

kuraray

Mowital[®] for Temporary Binder

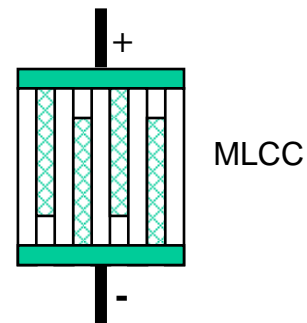
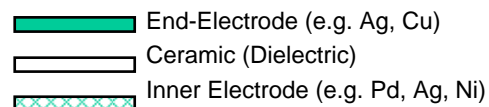
Introduction:

- PVB has been used as binder in ceramic slurries for preparing green tapes
- green tapes are used for the production of flat ceramic parts
- mainly for electronic applications (“IT-ceramics” or “functional ceramics”)

Ceramic Applications:

Examples for ceramics produced by using green tapes:

- Capacitors (MLCC, SLCC – Multi (Single) Layer Ceramic Capacitors, HVCC – High Voltage Ceramic Capacitors)
- Resistors (CCR – Ceramic Chip Resistors)
- LTCC (Low Temperature Co-fired Ceramics)
- Fuel Cells (e.g. SOFC – solid oxide fuel cells)
- Piezo Ceramics (actuators – e.g. valve control for direct injection of gasoline or diesel in car engines)



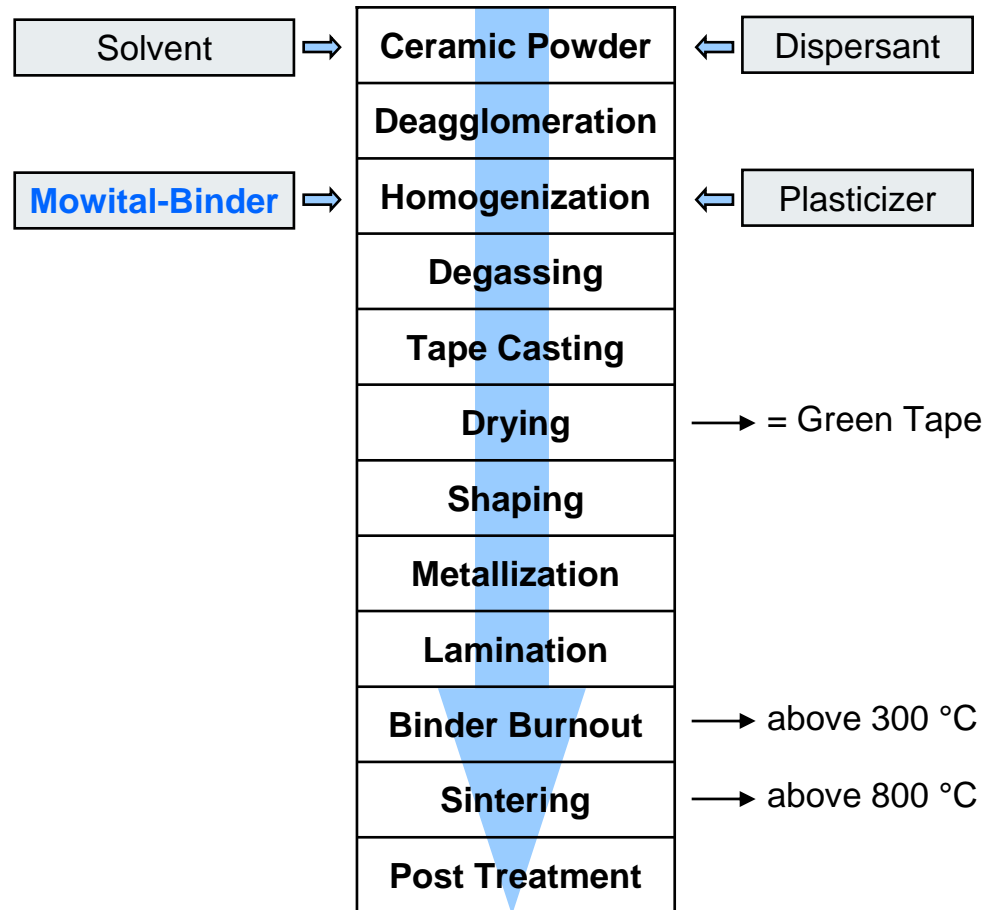
PVB is used for special ceramic products (e.g. passive components⁽¹⁾, chip supports / ceramic substrates) which are made from different ceramic powders.

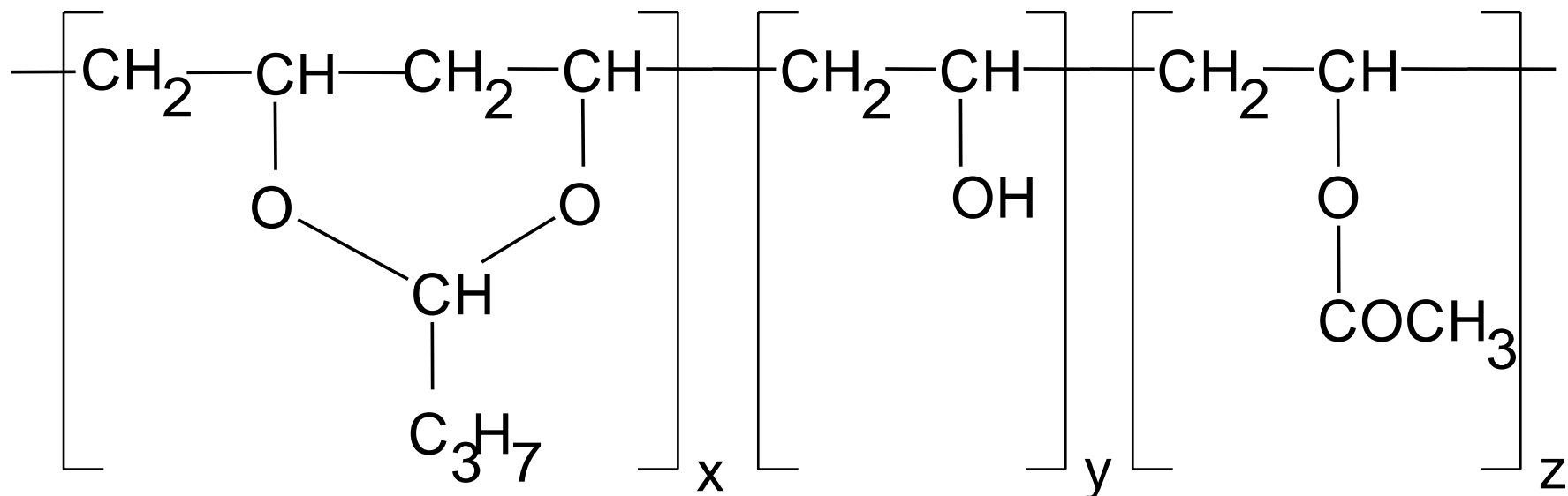
PVB is additionally used for metal pastes (e.g. metal membranes).

