soil mass), quicklime can be substituted by wood ash as a binding agent and no negative effects on the environment (groundwater) are to be expected.
- Work is currently underway on the preparation of a guideline that defines the technical, ecological and legal framework for the proper use of wood ash as a binding agent in road construction in order to create a uniform procedure for heating plant operators and recyclers that has been coordinated with the authorities.

Selected references related to ash utilisation

Investigation of possible utilisation paths for ashes from wood chips or bark-fired combustion plants

- Partners: University of Natural Resources and Life Sciences, Vienna, Graz University of Technology, Styrian Chamber for Agriculture and Forestry
- Investigation of the utilisation of wood ash as a fertilising agent on agricultural and forest land

Utilisation of wood ashes in composting

- Partners: Graz University of Technology
- Investigation of the effects of the admixture of wood ash as an additive to composting

Development of innovative processes for wood ash utilisation

- Customer: Fachverband der Holzindustrie Österreichs
- Project within the "Collective Research" program of the FFG to evaluate and develop innovative processes for wood ash utilisation

Field test regarding the storage of wood ash

Reduction of the Heavy Metals Content in Bottom Ashes from Biomass Installations

- Customer: ENBW, Germany
- Research project regarding the reduction of the heavy metal contents in grate ashes from biomass combustion plants

Analysed bottom and filter ash

Feasibility study for the Leader region Holzwelt Murau

- Customer: Umweltbundesamt GmbH, Vienna, Austria
- Feasibility study for the regional utilisation of wood ashes from biomass plants in the region of Murau

HOLZWELTMURAU

Analysis and evaluation of the bottom and cyclone fly ash of the biomass CHP plant in Lienz

- Customer: Stadtwärme Lienz, Austria
- Preparation of an ash utilisation and logistics concept for the biomass district heating plant Lienz (Tyrol, Austria)

Stadtwärme
Lienz

EDF Ash Study

- Customer: EDF, France
- Preparation of a study regarding ash related problems in biomass combustion plants as well as evaluation of selected plant manufacturers regarding the state-of-the-art concerning the reduction of ash related problems in fixed-bed biomass combustion systems

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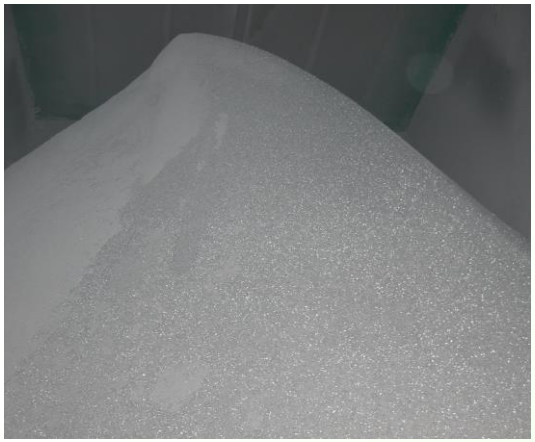
BIOMASS ASH UTILISATION
Characteristics – processing – utilisation options – references



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Auszeichnung des Landes Steiermark

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