

Comparison of Rapid Moisture Content Determination Methods for Wood Chips

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Introduction & research question

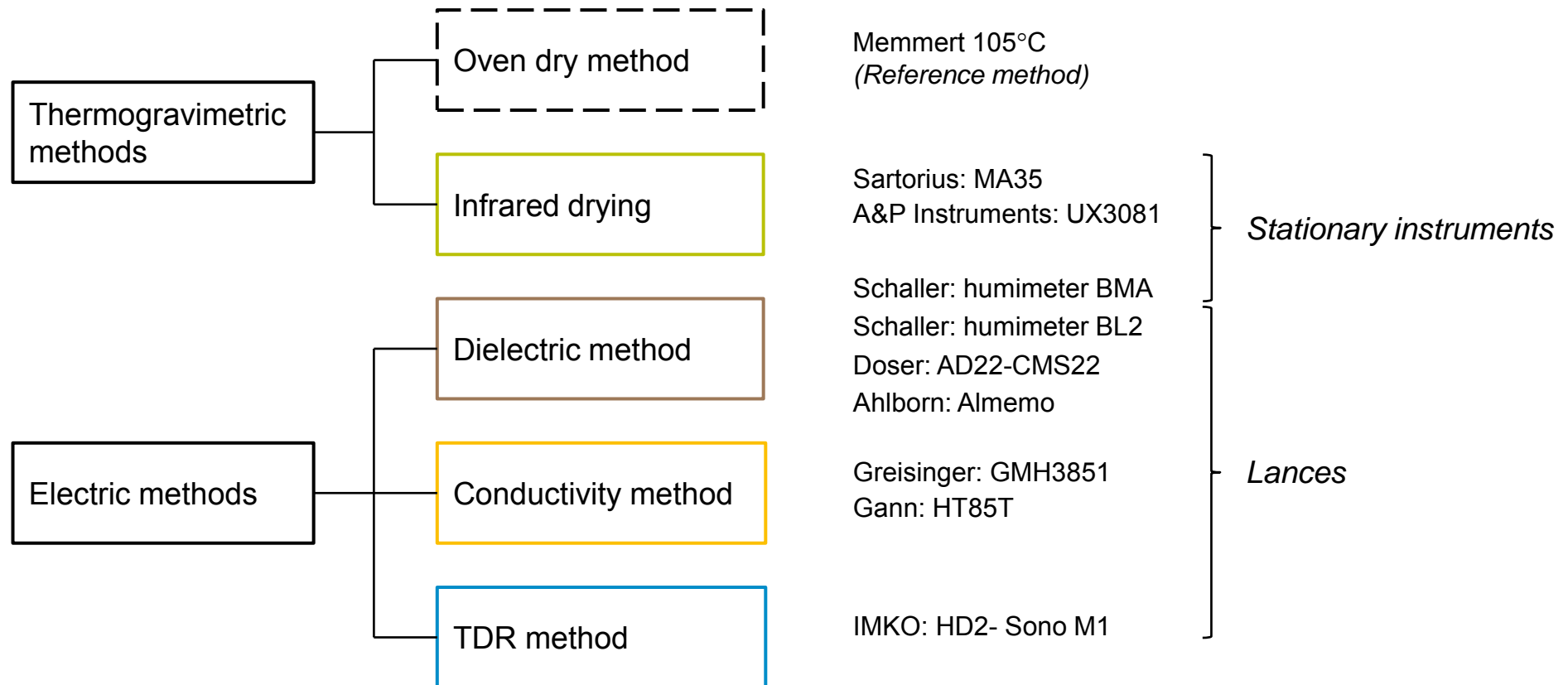
- Correct and on-time moisture content (MC) determination is crucial at many points during wood chip production
- The standardized method, i.e. oven drying according to ISO 18134, consumes both time and labor
- Newly developed gravimetric or electric methods may be suitable alternatives to provide a rapid and accurate MC determination



Aim: Determination and comparison of the accuracy of selected measuring instruments for rapid MC determination of wood chips

Materials & methods

- Research of currently available and suitable rapid determination methods
- Establishing contacts with manufacturers (8/20 positive feedbacks)



Materials & methods

Stationary instruments:



A&P Instruments:
UX3081



Sartorius: MA35



Schaller:
Humimeter BMA

Lances:



Schaller:
Humimeter BL2



Doser:
AD22-CMS22



Ahlborn: Almemo
Feuchtefühler



Greisinger:
GMH 3851



Gann: Hydro-
mette HT 85 T



IMKO: HD2

Materials & methods

- Wood chip types used for measurements:



1 = Energy roundwood chips: spruce

2 = Energy roundwood chips: beech

3 = Forest residue chips: deciduous trees

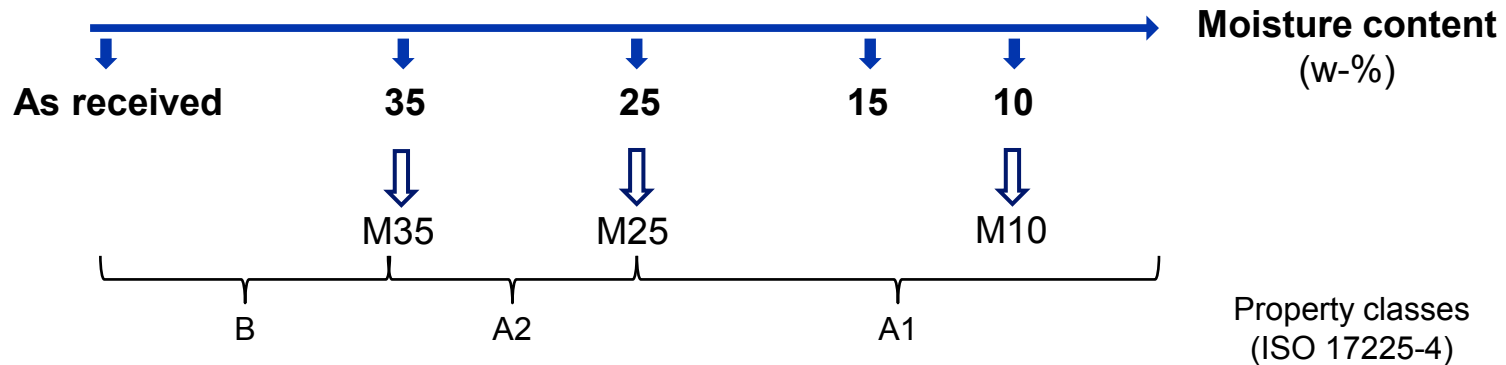
4 = Short rotation coppice chips: poplar

5 = Forest residue chips: coniferous trees



Materials & methods

- Moisture contents



- Number of measurements per measuring device:

5 moisture content levels x 5 wood chip types x n

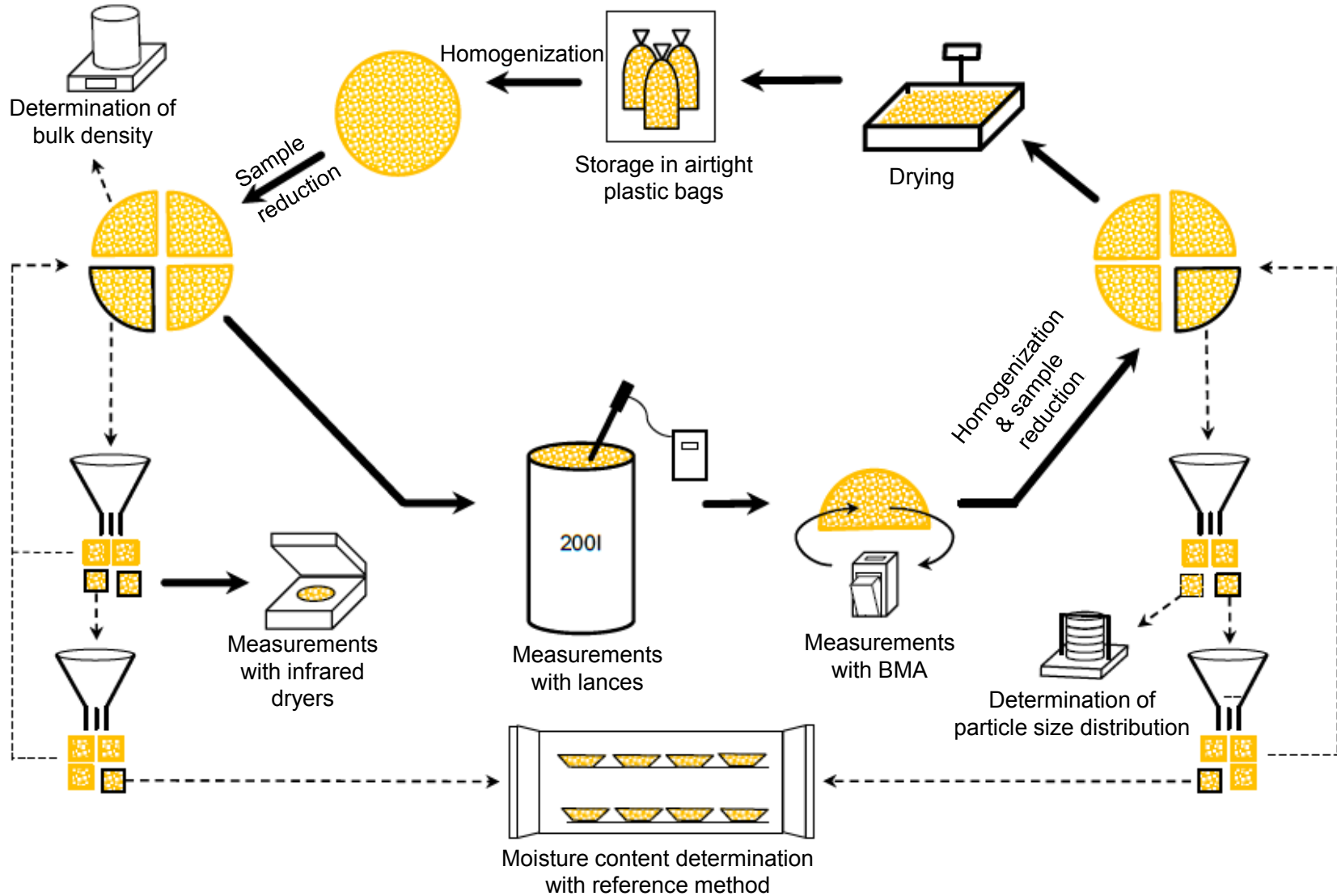
$n = 3-5$ for stationary instruments

$n = 10$ for lances

= **75 - 250** measurements in total

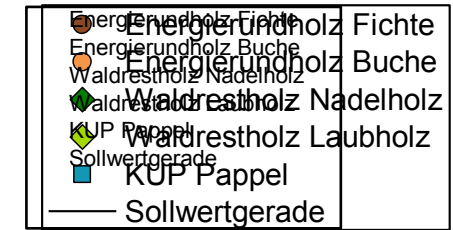
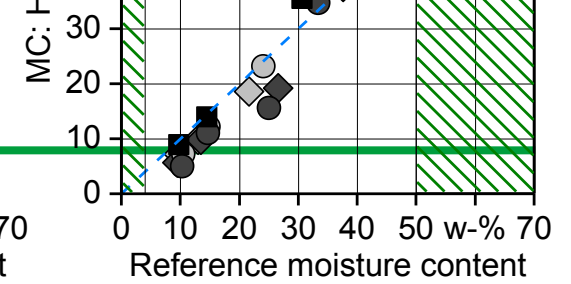
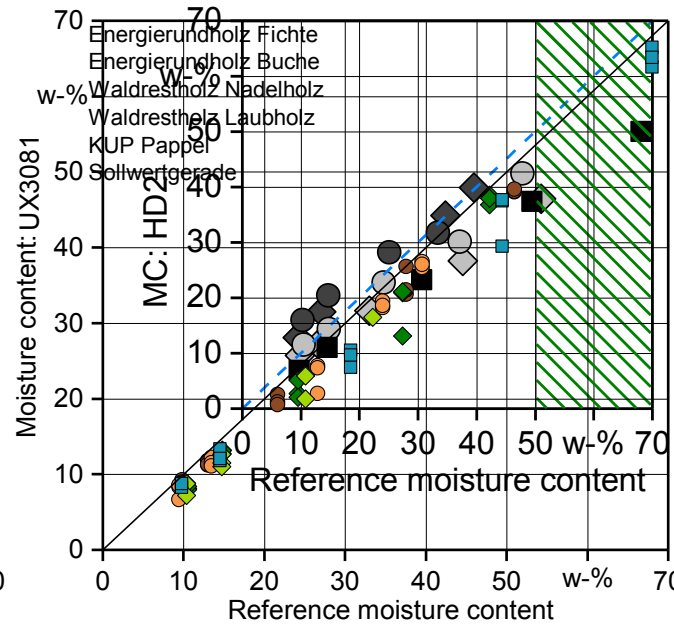
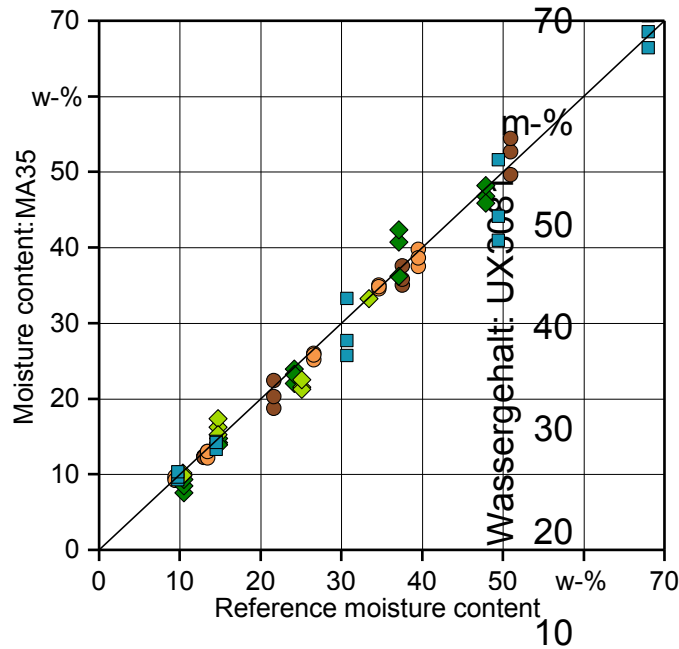


