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The Pore Size Distribution of Naturally Porous Cigarette Papers and its Relation to Air Permeability and Diffusion Capacity

Part 1

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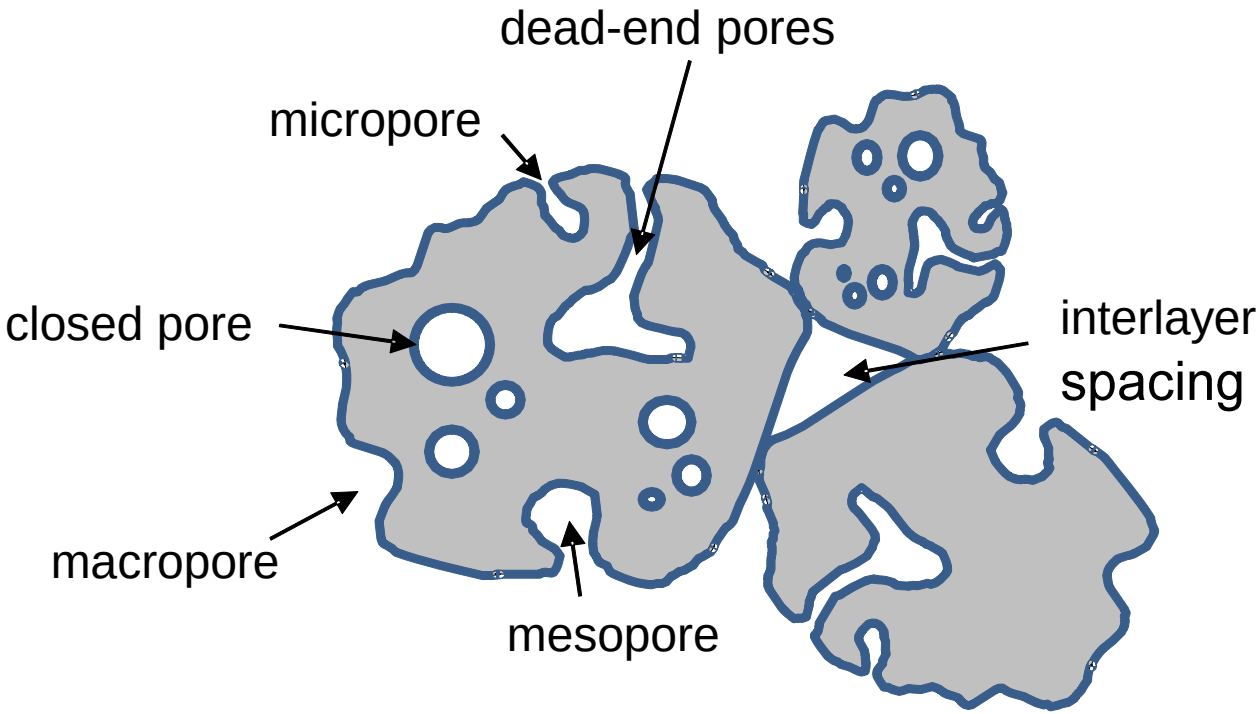
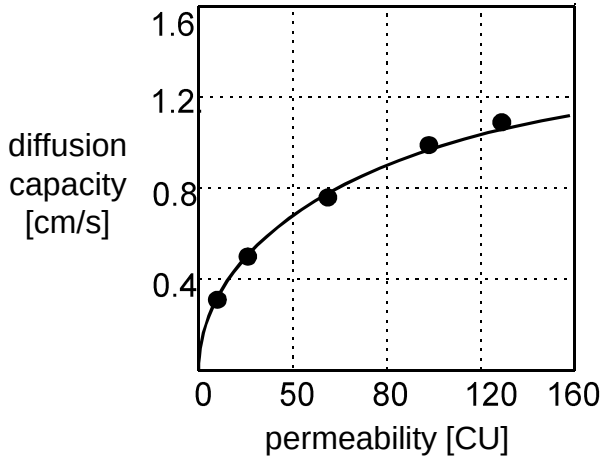
Porosity of paper