Product	Ceramic powder
Multi layer ceramic capacitor (MLCC)	BaTiO ₃ (Bariumtitanate)
Multi layer ceramic inductor (MLCI)	Fe ₂ O ₃ (Ferric oxide)
Substrate = Package (= support for surface mounted electronic device) e.g. chip)	Al ₂ O ₃ (Alumina) AlN (Aluminiumnitride)
Resistor	Al ₂ O ₃ (Alumina)

(1) passive components = capacitors, inductors, resistors

Process for preparing functional ceramics:





69-88 % weight %

11-27 % weight %

1-4 weight %

examples of monomer and oligomer plasticizers:

- Phthalates: DOP, DBP, butyl benzyl phthalate
- Phosphates: TBP, TOP
- di-esters of glycols: tri- or tetraethyleneglycol-di-n-heptanoic acid ester, dipropyleneglycol-di-benzoate
- others: esters of adipic and citric acid, Castor oil

examples of polymeric plasticizers:

- alkyd resin based on Castor oil: Rokraplast R-520
 - hydroxyl containing acrylic copolymer: Reactol AC 11
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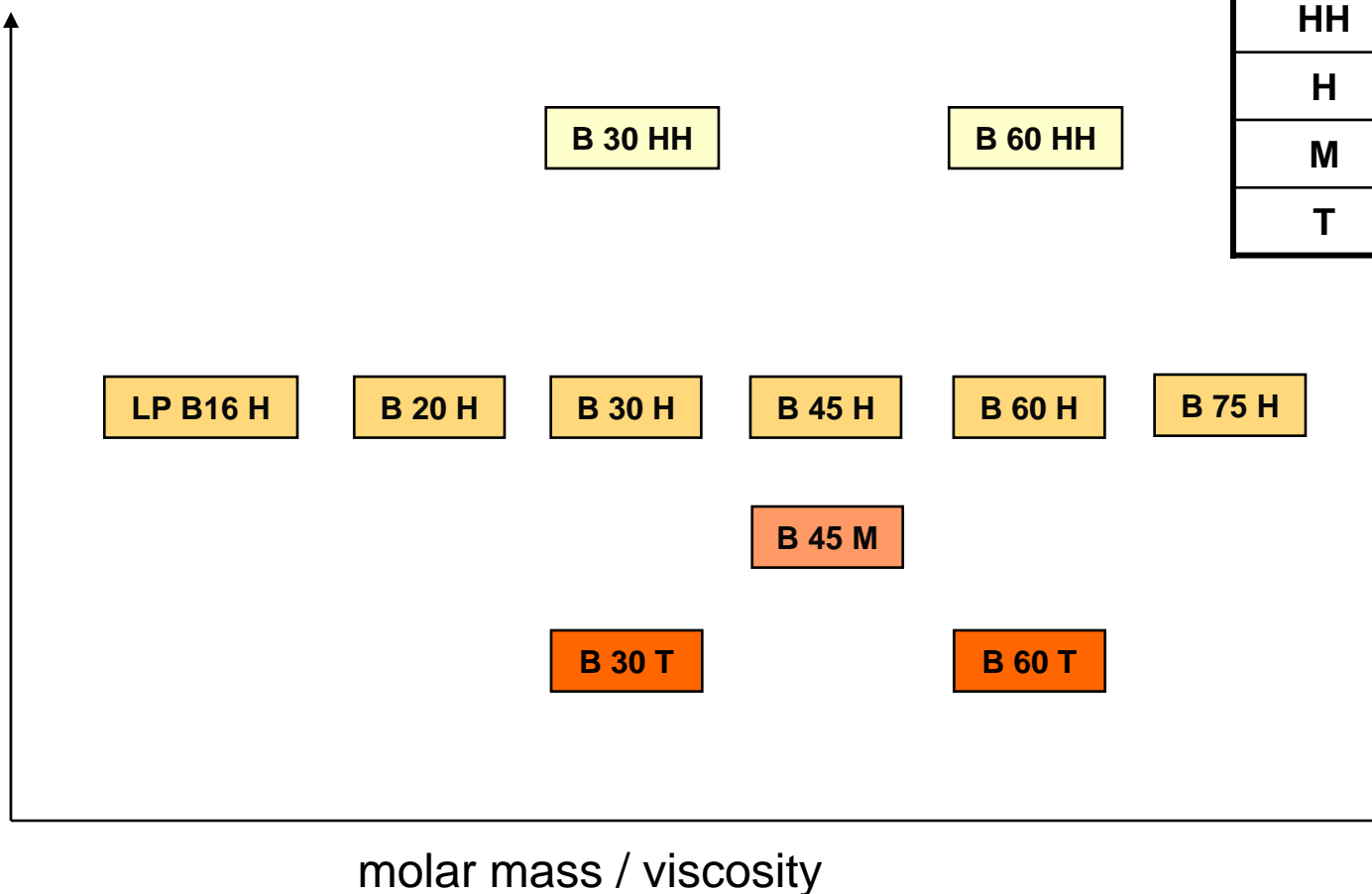
Degree of acetalization