Materials & methods



Results & discussion

Infrared dryer



* error measurements were excluded

Measuring instrument	Mean deviation (± SD) [w-%]
MA35	-0.7 (± 2.1)
UX3081	-2.6 (± 1.7)

Results & discussion

w-% 70
content



w-% 70
content

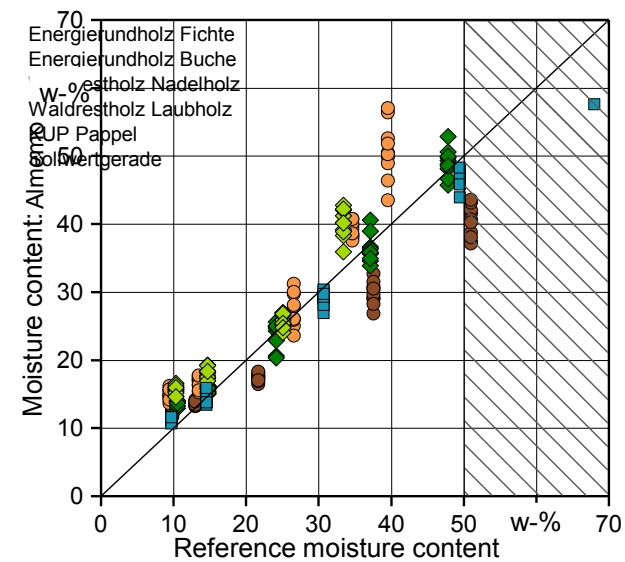
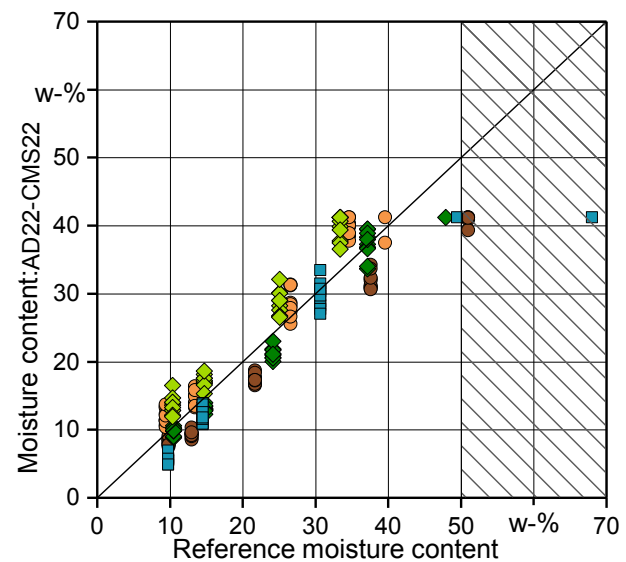
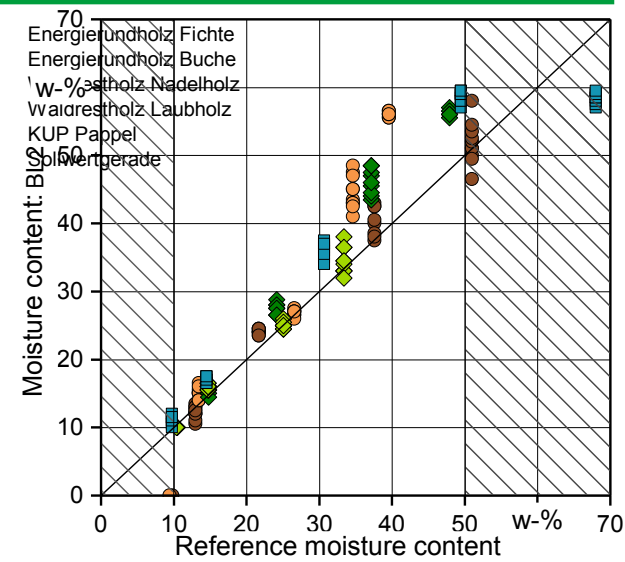
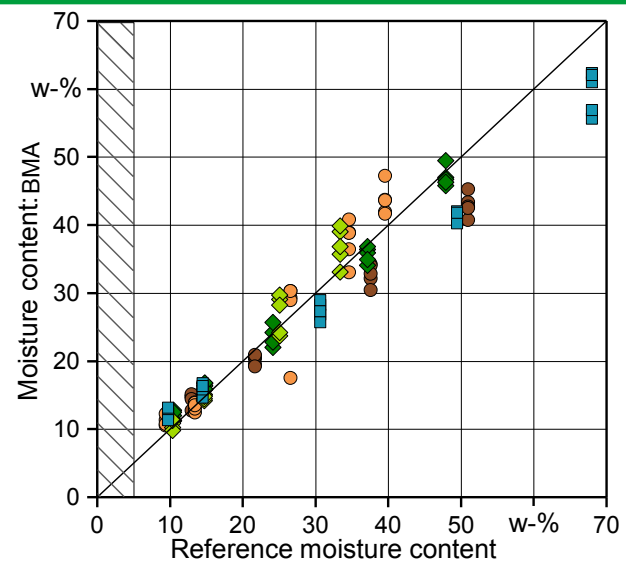
w-% 70
content