Detection of porosity: indirect

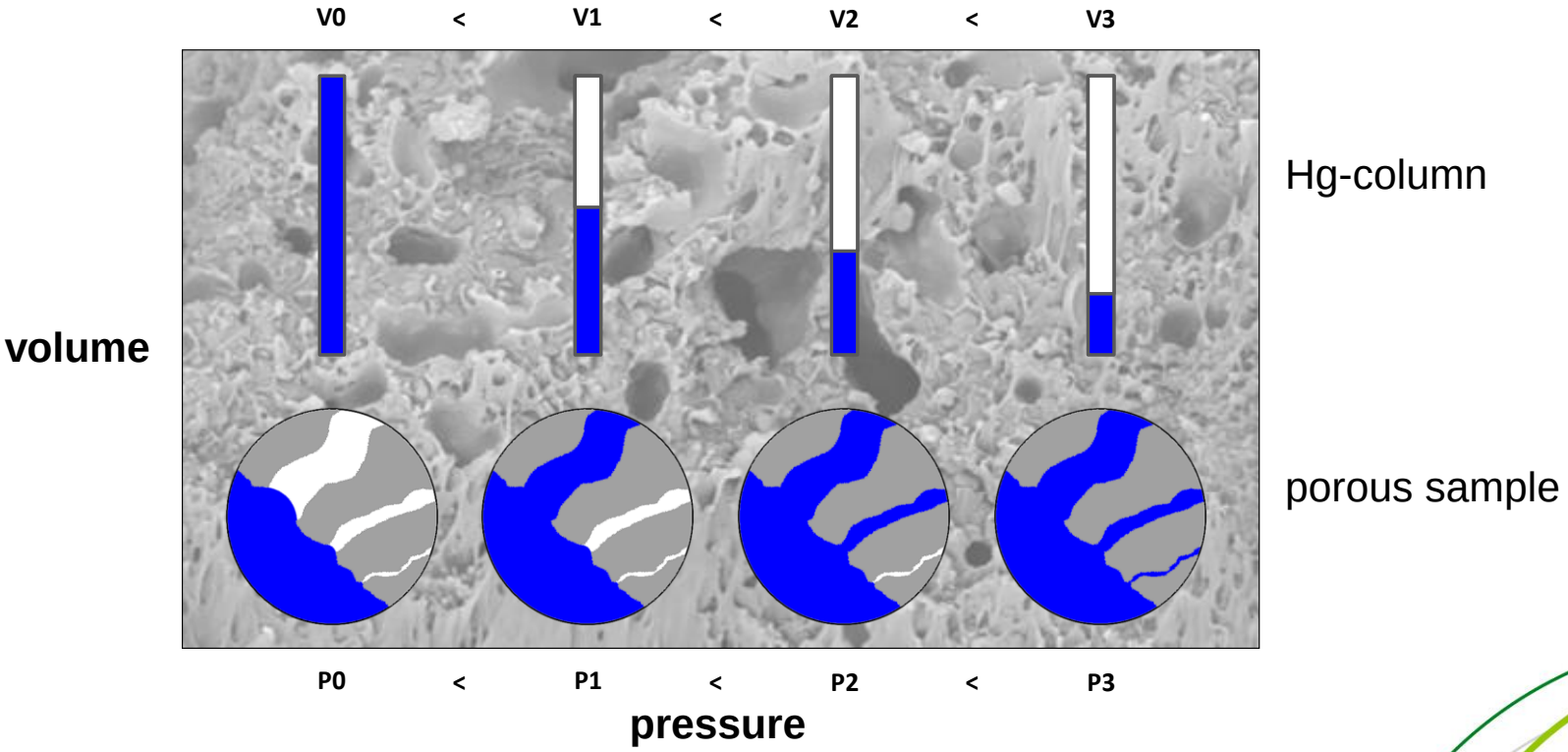
- Air permeability (Z):
  - air flow driven by a **pressure difference**
- Diffusion capacity (D*):
  - air flow driven by a **concentration difference**



Detection of porosity: direct

- Mercury (Hg) porosimetry
  - Non-wetting liquid cannot enter pores spontaneously
  - forced into the pores by application of external pressure
  - required equilibrated pressure is inversely proportional to the pore size

