Measurement of biogen CO_2-emissions in the frame of CO_2-emissionstrading

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AGENDA

1	**European regulation to report greenhouse gases**
2	Calculation based methology to analyse fossile CO2
3	Measurement based methology using Genius5 pmCTrace
4	Reference pmC of 100% biogenic
5	Summary

Commission Regulation 601/2012

L 181/30 EN Official Journal of the European Union 12.7.2012

COMMISSION REGULATION (EU) No 601/2012

of 21 June 2012

on the monitoring and reporting of greenhouse gas emissions pursuant to Directive 2003/87/EC of the European Parliament and of the Council

(Text with EEA relevance)

THE EUROPEAN COMMISSION,

Having regard to the Treaty on the Functioning of the European Union,

Having regard to Directive 2003/87/EC of the European Parliament and of the Council of 13 October 2003 establishing a scheme for greenhouse gas emission allowance trading within the Community and amending Council Directive 96/61/EC (¹), and in particular Article 14(1) thereof,

Whereas:

'support scheme' within the meaning of Article 2(k) and consequently financial support within the meaning of Article 17(1)(c) of Directive 2009/28/EC.

(3) For reasons of consistency, definitions laid down in Commission Decision 2009/450/EC of 8 June 2009 on the detailed interpretation of the aviation activities listed in Annex I to Directive 2003/87/EC of the European Parliament and of the Council (⁴) and Directive 2009/31/EC of the European Parliament and of the Council of 23 April 2009 on the geological storage of carbon dioxide and amending Council Directive 85/337/EEC, European Parliament and Council Directives 2000/60/EC, 2001/80/EC, 2004/35/EC, 2006/12/EC, 2008/1/EC and Regulation (EC) No 1013/2006 (⁵) should apply to this Regulation.

- Defines ambitious requirements for the determination of fossile greenhouse gas emissions from industry
- Opens door for measurement based methology to analyse fossile CO_2 emissions

Commission Regulation 601/2012

(6) It is necessary to establish basic monitoring methodologies to minimise the burden on operators and aircraft operators and facilitate the effective monitoring and reporting of greenhouse gas emissions pursuant to Directive 2003/87/EC. Those methodologies should include basic calculation and measurement methodologies. The calculation methodologies should be further differentiated into a standard methodology and a mass balance methodology. Flexibility should be provided to allow a combination of measurement methodologies, standard calculation methodology and mass balance within the same installation, provided the operator ensures that omissions or double counting do not occur.

- Defines flexibility to combine measurement methodologies, standard calculation methodology and mass balance.

Commission Regulation 601/2012

Article 28

Measurement systems under the operator's control

1. For determining the activity data in accordance with Article 27, the operator shall use metering results based on measurement systems under its own control at the installation, provided that all of the following conditions are complied with:

- Uncertainty mets the trier
- Include the uncertainty of Calibration

Commission Regulation 601/2012

Article 39

Determination of biomass and fossil fraction

1. Where subject to the tier level required and to the availability of appropriate default values as referred to in Article 31(1), the biomass fraction of a specific fuel or material are determined using analyses, the operator shall determine that biomass fraction on the basis of a relevant standard and the analytical methods therein, and apply that standard only if approved by the competent authority.

Two choices to determine the biogen fraction

- Analysing the fuel using EN 15440
- Analysing the stack emissions using ISO 13833

Commission Regulation 601/2012 accuracy levels for reporting

Material	Unit	Tier 4	Tier 3	Tier 2	Tier 1
Commercial standard fuel	[t] or [Nm³]	± 1,5%	± 2,5%	± 5%	± 7,5%
Other gaseous or liquid fuels	[t] or [Nm³]	± 1,5%	± 2,5%	± 5%	± 7,5%
Solid fuels	[t]	± 1,5%	± 2,5%	± 5%	± 7,5%

Defines ambitious accuracy levels for determining the annual fuel consumption with

- Caloric value [MJ/t]
- Emission factor [t CO_2/MJ]
- Biogenic carbon [C_{bio}/C_{total}]

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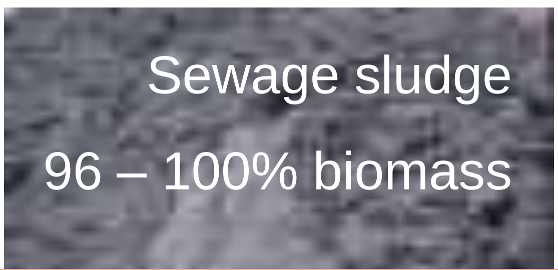
Samples of alternative fuels



How to prove that biogenic carbon > 97%
Directly from the fuel ?
-> Easier to analyse the stack emissions

Samples of alternative fuels

But how to get a representative sample directly from the fuel ?
-> Easier to analyse the stack emissions

Fossile and biogen fraction in mixed alternative fuels - *Art. 39*

Tier 2: determination using lab analysis = Typ II portion biomass *Art. 39 (1)*

- e.g. every 5.000 t (min. 4x/year) for soild residues
- analytical methods according DIN EN 15440:
  - Selectice solution method — sample amount = 1 g
  - ^{14}C-determination from waste — sample amount = 1 mg or less