80-88
high

75-81
medium

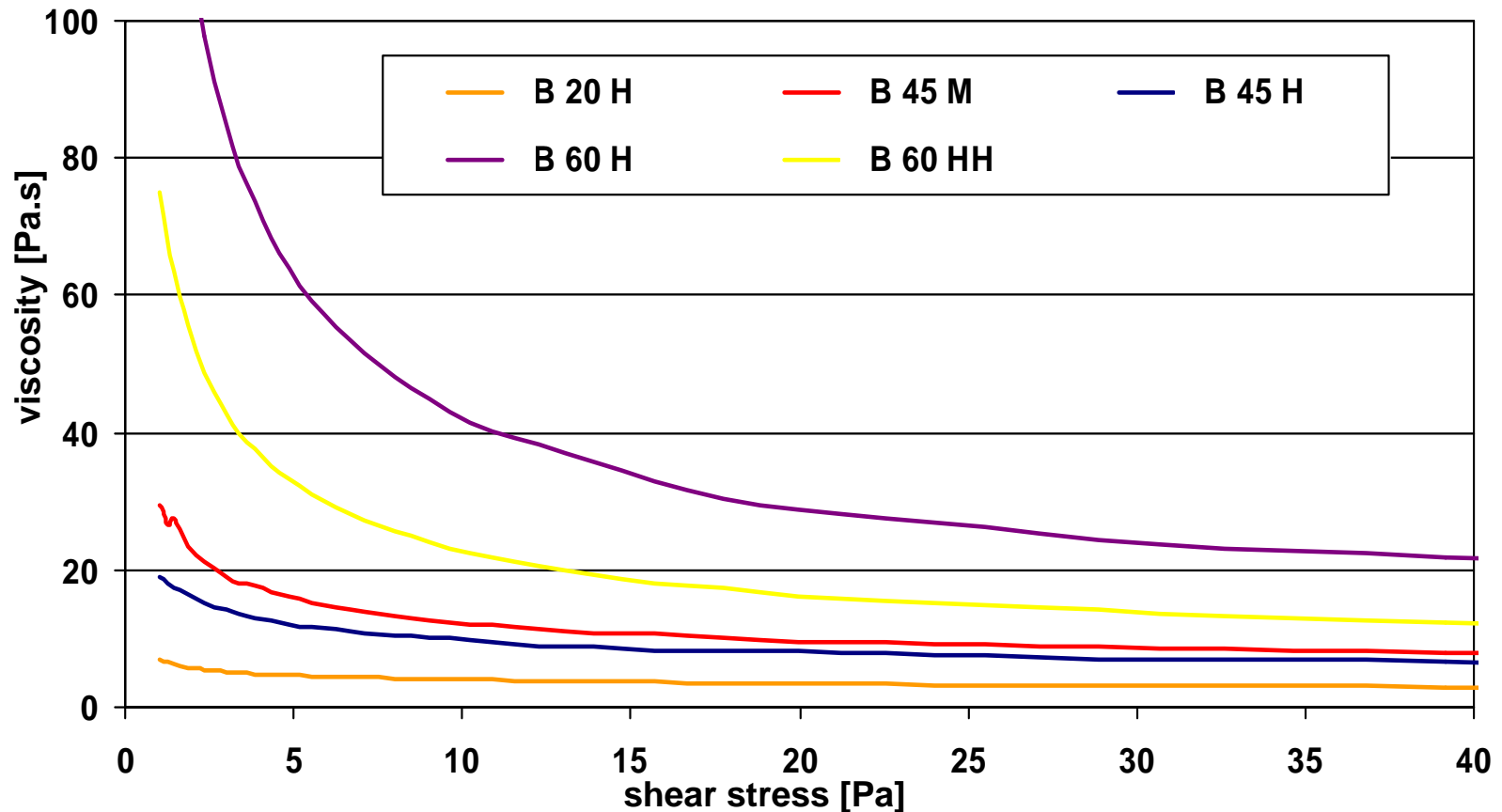
69-75
low

suffix	wt.-% PVOH
HH	11 – 14
H	18 – 21
M	21 – 24
T	24 – 27



Viscosities of Ceramic Slurries

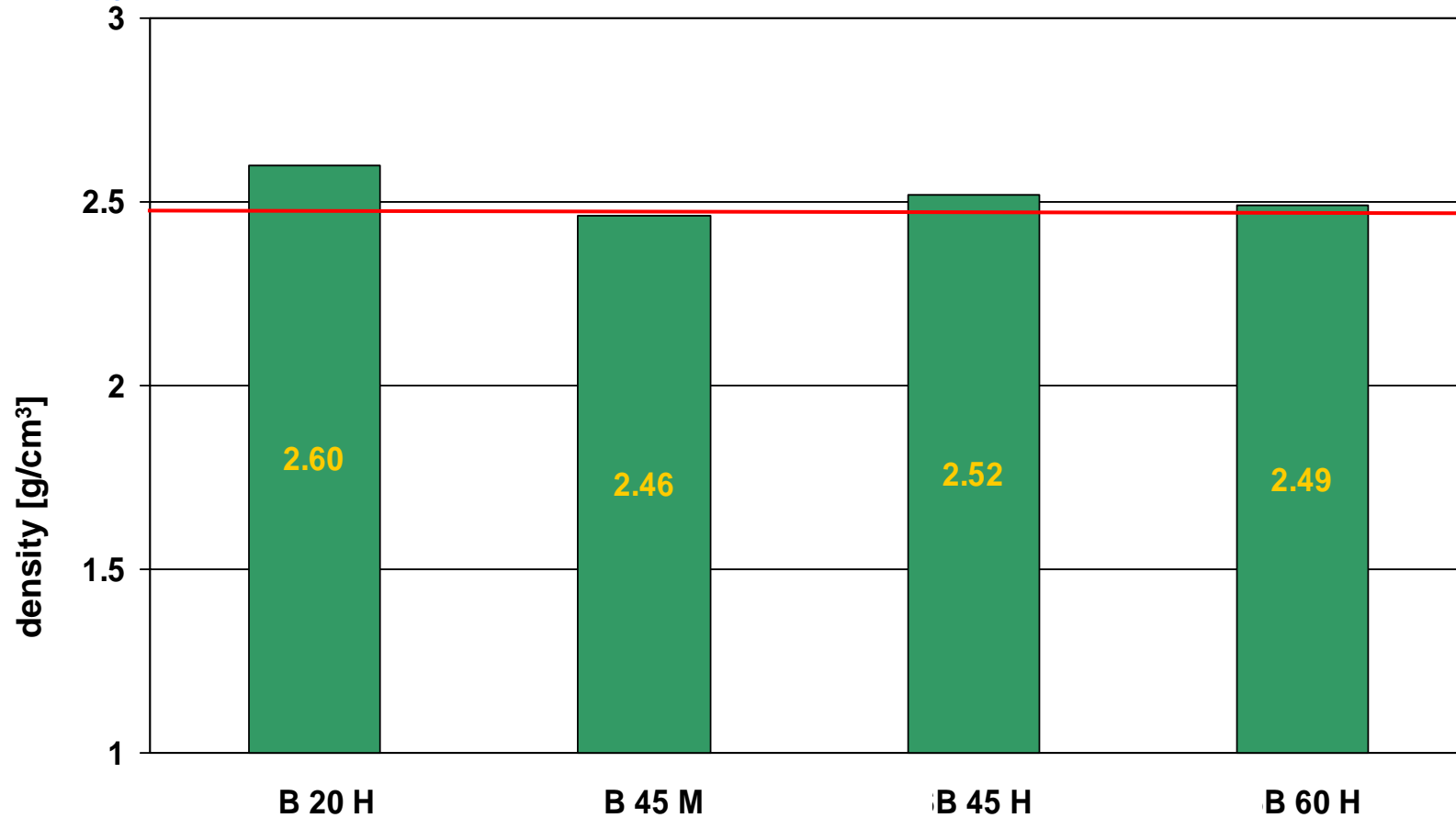
plate-cone rheometer UDS 200, ceramic slurries at 15 °C