Detection of porosity: direct

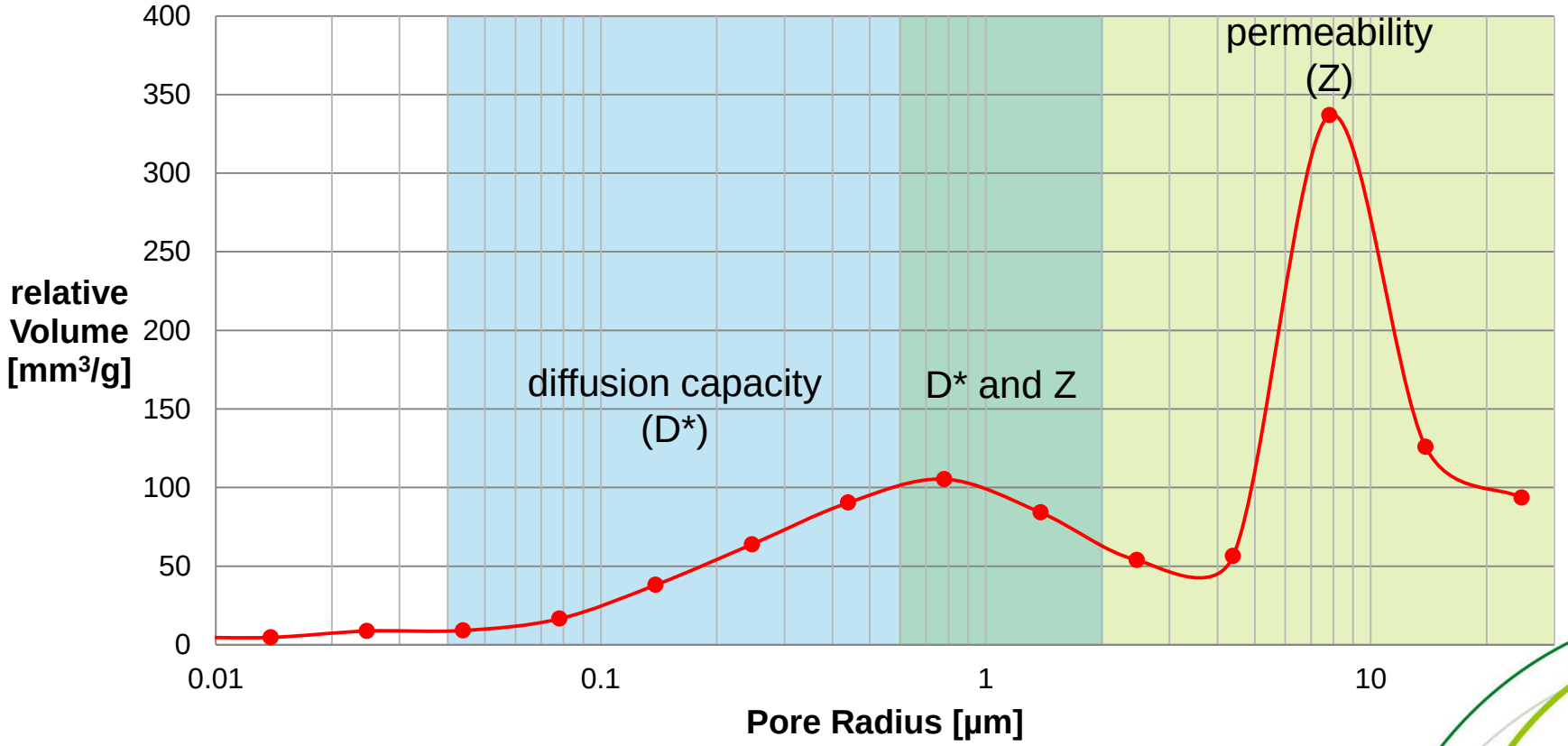


Assumptions

- Pore size vs. paper porosity
  - small pores more effect on diffusion capacity
  - larger pores more effect on air permeability
- Correlations between direct and indirect method?

Assumptions

Objectives | Procedure | Sample Sets | Results



Equipment

Pascal 140

0.01 kPa – 400 kPa (low pressure - LP)