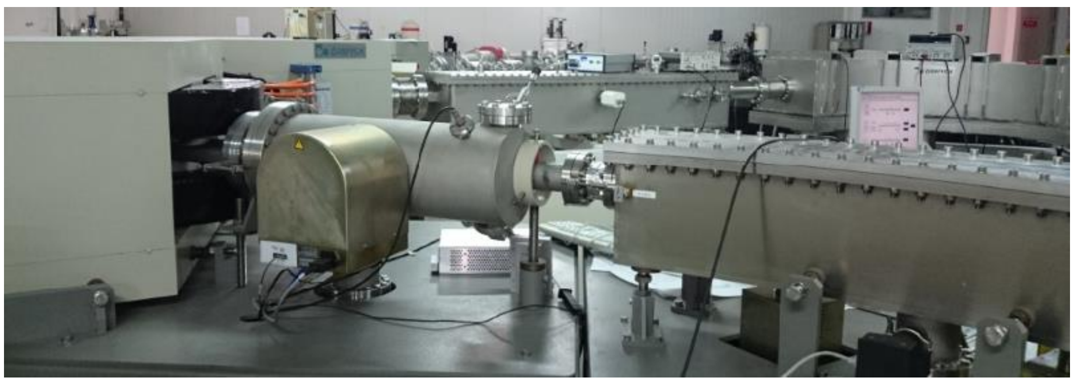
Experiences:

- **To produce representative sample is crucial**
- **Selective solution method is not suitable for gum, tyres and biodegradeable polymers**

EN 15440 to determine the biogen CO_2 fraction in solid samples

- selective sollution method

- ^{14}C-method (radionuclid-method)



Is it representative to do the analysis from solid material ?

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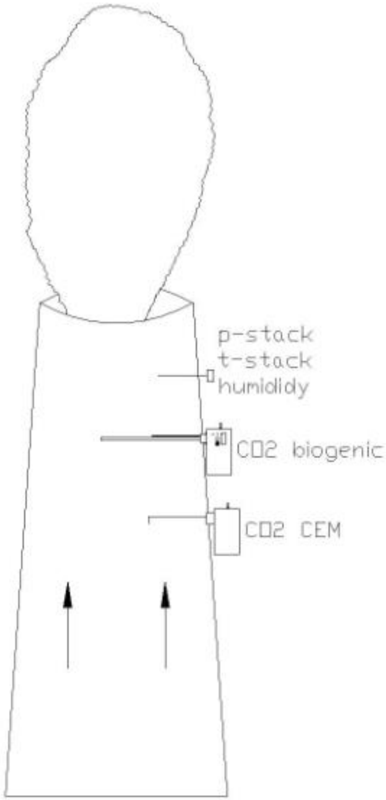
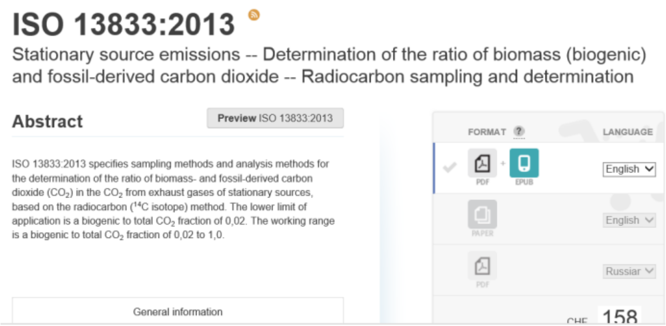
Analysing the stack emissions to increase accuracy



Big size incinerators:

- Measurement of CO_2 using CEMS
- Measurement of Volume flow with v, t, p and stack area
- Proportional CO_2 sampling using the pmCTrace

Standards to determine biogenic CO_2 fraction


ISO 13833:2013

Stationary source emissions -- Determination of the ratio of biomass (biogenic) and fossil-derived carbon dioxide -- Radiocarbon sampling and determination

Abstract

Preview ISO 13833:2013

ISO 13833:2013 specifies sampling methods and analysis methods for the determination of the ratio of biomass- and fossil-derived carbon dioxide (CO_2) in the CO_2 from exhaust gases of stationary sources, based on the radiocarbon (^{14}C isotope) method. The lower limit of application is a biogenic to total CO_2 fraction of 0,02. The working range is a biogenic to total CO_2 fraction of 0,02 to 1,0.

General information

FORMAT | LANGUAGE

PDF + EPUB — English

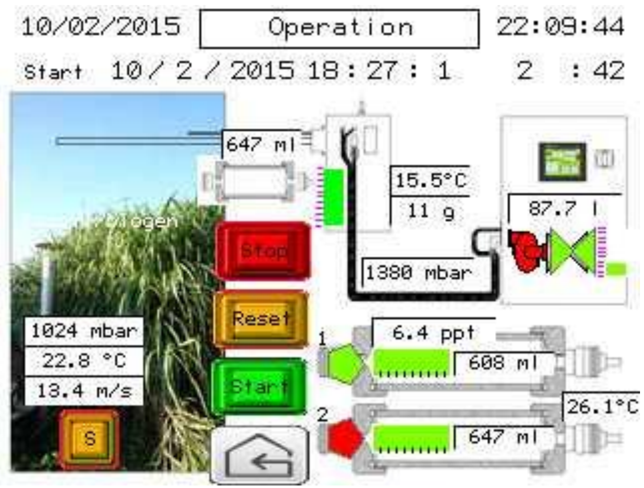
PAPER — English

PDF — Russian

CHF 158

- Validated standard
- Proportional sampling from flue gas
- Minimum sampling time 2 hours
- Maximum sampling time 1 month
- Sample analysis using LSC or High acceleration MS

Principle of ISO EN 13833



- Extraction of primary stream from stack
- Extraction of small flow proportional to the flue gas velocity (around 1 ml/min)
- Absortion of extracted CO_2 to an alkaline adsorbent
- ^{14}C analysis of the absorbed CO_2 with high acceleration mass spectrometer