Rheology of all slurries is pseudoplastic which corresponds to easy processing during film casting

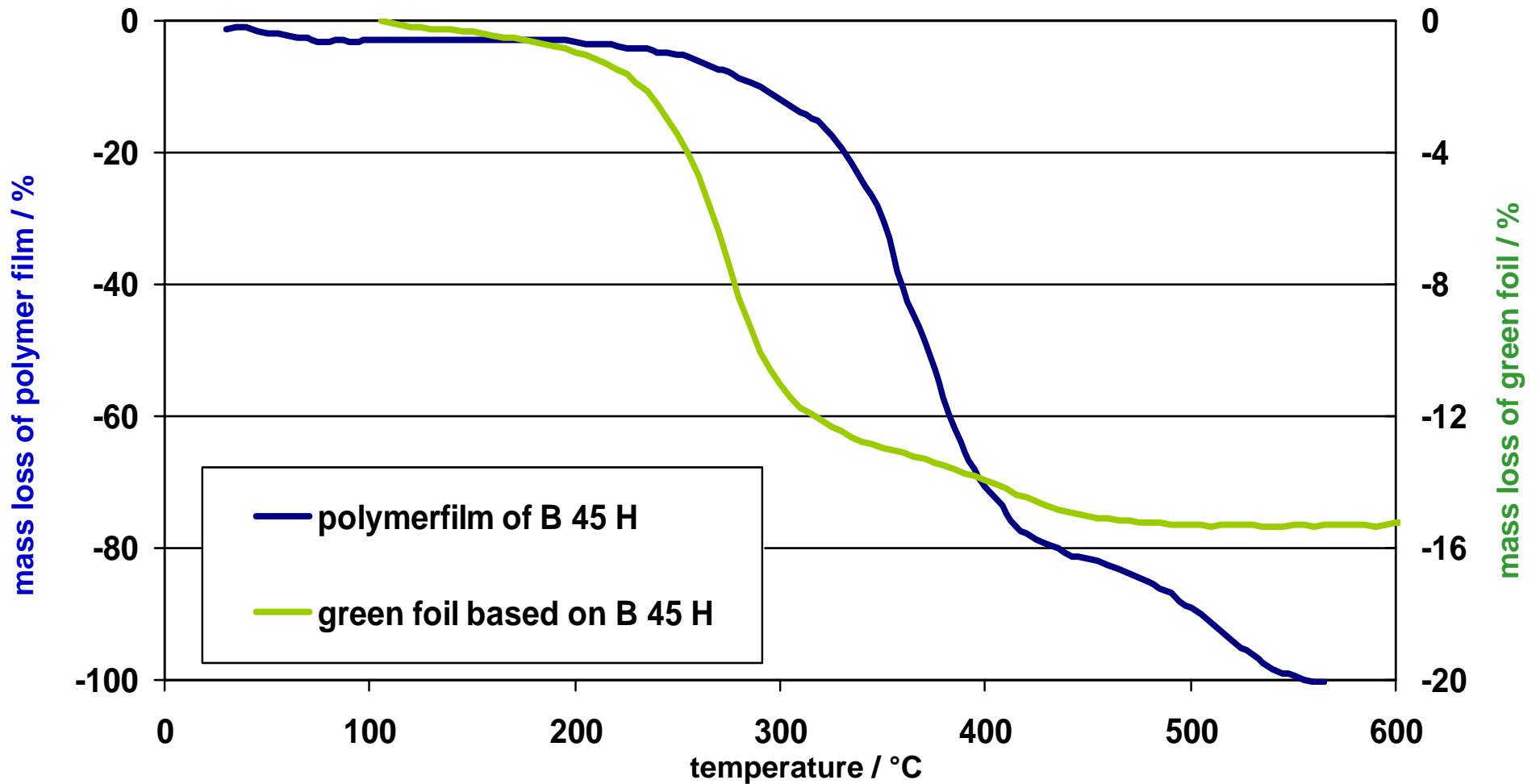
Density of Green Sheets

(calculated from weight and dimension of punched pieces)