Pore radius: 300 µm - 1.9 µm

Porosimeter 2000

0.1 MPa – 200 MPa (high pressure - HP)

Pore radius: until 3.7 nm

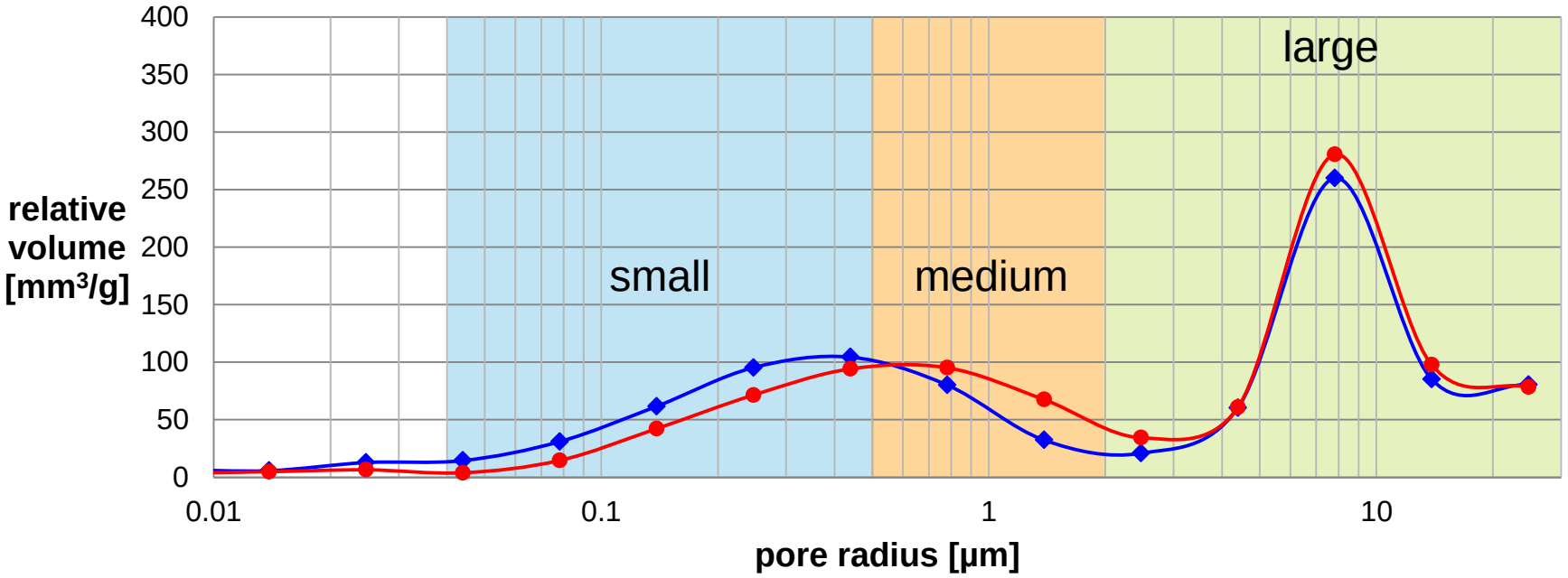
Procedure

- Defined amount of paper into dilatometer with small amount of Hg
- Sealing with capillary and final sealing
- Gravimetric analysis before measurement
- First LP-, then HP-analysis
- Transfer of data to software
- Combination of LP and HP measurements to pore size distribution curve