Step 1:
Long term proportional sampler

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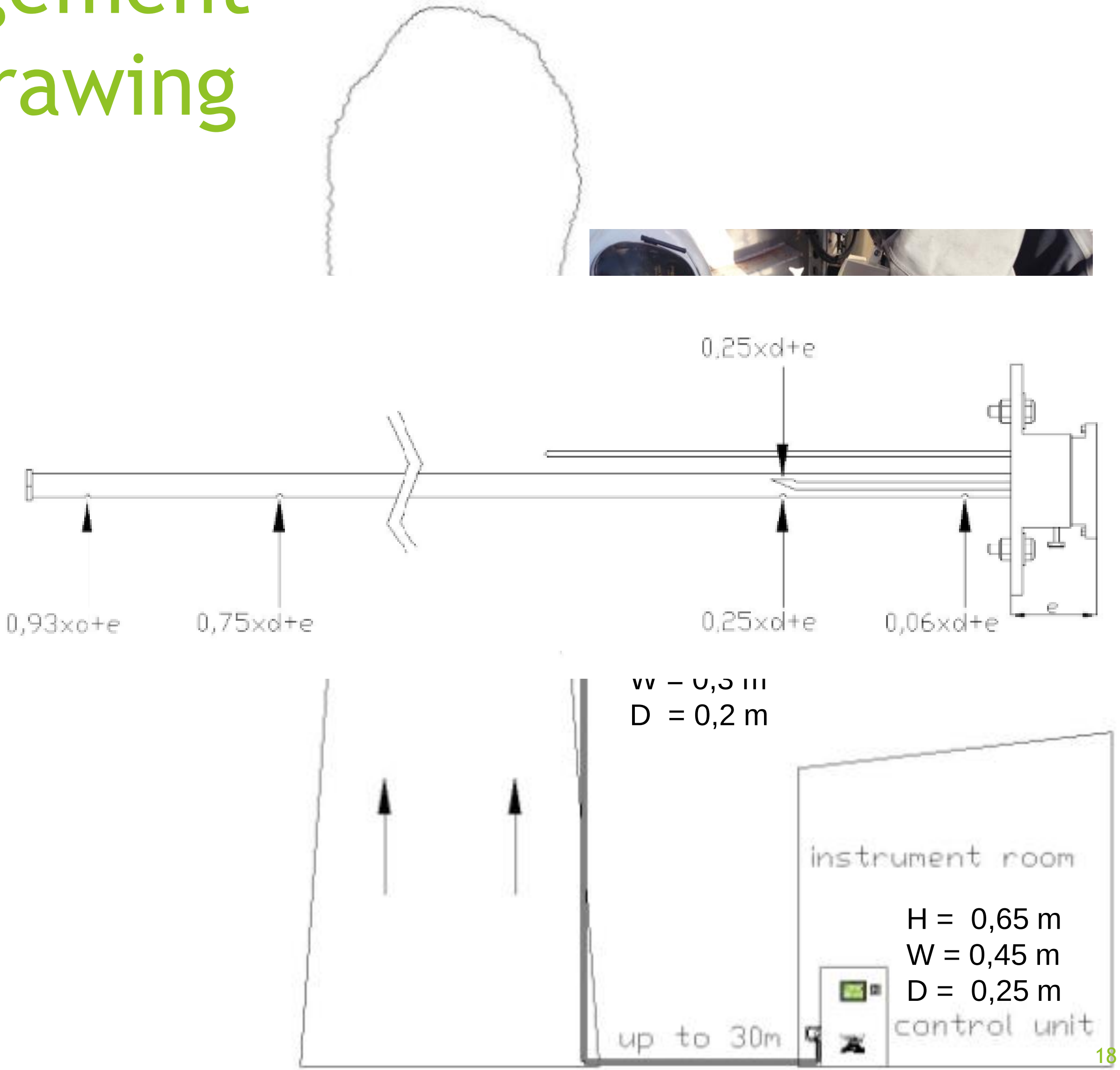
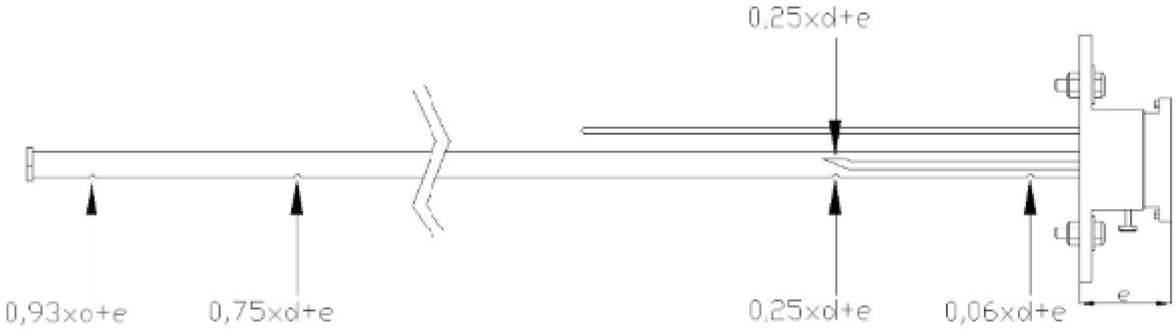
Arrangement drawing