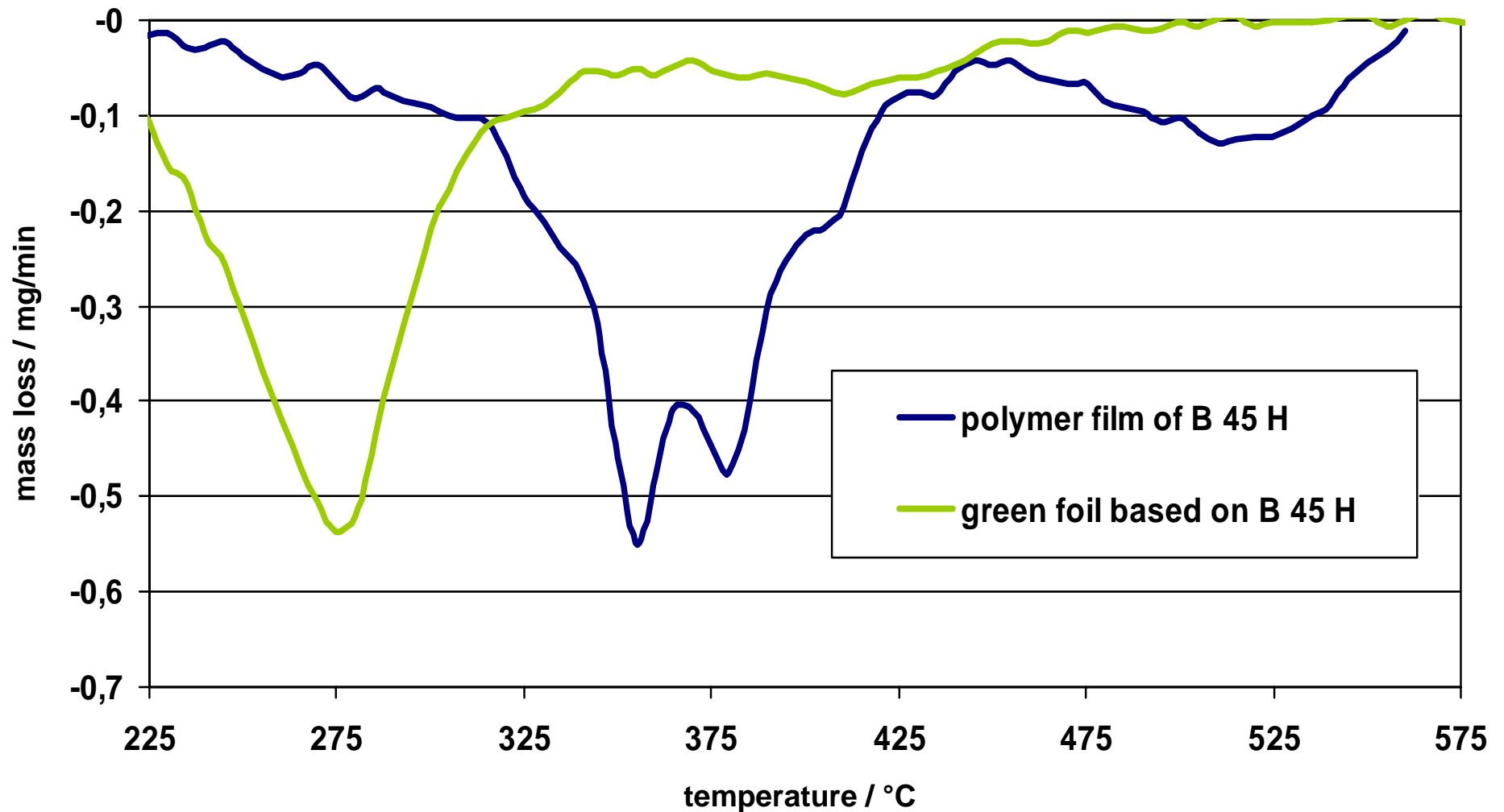


The higher density indicates very good dispersing power and/or compatibility with all raw materials.