Cigarette paper sample sets

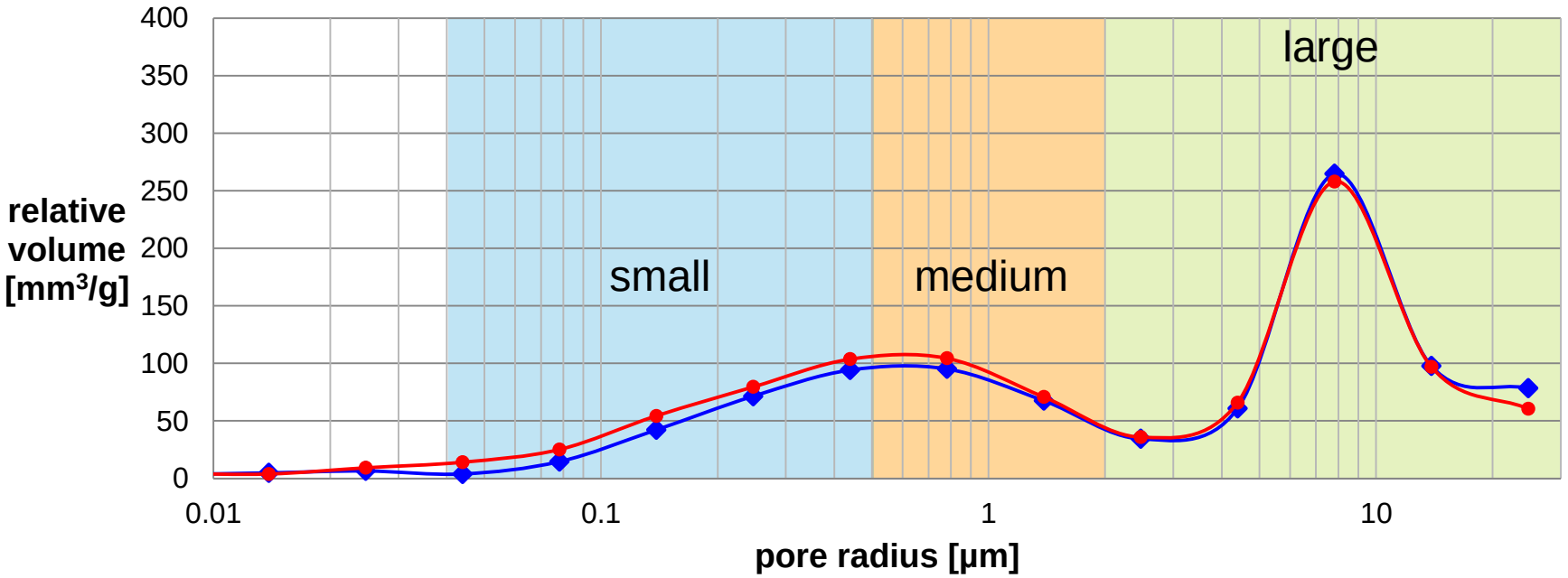
sample	permeability [CU]	chalk content [gsm]	burn additive [%]	furnish
set 1: permeability				
25 CU	25	7	1	wood
50 CU	50	7	1	wood
set 2: chalk content				
7 gsm	50	7	1	wood
10 gsm	50	10	1	wood
set 3: thermal decomposition				
2% B.A	75	7	2	wood
set 4: furnish				
wood	75	7	2	wood
flax	75	7	2	flax

