

Institut für Bioenergie

Analysis of critical feedstock parameters
An overview

Dr. Martin Englisch

BEA Institut für Bioenergie GmbH

A-1150 Wien,
Avedikstrasse 21
www.bioenergy.institute

About us

BEA offers technical services for production and thermal utilization of solid biofuels, especially pellets.

Engineering and consultancy

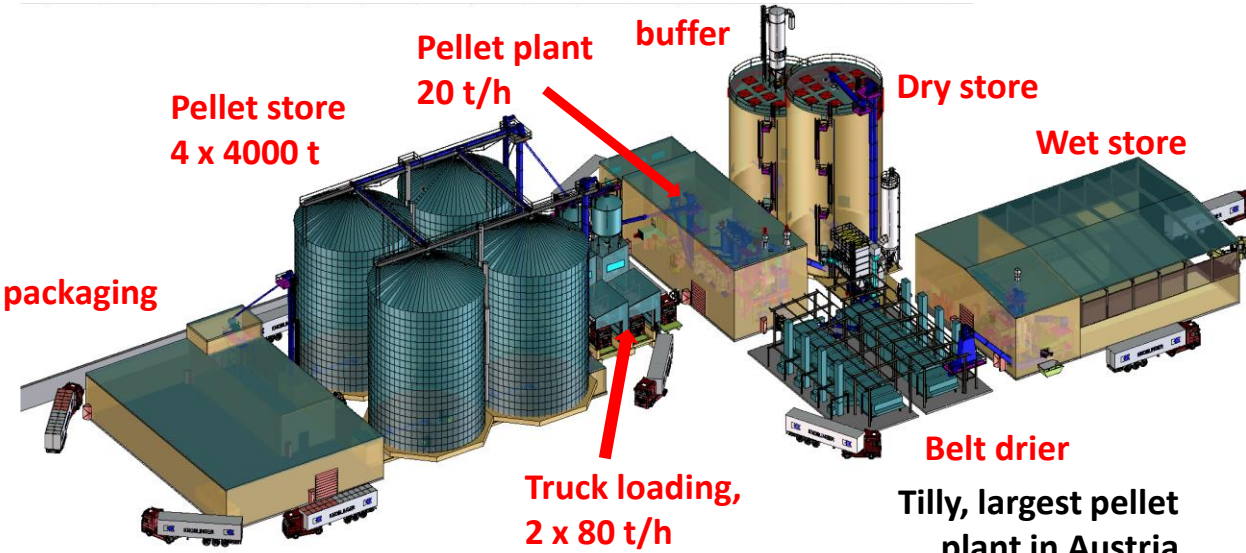
- Process Development (e.g. Torrefaction)
- Engineering incl. permissions for pellet plants
- Business plans and Feasibility studies



Source: Gutmann



Source: Andritz AG



About us

Production and supply of lab equipment

- For pellet plants
- For fuel laboratories

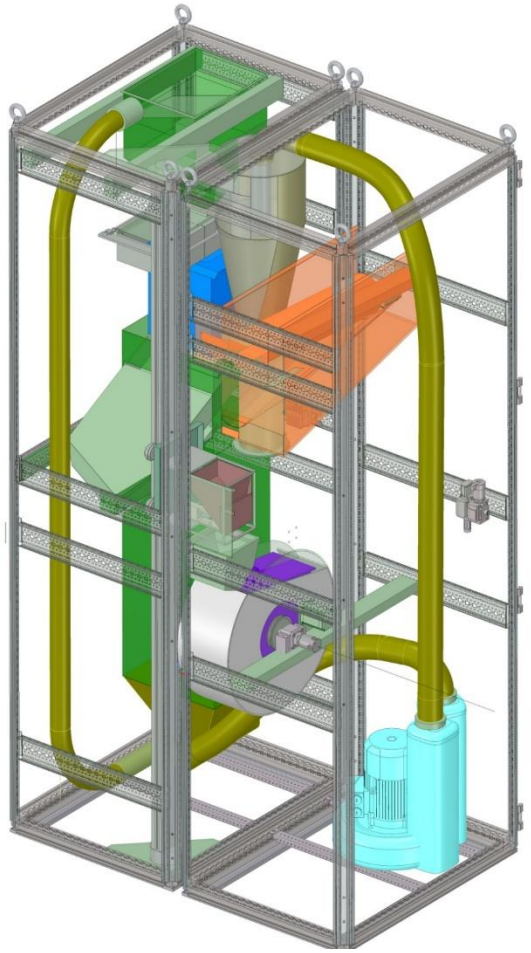
Fuel analysis and Quality control

- Accredited laboratory for solid fuel analysis
- Analysis for industry, samples worldwide: 1000+ samples / a
- EN*plus*®/DIN*plus* certification:

  150+ pellet plants worldwide
- Experts with > 20 years experience



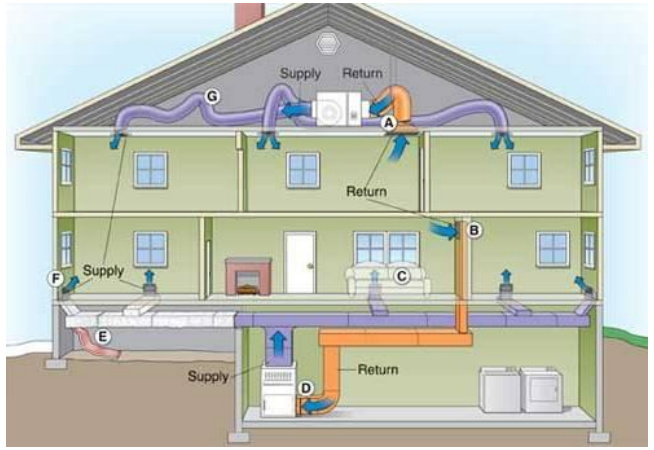
BEA lab equipment


professional pellet analyzer

Biomass use is divers



Power generation
~ 50% of current pellets use



Heat & hot water
Residential/ commercial/ institutional
~ 50% of current pellets use

Source: Wood Pellet Association of Canada

Animal bedding & oil patch absorbent & Smoking stove
High price, low quantity





Cooking
Logwood, charcoal and starting: pellets
Africa/Asia







Source: Mimimoto

Fuel requirements are different

Cook stoves

- dimensions, water content
- ignition behavior, ash content

Pellet boilers

- contamination (foreign objects)
- oversizes, fines content
- ash melting behavior

Power plants

- chlorine, nitrogen
- major elements
- heavy metals

Industry

- heating value
- major elements, heavy metals



Source: Gilles Gauthier





Source: Drax



Source: Lafarge

Fuel specification and classes

International standards series: ISO 17225

- Part 1: general requirements
- Part 2: wood pellets
- Part 3: wood briquettes
- Part 4: wood chips for small applications
- Part 5: firewood
- Part 6: non-woody pellets
- Part 7: non-woody briquettes
- Part 8: thermally treated biomass (TS)
- Part 9: graded hog fuel and wood chips for industrial use

➢ More to come if there is a need



ÖNORM
EN ISO 17225-1
Edition: 2021-11-01

Solid biofuels — Fuel specifications and classes
Part 1: General requirements
(ISO 17225-1:2021)

Biogene Festbrennstoffe — Brennstoffspezifikationen und -klassen —
Teil 1: Allgemeine Anforderungen
(ISO 17225-1:2021)

Biocombustibles solides — Classes et spécifications des combustibles —
Partie 1: Exigences générales
(ISO 17225-1:2021)

Key properties of solid biofuels

Is it possible to derive the combustion properties from visual appearance?

Only in few cases with high experience!

And even then you may be wrong





?