Netzsch STA 409, heating speed 5 K/min, under air

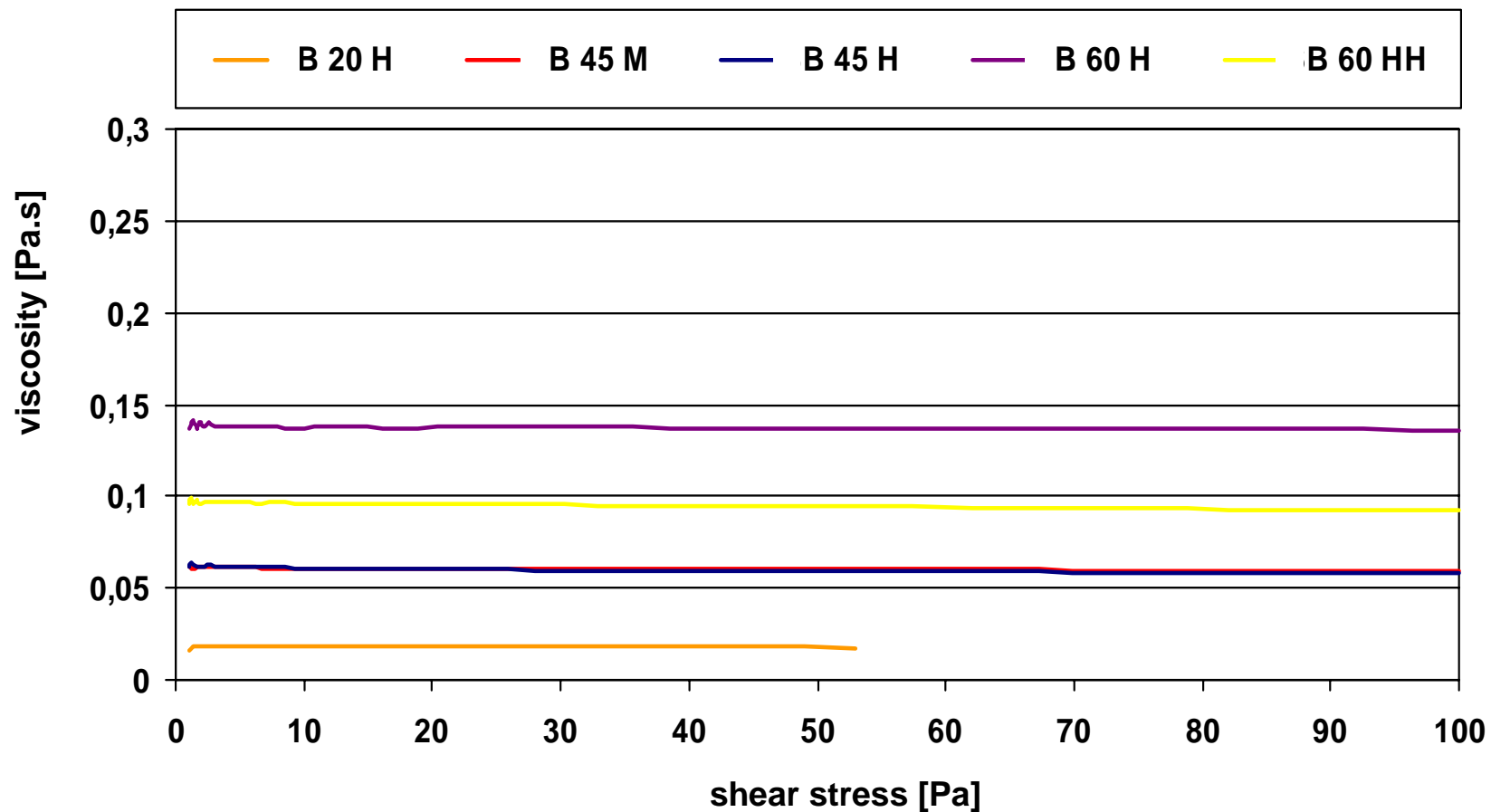


Netzsch STA 409, heating speed 5 K/min, under air

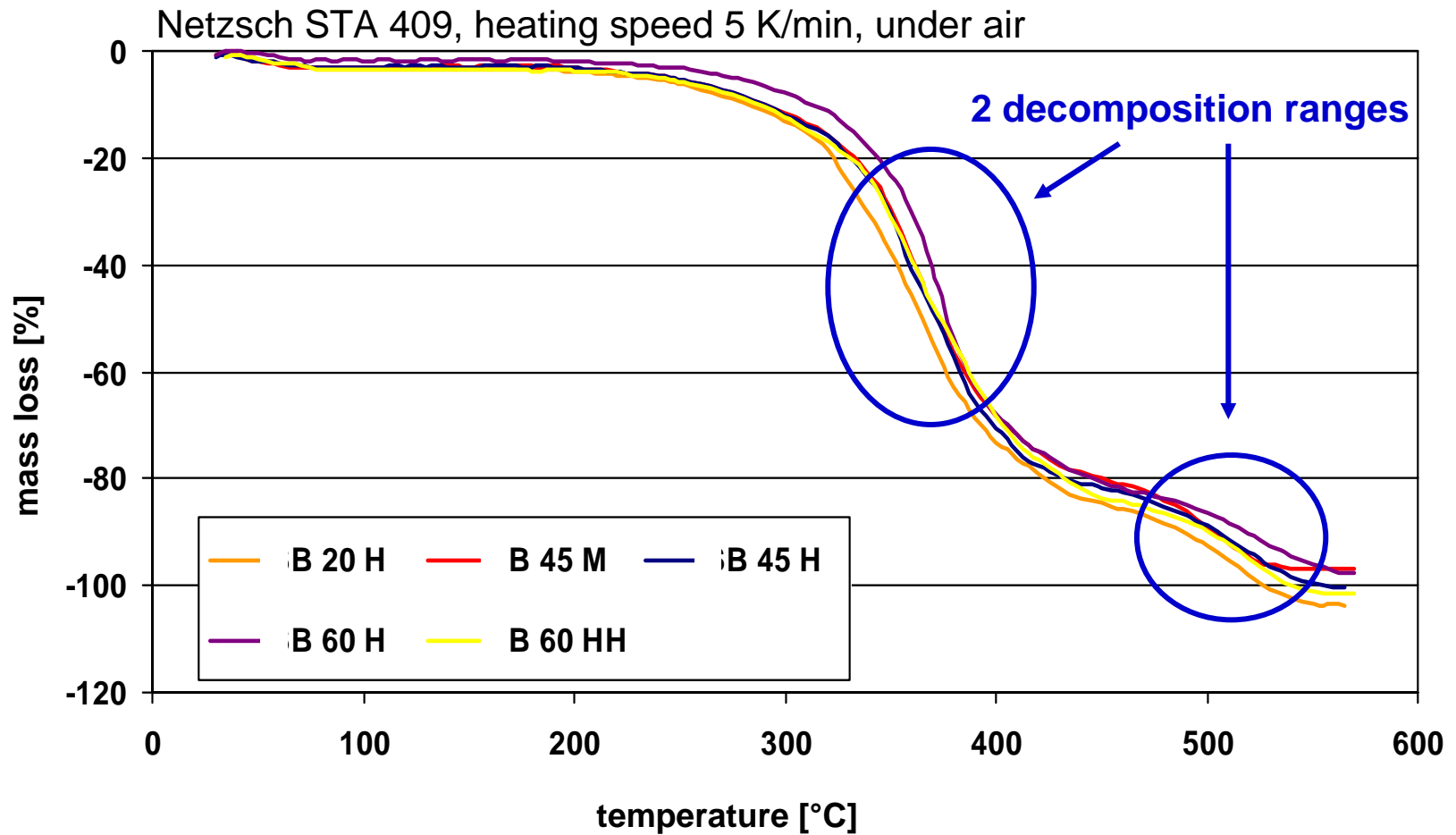