Dielectric methods

- Energierundholz Fichte
- Energierundholz Buche
- ◆ Waldrestholz Nadelholz
- ◆ Waldrestholz Laubholz
- KUP Pappel
- Sollwertgerade

* error measurements were excluded

Measuring instrument	Mean deviation (± SD) [w-%]
BMA	-0.5 (± 4.0)
BL2	3.8 (± 4.7)
AD22-CMS 22	-0.7 (± 4.0)
Almemo	1.5 (± 4.2)

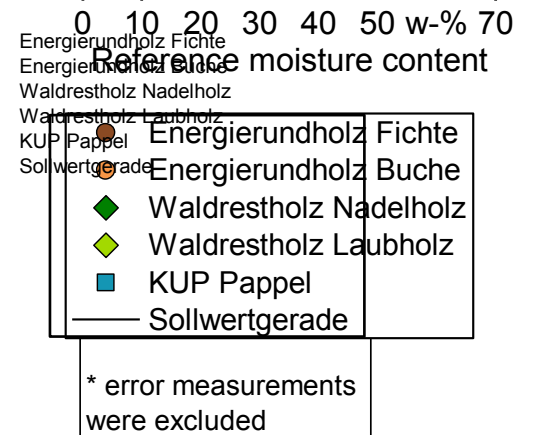
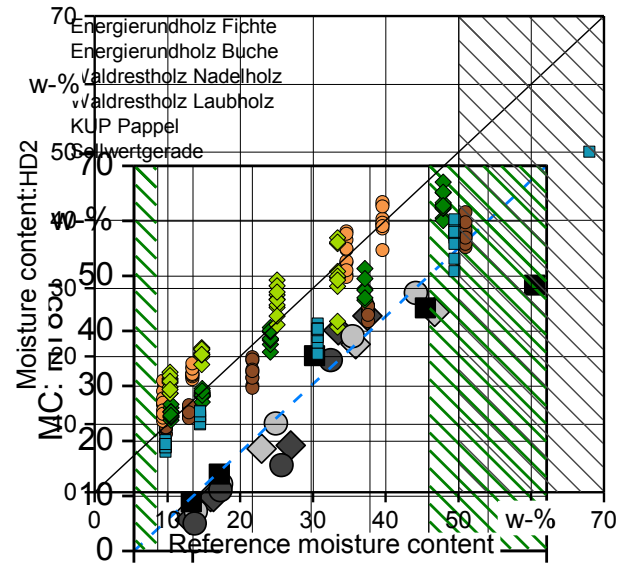
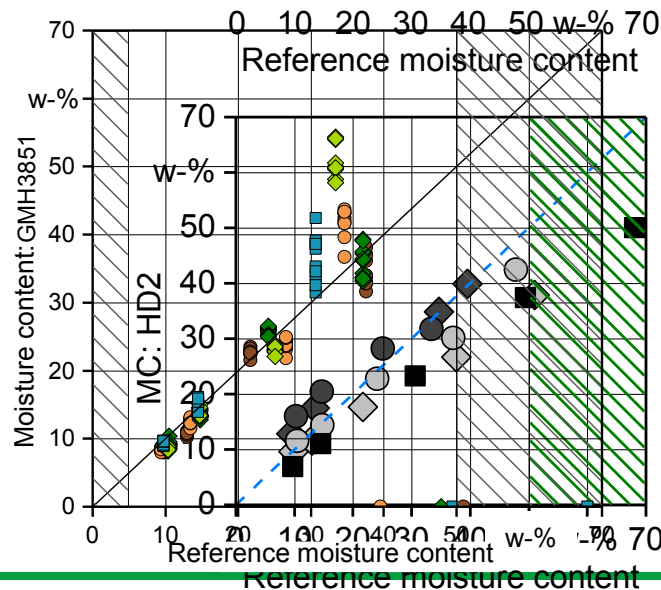
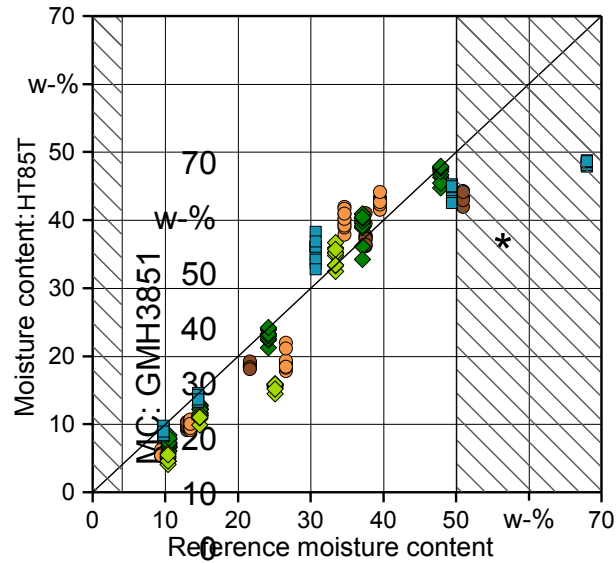