Arrangement drawing inside stack



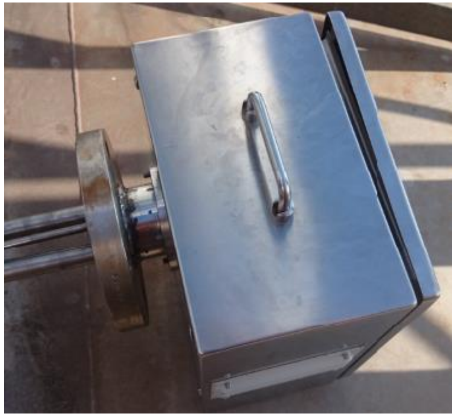
Installation position
at measurement

Minimum flange size: 3“
All flange sizes available

Installation pictures
installation at biomass incinerator

In Control room

at stack



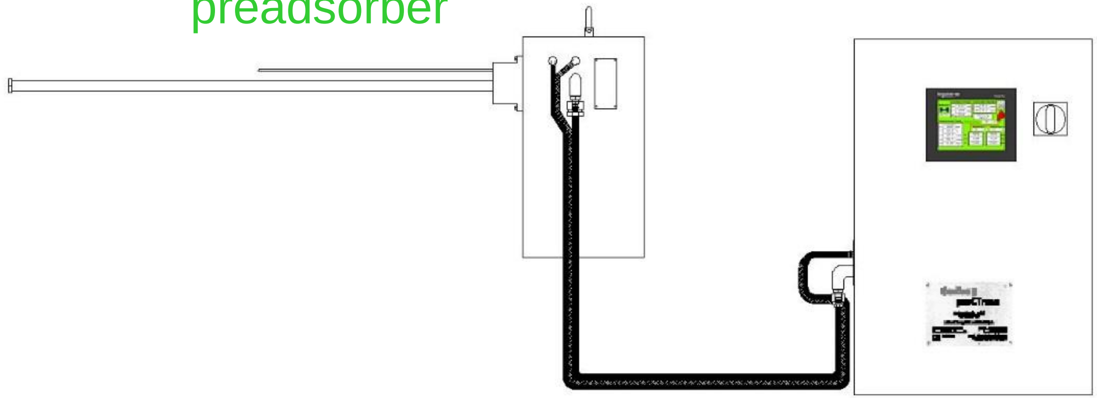
Flange detail

Installation pictures at cement plant

Function of components

Sampling unit including

velocity measurement,
condenser
preadsorber



Controller cabinett including

touchsreen display and controller
flow division system
massflow controller to adjust volume
flow to velocity in stack
2 pcs of CO2 absorbing cartridges

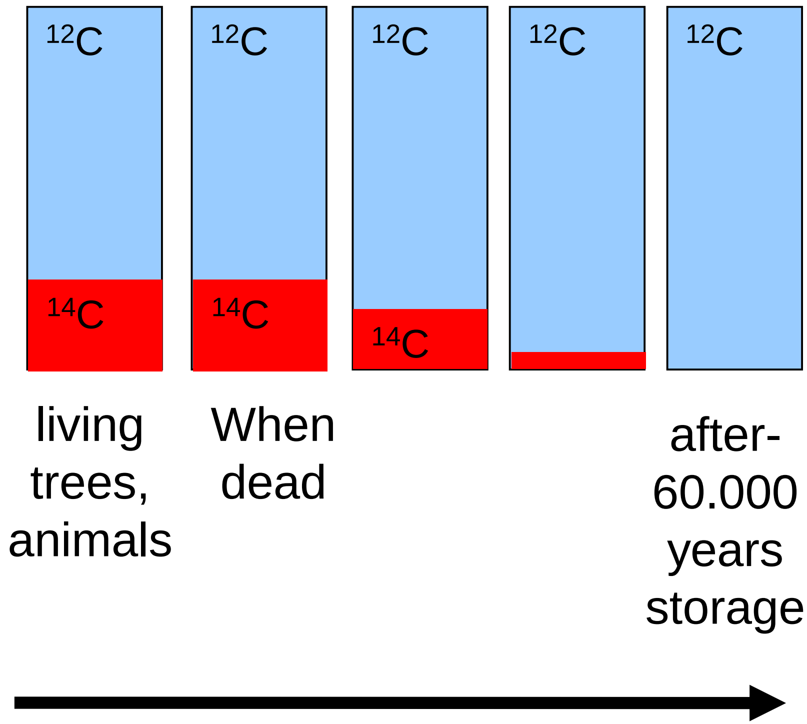
Step 2:
^{14}C-measurement in the laboratory

High Accelleration Mass spectrometry
(AMS) uncertainty + 0,3 pmC

Proportional-Szintillations-counter
(PSM) uncertainty + 2 pmC

Principle of ^{14}C method

- C-isotope distribution in atmosphere:
  - ^{12}C: 98.89 %
  - ^{13}C: 1.11 %
  - ^{14}C: 10^{-10} %
- Half-life period ($t_{1/2}$) of ^{14}C: 5568 years



^{14}C content decreasing with the age

Concentration of $^{14}CO_2$ isotope in fossile fuel = Zero!

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Annex VIII – Accuracy requirements to measure fossil CO2 from emissions

Experiences for uncertainty:

- U_{volume} = 1,24 %
- U_{CO2} = 1,63 %
- $U_{biomass}$ < 1 %

Source: VDI report Nr. 2215, 2014

Accuracy requirements

Tier 4
± 2,5 %
N.A.
± 2,5 %

- Total mass of CO_2 /year
- biogen Fraction of CO_2

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4	**Reference pmC of 100% biogenic**
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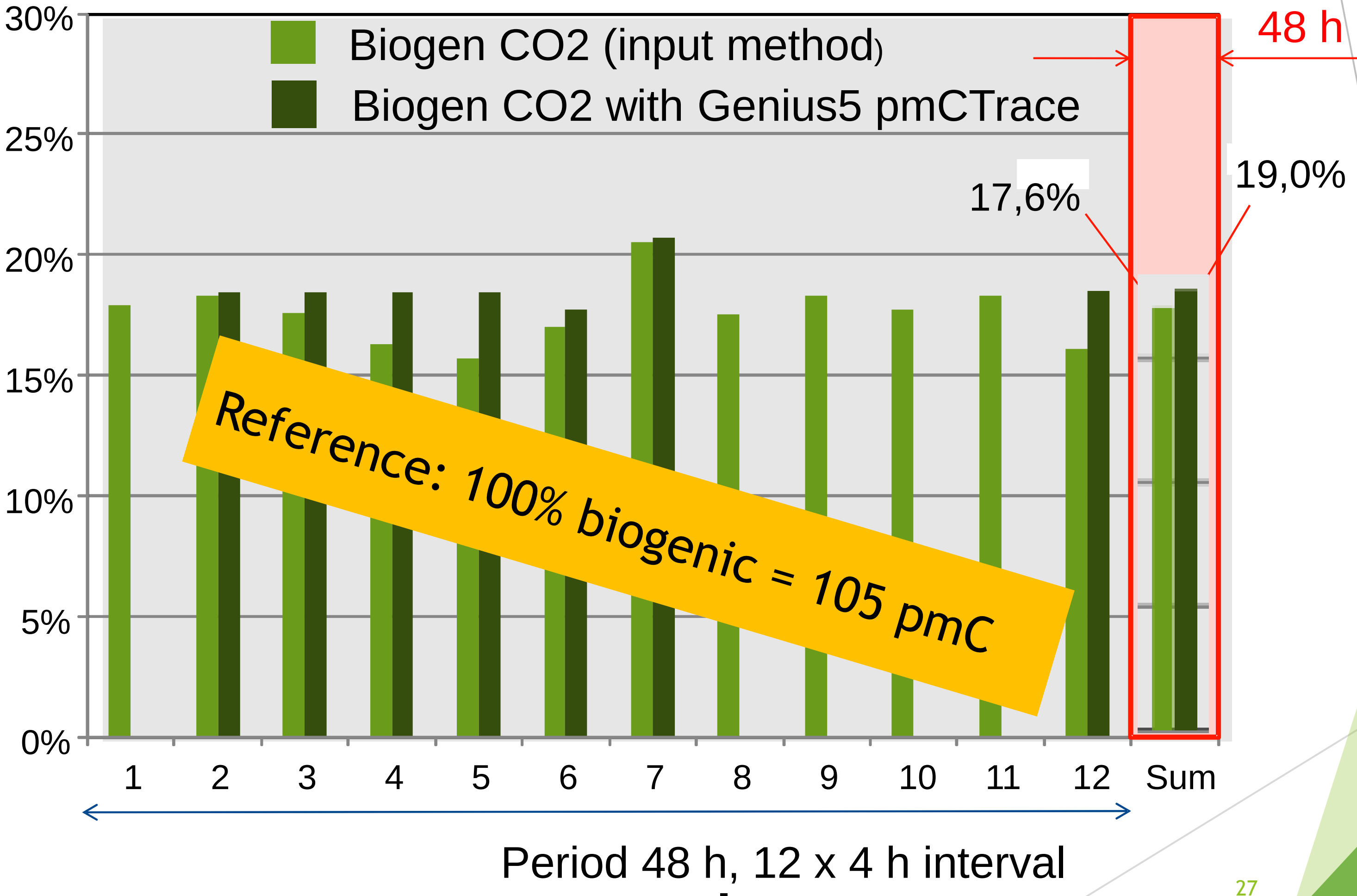
Result of 48 hours comparison test
Input versus measurement method



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pmC reference

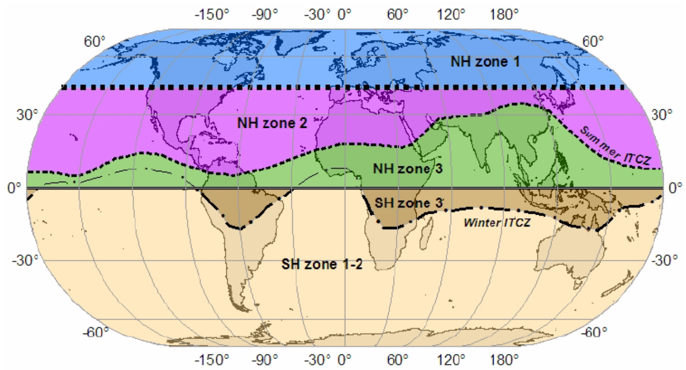


Figure 2 World map showing zonal atmospheric bomb ^{14}C. The mean positions of the summer and winter ITCZ are adapted from Linacre and Geerts (1997).