EN plus A1 ISO 17225-2

Key properties of solid biofuels

- Contaminations
- Ash content

→

- Increased wear of machines
- Damage of machines
- More cleaning, cost for disposal

- Moisture content
- Calorific value

→

- Bad combustion: smoke, incomplete
- Loss in efficiency
- Higher fuel costs, higer transport costs

- Chemical composition:
  Cl, S, N, heavy metals

→

- Corrosion
- Emissions and health issues

Contamination



Metals in wood chips



Stones in forest chips

Plastic, coatings, paints,…

in recycled wood



Typical contaminants:

- Metals
- Stones
- Sand and soil
- Chemical contamination

Examples for sophisticated contaminations

Coconut husk pellets: Contamination from poor processing equipment

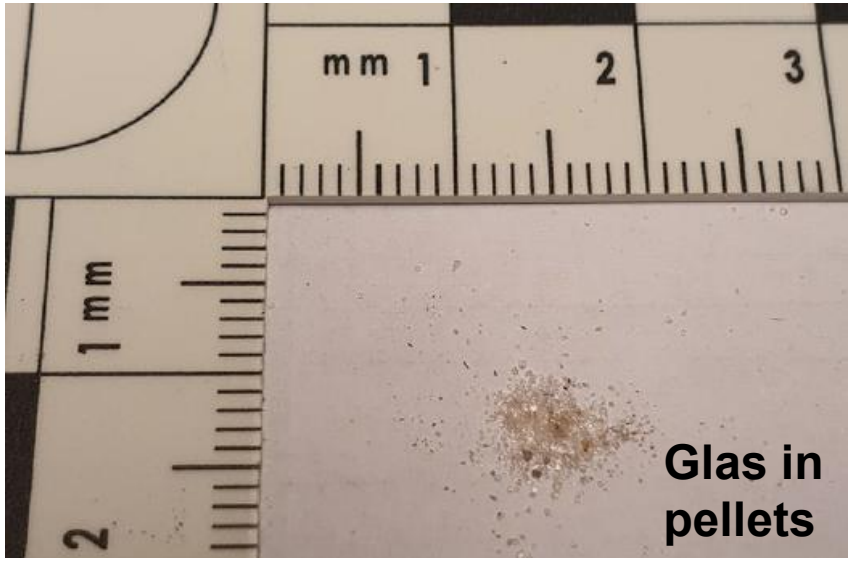






Wood pellets: sand and minerals causing massive slagging





Analysis and quality control

Reference method:

- ISO 19743 heavy extraneous materials larger than 3,15 mm
- **or** manual sorting
- Precision: unknown
- Time: 1-3 h

Low cost - field

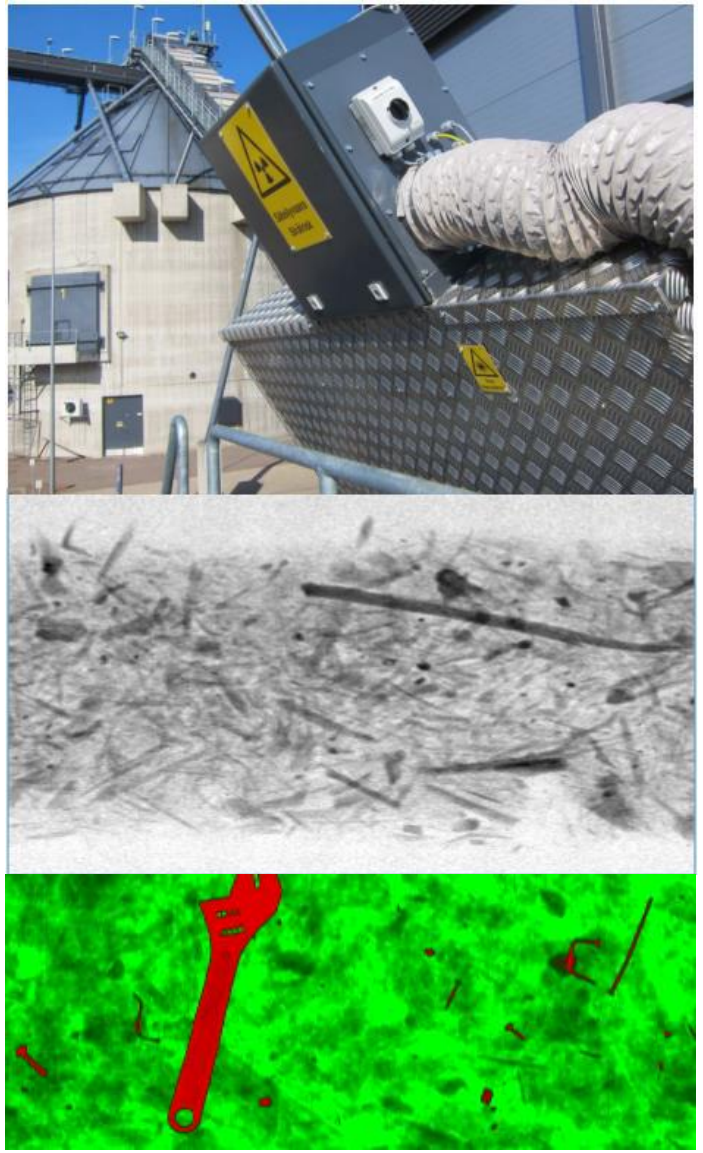
- None (=> visual, manual)