Results & discussion

Conductivity and TDR method

Measuring instrument	Mean deviation (± SD) [w-%]
GMH3851	0.7 (± 4.9)
HT85T	1.9 (± 3.7)
HD2	-1.6 (± 5.1)

Wassergehalt: UX3081

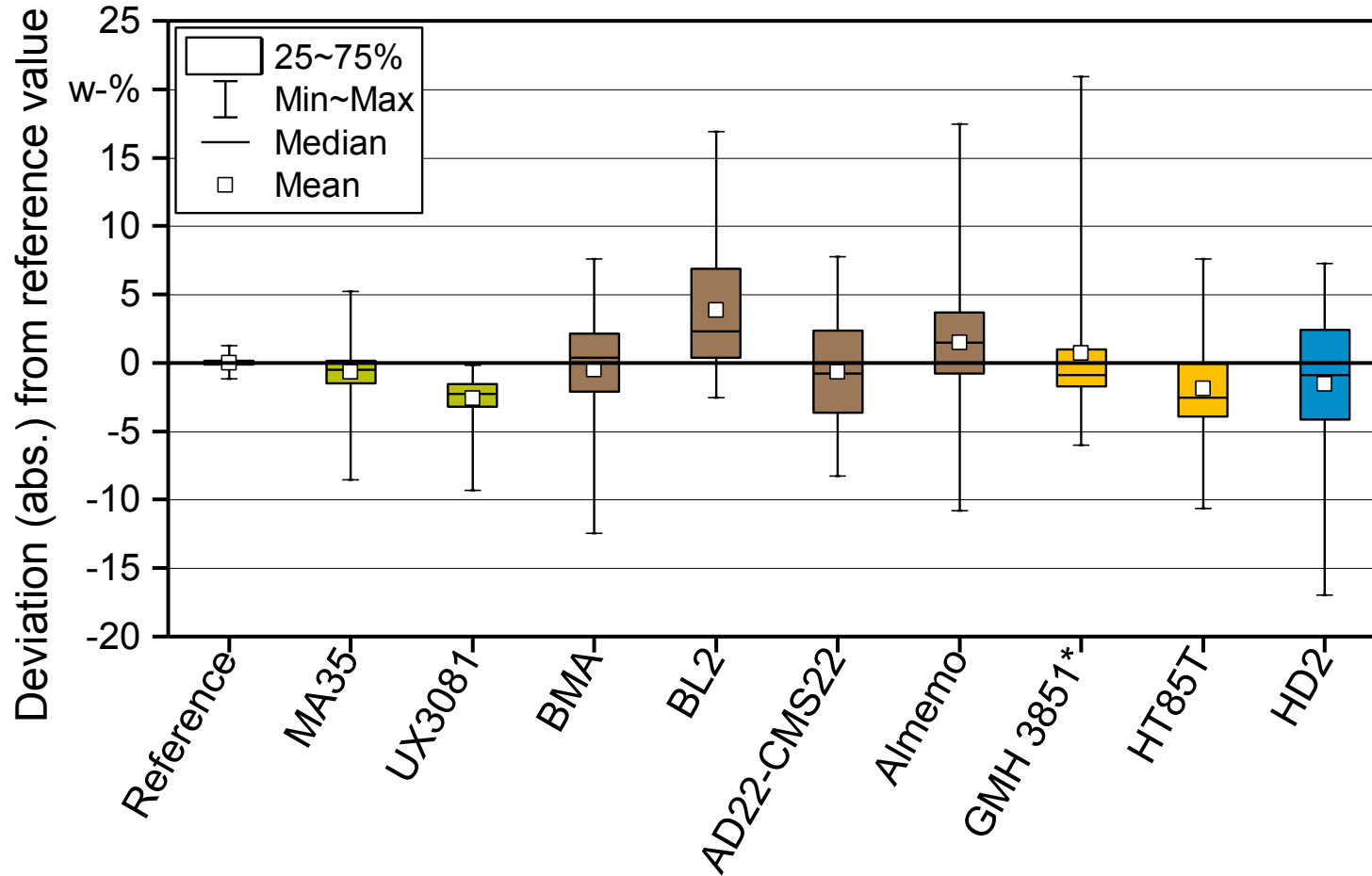


Results & discussion

	Measuring instrument	Measuring range [w-%]	<i>n</i>	Mean deviation (± SD) [w-%]	Y intercept	Slope	<i>r</i> ²
Infrared	Sartorius: MA35	0 – 100	67	-0.7 (± 2.1)	-0.66	1.00	0.98
	A&P Instruments: UX3081	0 – 100	68	-2.6 (± 1.7)	-1,66	0.96	0.99
Dielectric	Schaller: humimeter BMA	5 – 70	120	-0.5 (± 4.0)	3.65	0.85	0.95
	Schaller: humimeter BL2	10 – 50	190	3.8 (± 4.7)	-3.50	1.28	0.96
	Doser: AD22-CMS 22	0 – 50	220	-0.7 (± 4.0)	1.00	0.93	0.90
	Ahlborn: Almemo	0 – 50	220	1.5 (± 4.2)	2.88	0.94	0.90
Conductivity	Greisinger: GMH3851	5 – 50	190	0.7 (± 4.9)	-3.53	1.21	0.88
	Gann: HT85T	4 – 50	220	1.9 (± 3.7)	-4.27	1.10	0.94
TDR	IMKO: HD2-Sono M1	0 – 50	206	-1.6 (± 5.1)	4.14	0.76	0.86