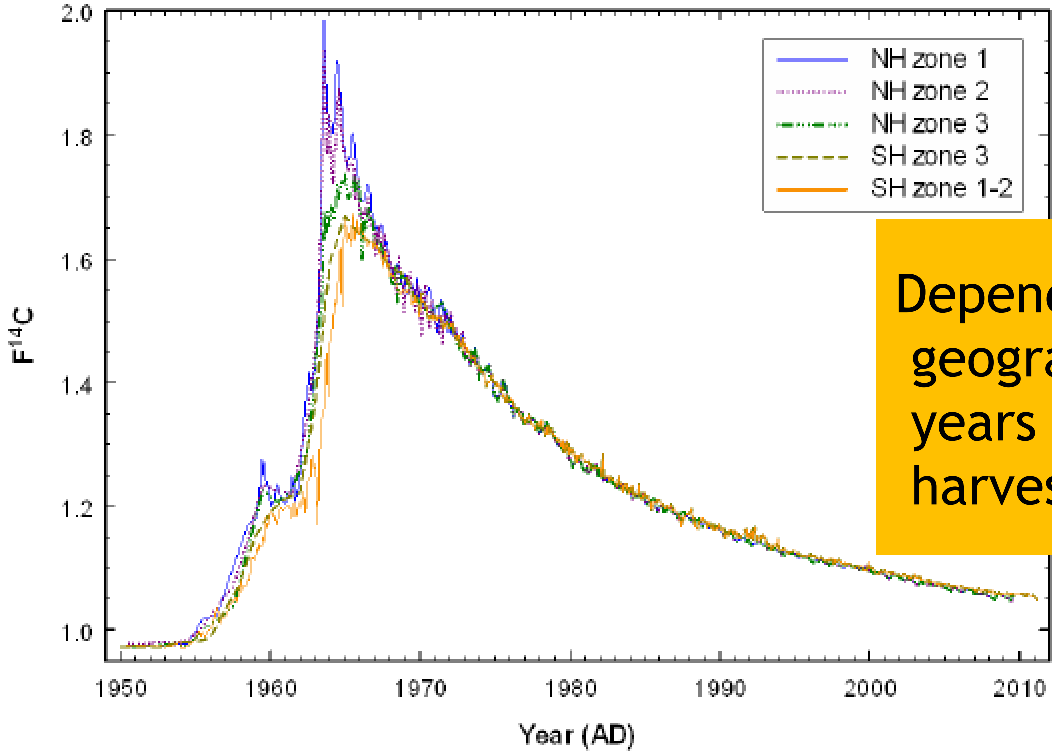
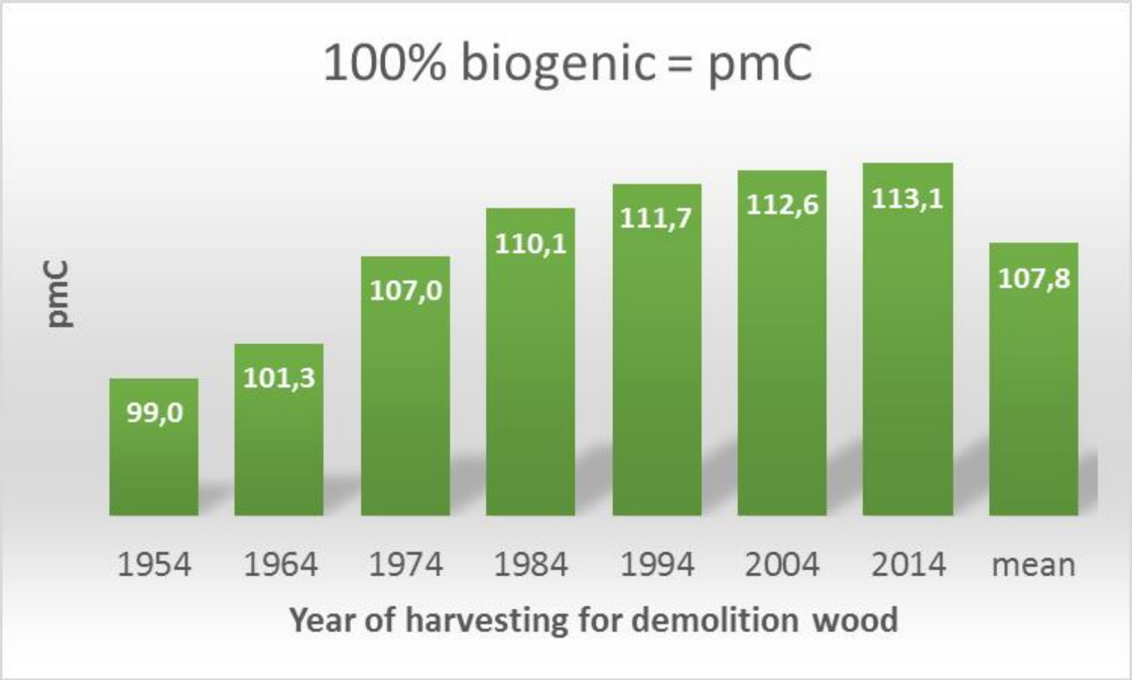


Figure 5 Compiled (extended) monthly atmospheric ^{14}C curves for 5 different zones (NH zone 1, NH zone 2, NH zone 3, SH zone 3, and SH zone 1-2). The compiled data sets are reported in Tables S3a–e (online Supplementary Material).

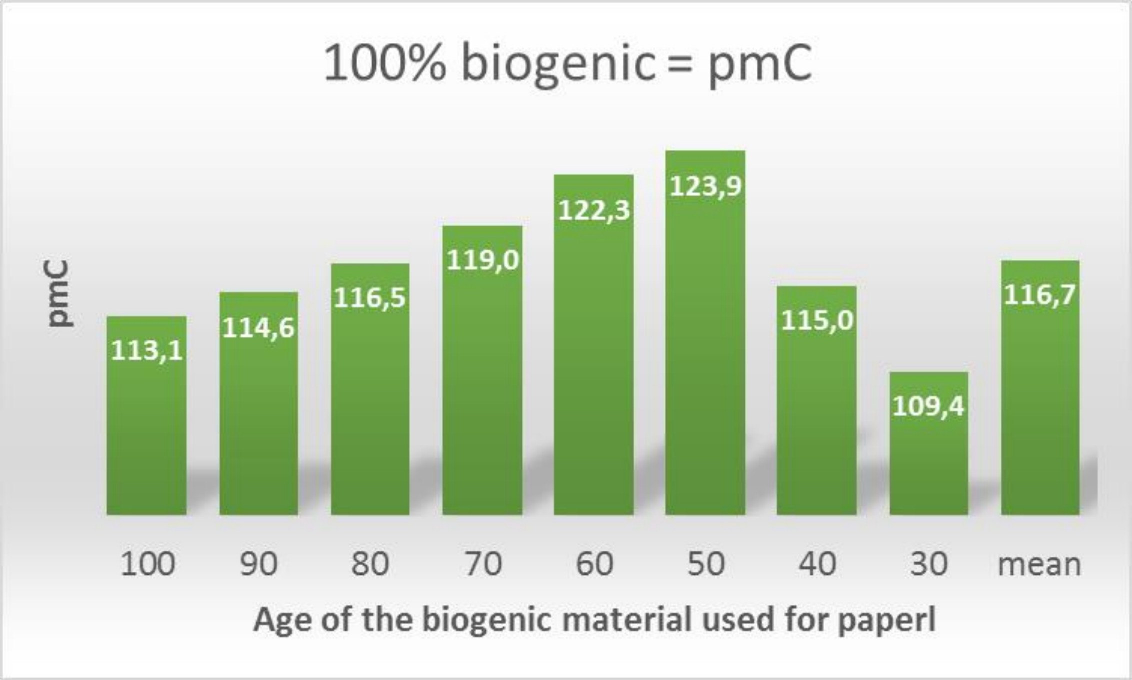
Dependent on
- geographical zone
- years of growth
- harvesting