SET 1: air permeability



sample	permeability [CU]	diffusion capacity [cm/s]
25 CU	23	1.18
50 CU	48	1.58

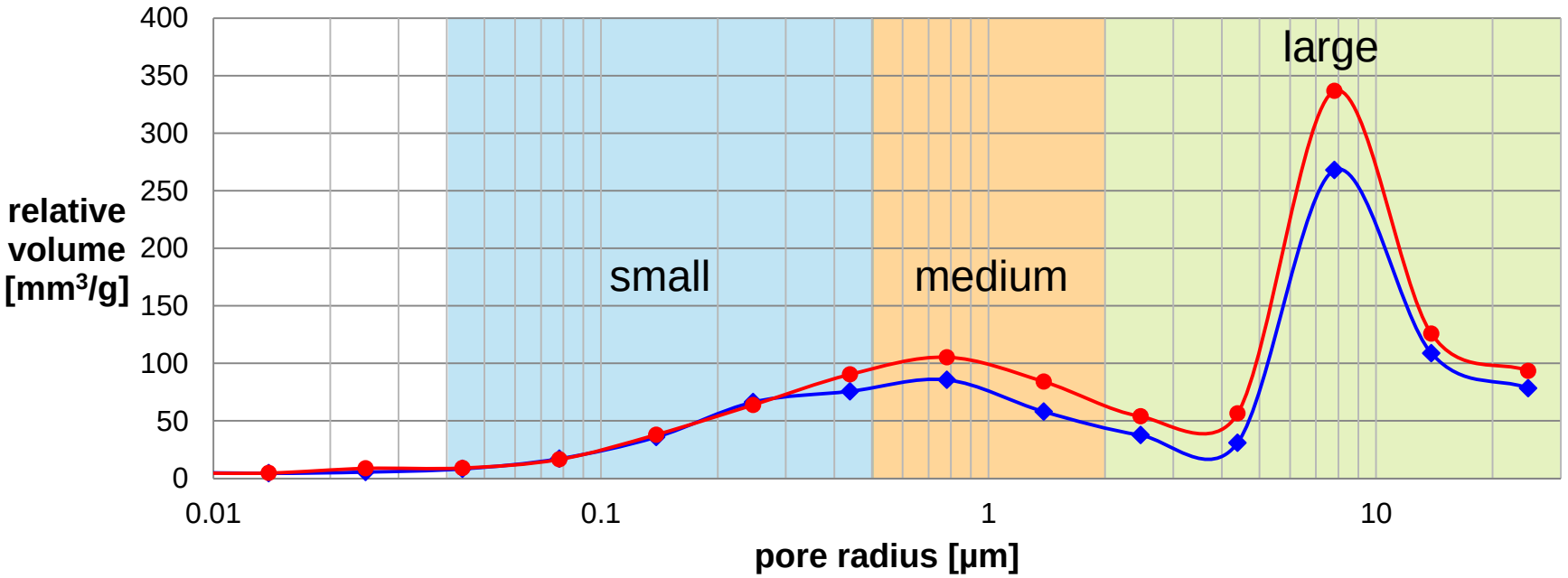
SET 2: chalk content



sample	permeability [CU]	diffusion capacity [cm/s]
7 gsm	48	1.58
10 gsm	51	1.84

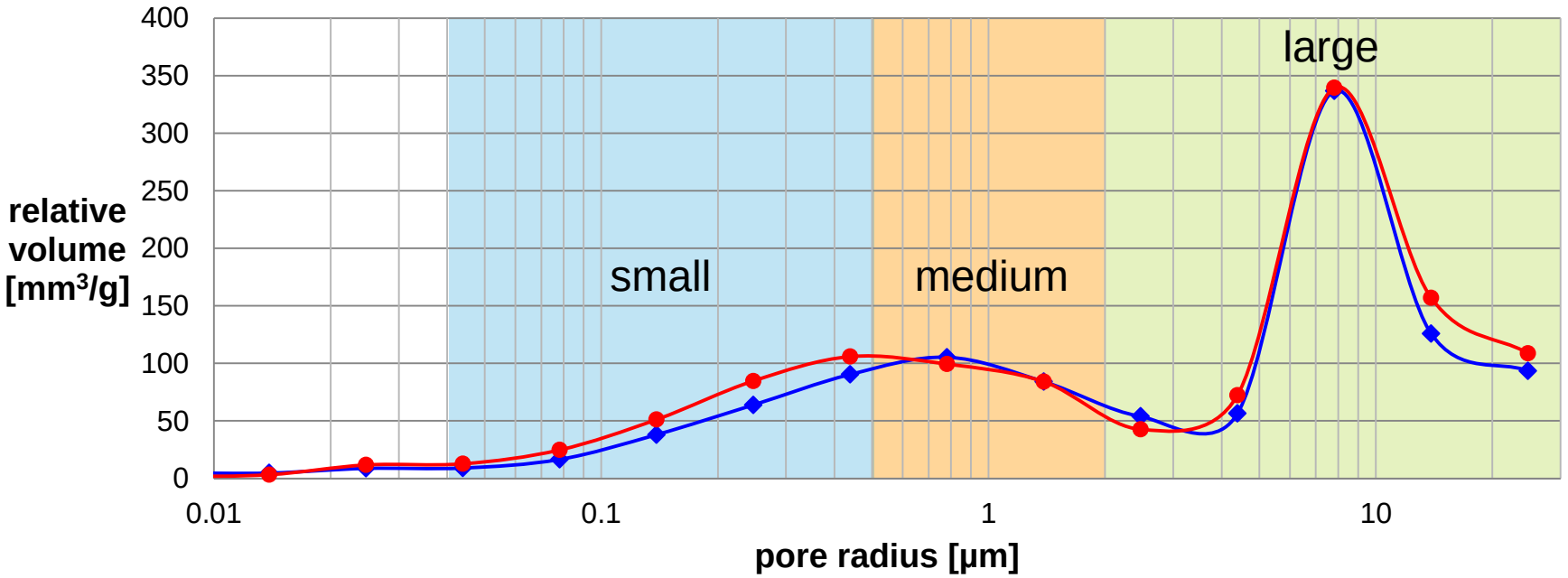
SET 3: thermal decomposition

Objectives | Procedure | Sample Sets | Results



sample	permeability [CU]	diffusion capacity [cm/s]
RT	71	1.50
HT	99	1.98

SET 4: furnish



sample	permeability [CU]	diffusion capacity [cm/s]
wood	71	1.50
flax	68	2.04

Summary

- Detection of paper porosity
  - indirect: air permeability, diffusion capacity
  - direct: Hg-porosimetry
- 4 sets for investigation of effect on pore size distribution
- Correlation of direct and indirect method
  - section 1 (small): larger effect on diffusion capacity
  - section 2 (medium): effect on diffusion capacity and air permeability
  - section 3 (large): larger effect on permeability

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