Viscosities of Binder Solutions → all binder solutions show Newtonian rheology

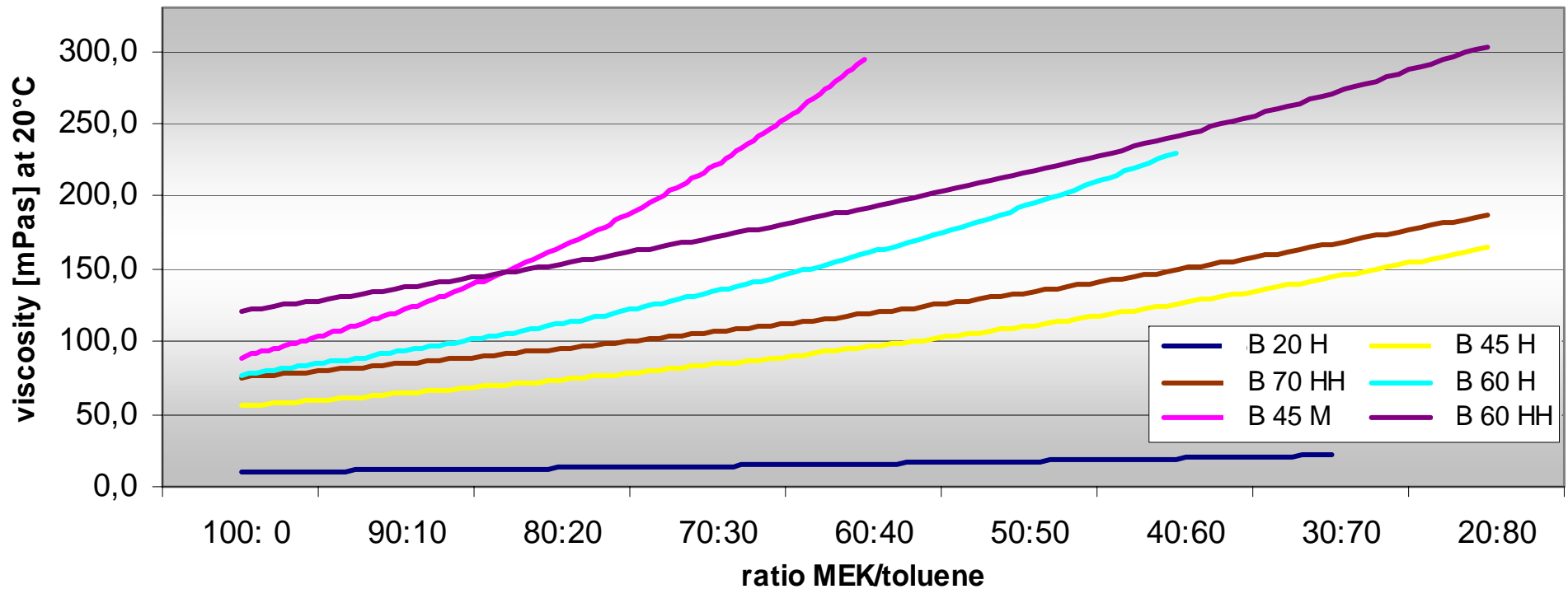
- plate-cone rheometer UDS 200, 10% solutions in ethanol/toluene (34/66 Vol.%) at 25 °C