pmC reference - demolition wood
100 % biogenic = 107,8 pmC



Typical tree = spruce
Typical age = 100 years
harvest 1984 as a mean

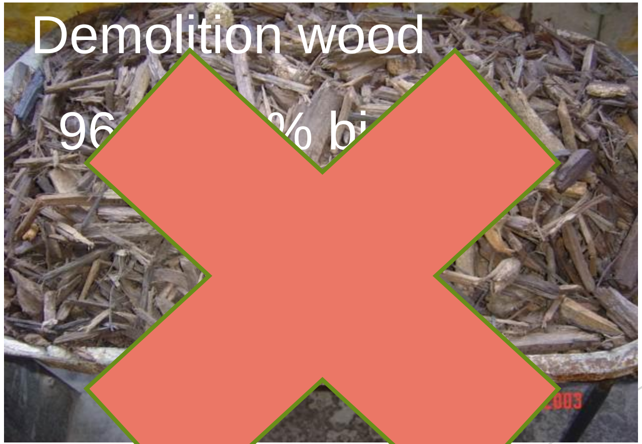
pmC reference of paper fraction 100 % biogenic = 116,7 pmC



Typical trees = spruce, poplar
Typical age = 30 – 100 years
harvest in 2012 - 2014

pmC reference of fresh biomass
100 % biogenic = 105 pmC

Typical age = < 1 year
growing in the year of harvest



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1	Use of alternative fuel in cement industry
2	Analytical determination of biogen fraction in solid fuels
3	Determination of CO_2 and biogen fraction in the stack
4	Reference pmC of 100% biogenic
5	**Summary**

Summary

- To increase accuracy the determination of the biogen fraction with measurement method requires the splitting into 3 fractions
  - % of fresh biomass
  - % of biomass from paper/wood (harvest < 3 years)
  - % of biomass from demolitian wood (> 3 years)

Summary

- Indiviual reference pmC of 100% biogenic fraction
  - 105 pmC for fresh biomass
    - Straw, elephant grass, bamboo,
    - Rice shells
    - Sewage sludge
  - 117 pmC for paper made from wooden fibres
    - Based on trees harvested recently with an age of 30 – 100 years
  - 108 pmC for demolition wood
    - used 30-60 years before thermal recovery
    - Base on trees with 80-120 years age

Summary – Calculation of total biogenic fraction

$$f_{bioC} = pmC_{measured} * \left(\frac{m\%_{freshbiomass}}{104{,}8} + \frac{m\%_{demolition\,wood}}{107{,}8} + \frac{m\%_{paperfraction}}{116{,}7}\right)$$

$$f_{fossilC} = 1 - f_{bioC}$$

$$m\%_{freshbiomass} + m\%_{demolition\,wood} + m\%_{paperfraction} = 100$$

With

f_{bioC} ……………... Biogenic fraction

$pmC_{measured}$ ……… pmC value received from ^{14}C lab

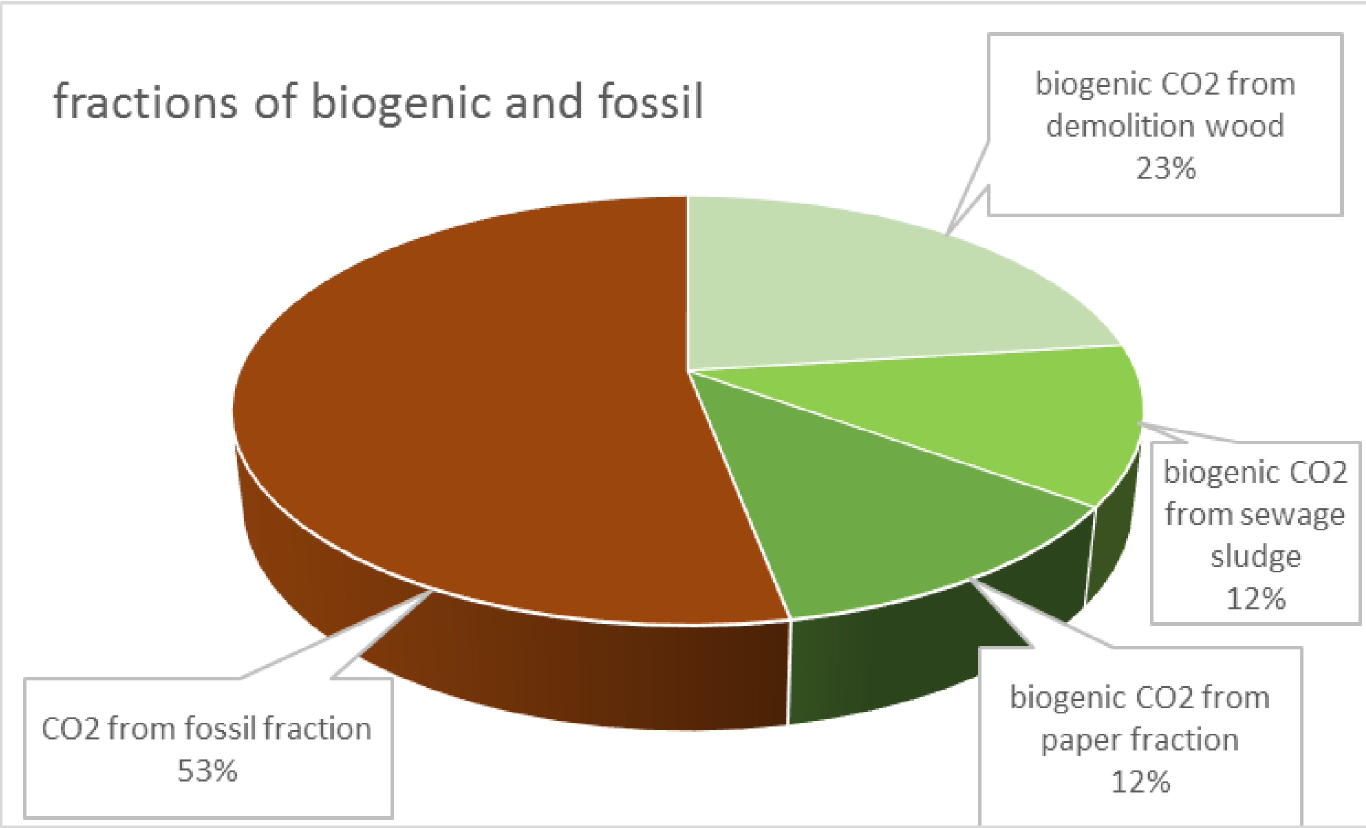
$m\%_{freshbiomass}$ ……. Mass fraction of recently growing biomass