High end – industrial process control

- Real-time using X-ray technology
  - Designed for power plants, sawmills and bio-refineries
  - Fully automatic on-line analysis, measures whole amount of fuel

Advantage: fast and without manpower

Disadvantage: complex and expensive



Sand, soil and mold



Old beech, mold and bark:

A: + 1 - 3%

Aged spruce sawdust:
+ 0,4 - 0,6%
+ ash melting issues!





traditional harvesting, covered with mud:

A: + 1 - 5%

Soil in sawdust:
+ 0,1 - 0,5%
+ ash melting issues!



Analysis and quality control

Reference method:

- ISO 18122 determination of ash content
- High precision ± 0,1 %
- 6 hours and eventually sample preparation





Low cost & field

- Manual washing (Sink-and-Float Separation)
- Low-cost ash analyzers usually do not work!

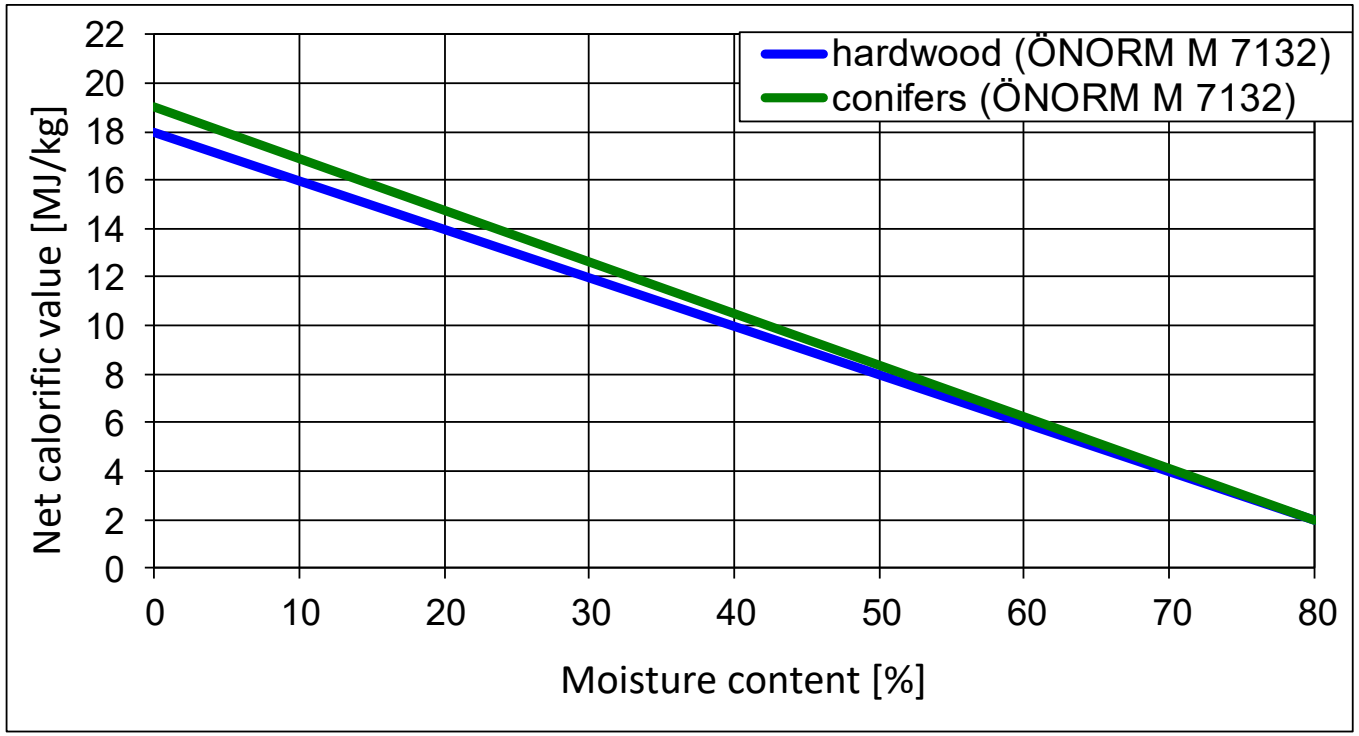
High end & industrial process control

- X-ray technology
- NIR (limited use since IR not sensitive to ash content!)

Advantage: fast, whole amount of fuel

Disadvantage: complex and expensive, sensitivity for minerals is low

Moisture content – calorific value

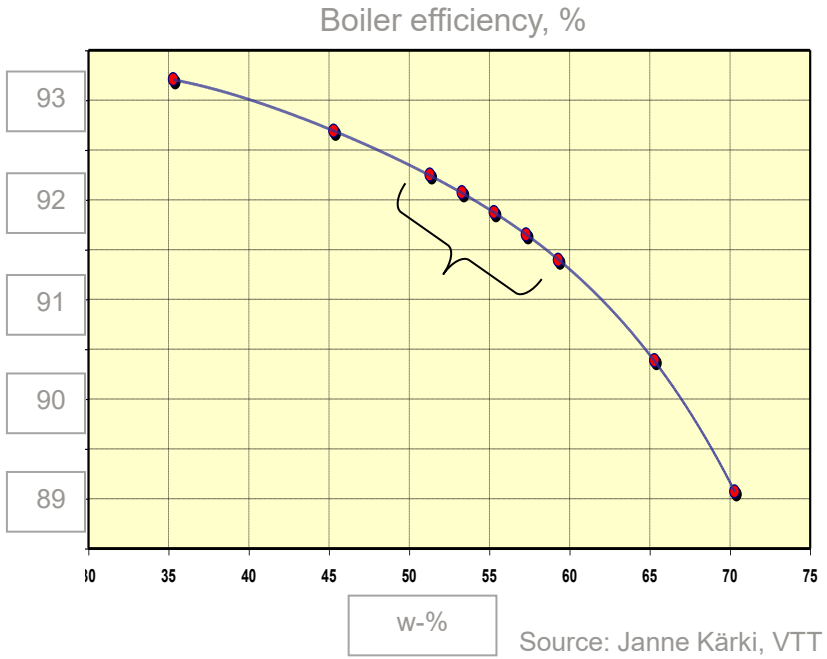


Example pellet Production:

- 100.000 t production / a
- 8% water instead of 6%
- 2000 t (water) sold less / a
- € 400.000.- /a lost

Example 400 MWth boiler

- 1% efficiency change in boiler efficiency
- ~ 40 GWh more fuel needed
- € 500.000.- /a lost



Source: Janne Kärki, VTT

Analysis and quality control

Reference method:

- ISO 18134 oven dry method
- High precision ± 0,2 %
- 6 hours





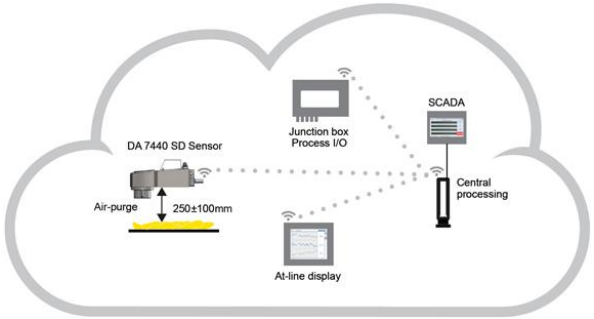
High end – industrial process control

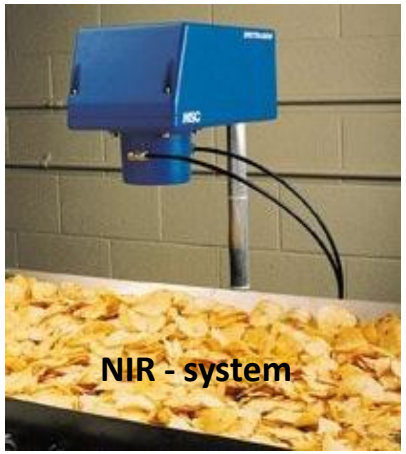
- Near Infrared (NIR)
- capacitive analyzers
- High end real-time
  - Highly developed systems (food, plastics, wood-panels, etc.)
  - Many parameters possible: **moisture**, extractives, proteins, ash (density, durability, energy content)

Advantage: online, accuracy depend on technology and implementation

Limits: expensive ($ > 20.000.-), calibration and correct implementation maybe difficult







Source: www.acoweb.de, prozesstechnik.industrie.de, www.perten.com

Analysis and quality control, examples

Low cost - field

- Capacitive or conductiv
- Large variety from $ 10.- to $ 5.000.-

Fast, low accuracy (± 2 - 5%); $ 20- $ 500



Log wood



Grain, saw dust



straw



Chips, nut shells

Fast, high accuracy (± 0,1 - 2%); $ 500 - $ 5000

Milled samples, pellets





chips



Chemical composition

Sulfur

- S mainly from organic sulfur compounds
- SO_2 formed in combustion => sulphurous acid emissions
- usually low in biomass => not relevant

Chlorine

- Cl forms hydrochloric acid in combustion
- HCl mainly responsible for corrosion (high temperature & condensation)
- Low in wood, high in grasses

Alkali metals (K, Na)

- Form aerosols in combustion
- Cause fauling in boilers
- Participate in slagging behavior, reduce ash deformation
- General high in biomass



Analysis and quality control

Reference method:

- ISO 16994 Sulphur and Chlorine => calorimetric combustion, IC
- ISO 16967 Major elements => microwave digestion, ICP
- Precision: high
- Time: 1 - 20 days, advanced lab necessary, invest > $ 100.000.-

High end – industrial process control

- S and Cl in online flue gas analysis (required in Europe for waste incineration and large industries)
- Major elements by online-sampling and XRF (e.g. use in cement and metal industry)
- Disadvantage: complex and very expensive > $ 50.000.-

Analysis and quality control

Low cost - field

- Principle of ISO 16995 Water soluble content of chloride, sodium and potassium
- Relatively cheap, applicable even in remote areas
- Need to be adopted to fuel type, calibration very important => limited research required

Form of solid biofuel	Sample preparation
Straw and straw-like materials	Cut the material into pieces of maximum length 3 cm
Grains, seeds and shells	Mill the material in a coffee mill for about 10 seconds
Pellets	Blend the pellets in a blender for 10 – 30 seconds, depending of the durability of the pellets
Chips and shavings	Run a larger portion of the material, e.g. ½ kg, through a garden shredder

Sample preparation



Simple test kits or electrodes

	field method	CEN/TS 15105
Wood chips	< 0,03	0,012
Almond kernels	0,02	0,033
Rape straw	0,29	0,24
Cynara	1,53	1,60
Coconut shells	0,26	0,18
Exhausted olive residue	0,37	0,18
Seaweed	0,45	0,14

Cl results field - lab

Source: EU, BioNorm II project, final report 11.1.2010

Summary

Analysis of critical feedstock parameters in professional labs

- Lab methods are established and work reliably if applied correctly
- Some methods require expensive equipment and experienced staff
- Experienced accredited labs are highly recommended

High-end industrial process control

- Methods for most of the critical parameters exist
- The use is often limited due to high / very high investment cost
- Biomass industry is implementing more analysis and automatization, at least in Europe

Low-cost field methods

- Many (cheap) methods for moisture are offered and are used
- For other parameters few methods exist and their use is very rare => lot of future potential

Knowledge of fuel suppliers is often very low, training for better understanding recommended



Institut für Bioenergie

Thank you for the kind attention.

Questions & lab services:

martin.englisch@bioenergy.co.at



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A-1150 Wien,
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