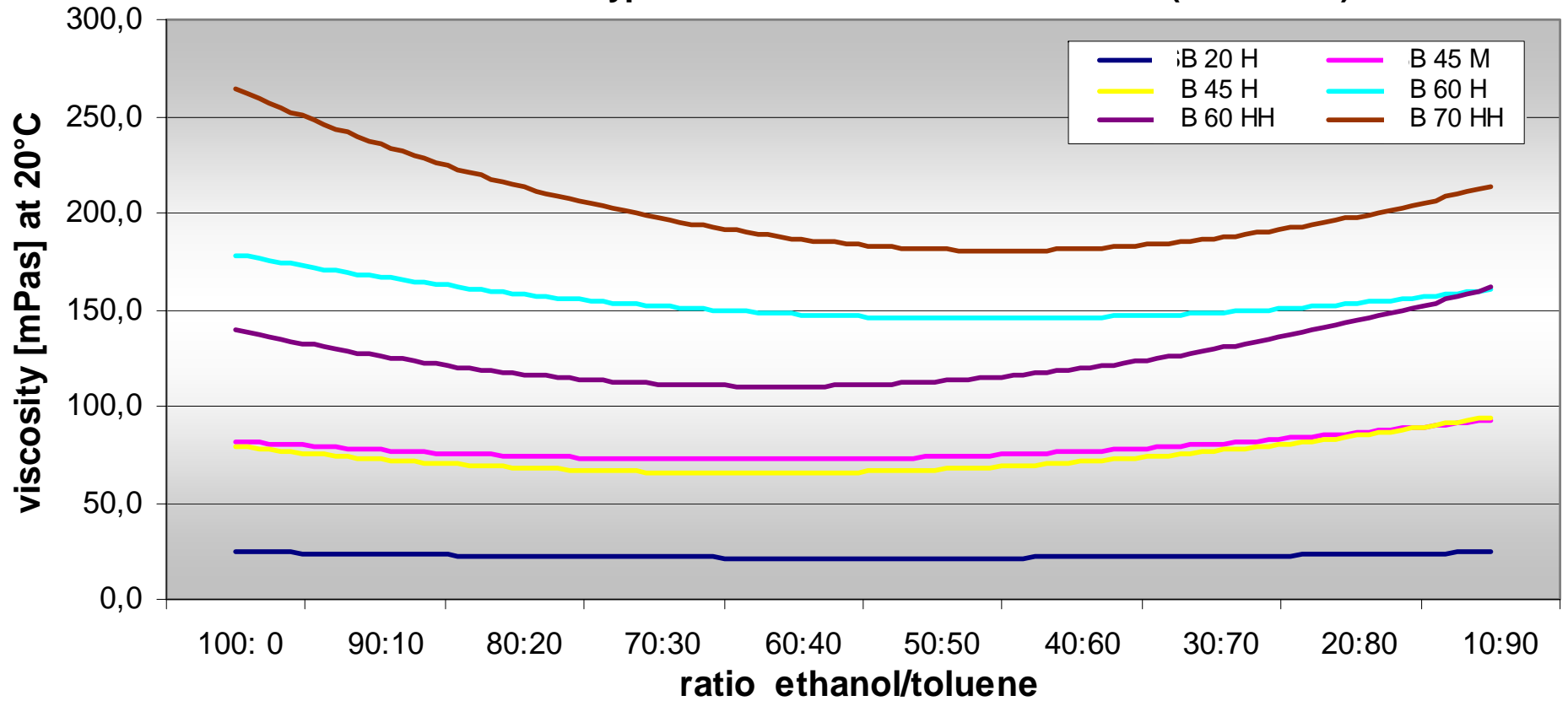
Thermogravimetric Analysis of Binders



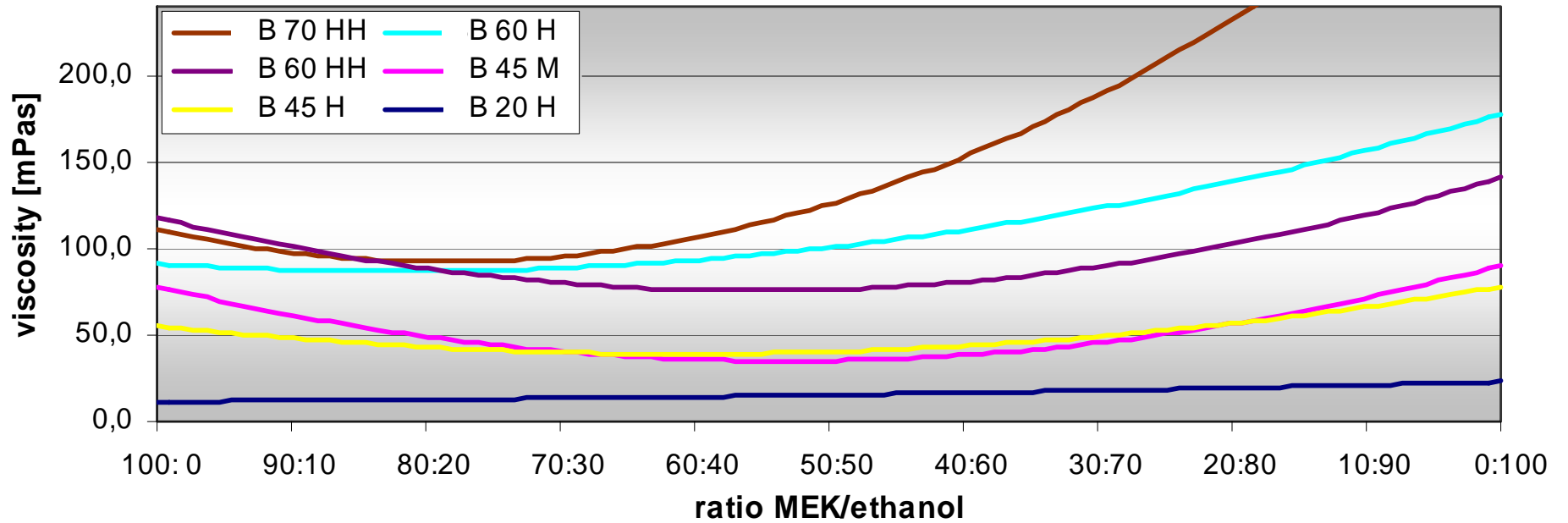
Viscosities of Mowital types in **MEK-toluene** mixtures (10% solid)



Viscosities of Mowital types in ethanol-toluene mixtures (10% solid)



viscosity of Mowital types in MEK-ethanol mixture (10% solid)



products of decomposition at 300°C (analysis by GC-MS)

under air	wt-%	under nitrogen	wt-%
Formaldehyd, Air, and CO ₂		Butenal	23
Acetaldehyde	6	Acetaldehyde	5
Ethanol	1.2	Ethylcyclopenten	3
Aceton	3	Aceton	1
iso-Propanol	0.4	2-Ethyl-2-hexanal	16
Formic acid	2.7	Butylhydroxytoluen	19
Butanal	50	Butanal	18
Acetic acid	12	Dihydrofuranon	12
Crotonaldehyde	1.5		
n-Butanol	1	total	97
3-Penten-2-on	0.3		
Butanoic acid	14		
Dihydrofuranon	0.2		
Phenol	0.3		
Acetophenon	0.2		
total	96.8		

kuraray Advantages of [®]Mowital as Temporary Binder

- ➔ Good solubility in a broad range of solvents
 - ➔ Good compatibility with common plasticizers for ceramic systems
 - ➔ Low binder migration during drying process of the green tape
 - ➔ Excellent green-strength and flexibility of ceramic green tape
 - ➔ Excellent adhesion in multilayer structures
 - ➔ Low ion content
 - ➔ Complete debinding under air and inert atmosphere
 - ➔ Low debinding temperature
 - ➔ Easy recycling of green tape
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