e.g.: sewage sludge, straw, rice shells, ….

$m\%_{demolitionwood}$ …. Mass fraction of biomass, used for construction

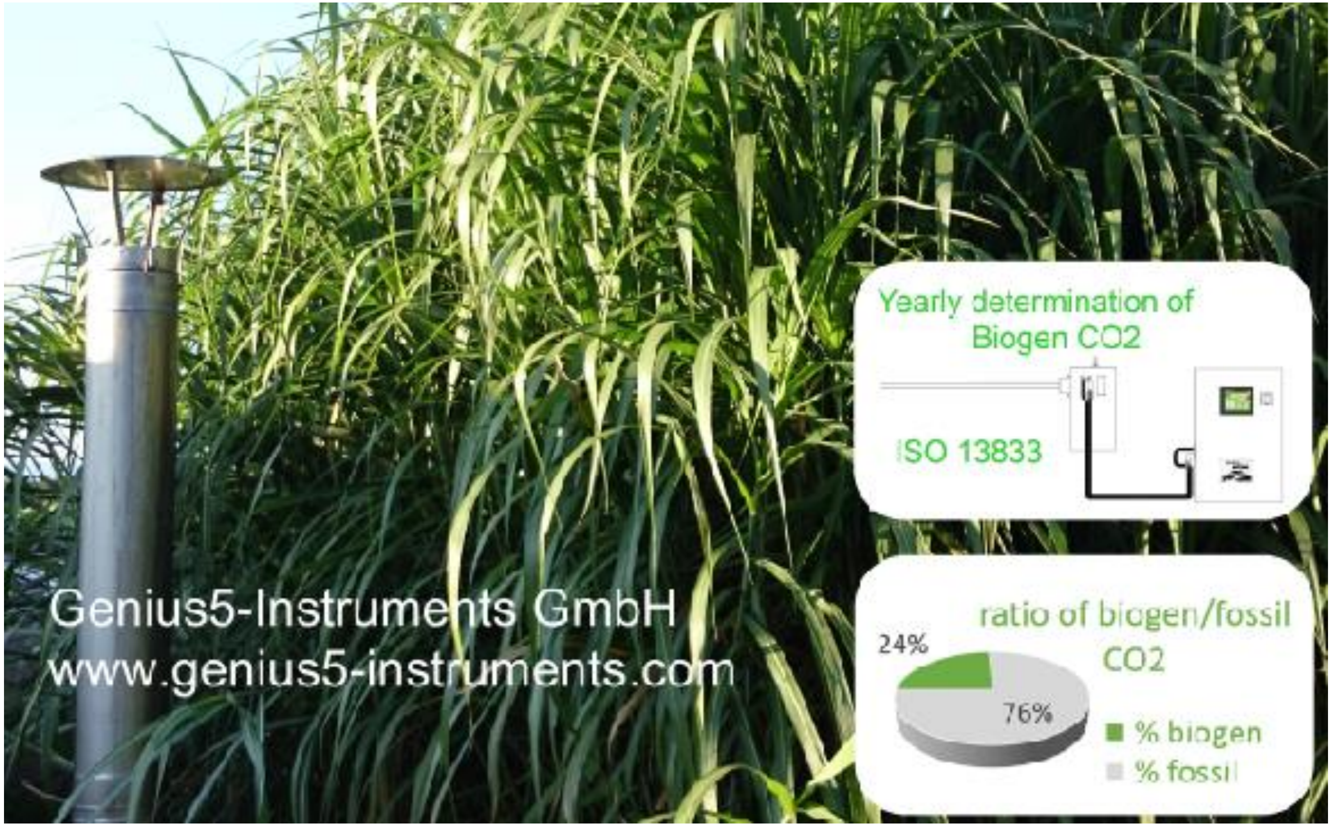
$m\%_{paperfraction}$ …… Mass fraction of the paperfraction

Summary



fractions of biogenic and fossil
biogenic CO2 from demolition wood 23%
biogenic CO2 from sewage sludge 12%
biogenic CO2 from paper fraction 12%
CO2 from fossil fraction 53%

Thank your for your interest



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