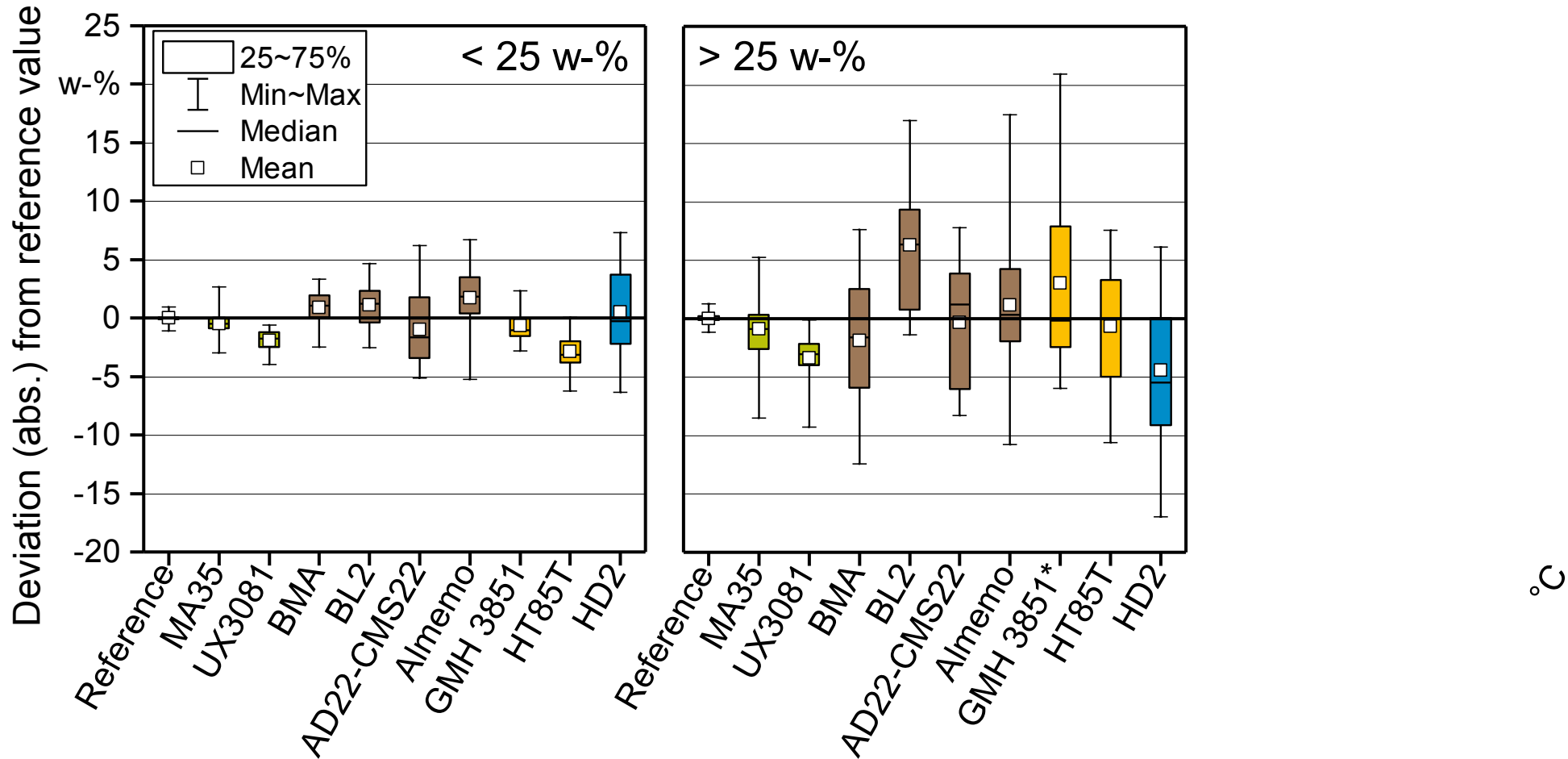
Results & discussion

- Comparison of measurements accuracy



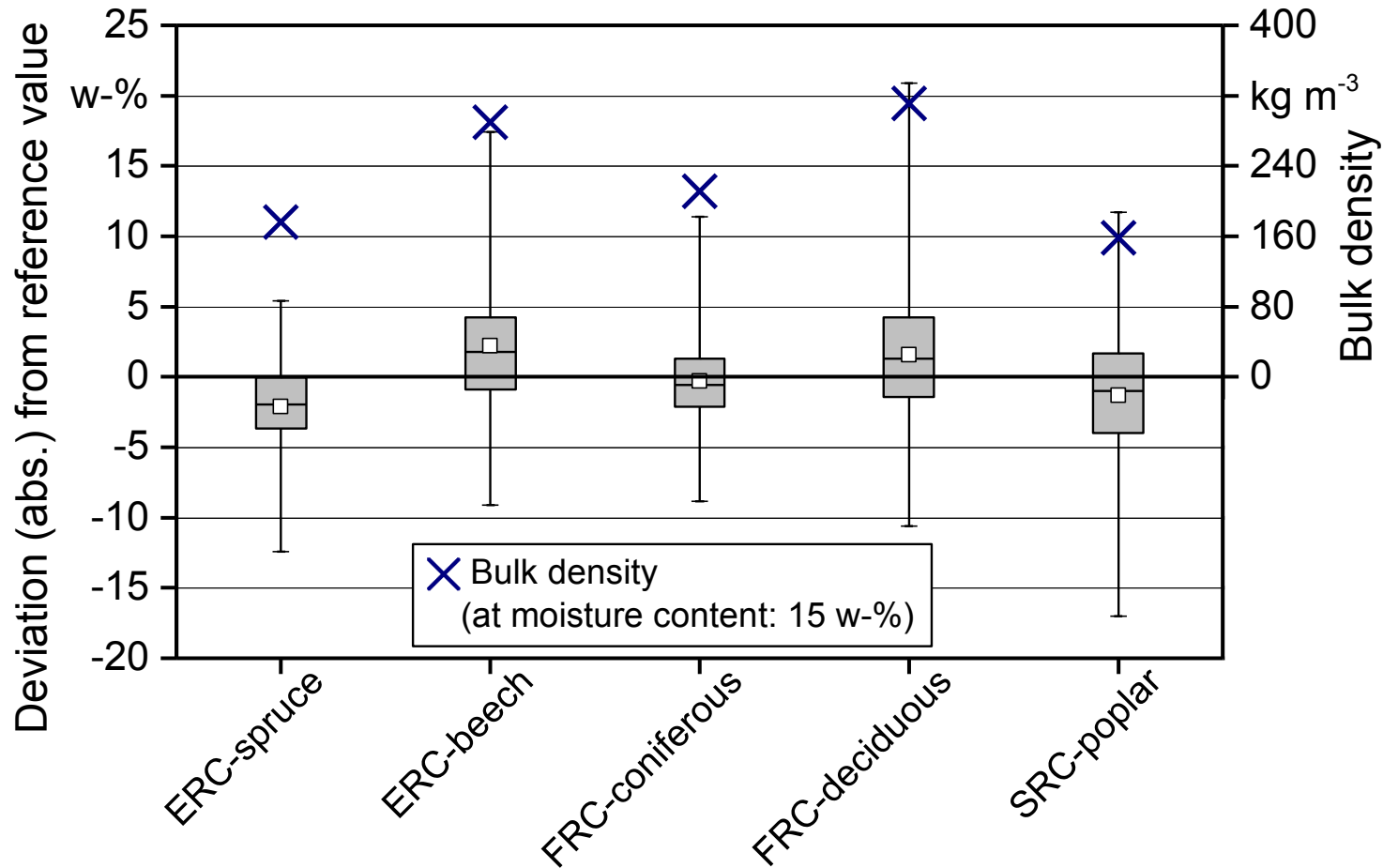
Results & discussion

- Influence of different moisture contents on accuracy of measurements



Results & discussion

- Influence of bulk density on accuracy of measurements



Conclusion

- The **high accuracy of the oven dry method** could not be reached by any of the tested devices
- ➔ by using a high amount of samples the average MC of all measurements approximated the reference value
- **With increasing MC** the **accuracy** especially of electric methods **decreased**
- **Individualized calibration** curves can increase accuracy
- The MA35 scored best results despite of a small sample size and large measuring range
- Nevertheless, the **heterogeneity of wood chips** should not be disregarded
- ➔ Representative sampling and accurate sample preparation are thereby fundamental for obtaining high-quality results

Thank you for your attention!

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