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Fractionation of Flash Pyrolysis Condensates by Staged Condensation

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Fractionation of Flash Pyrolysis Condensates by Staged Condensation

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Chania, Crete, 01.10.2015

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AGENDA

1. Ablative Flash Pyrolysis

2. Staged pyrolysis vapour condensation
   - Two staged condensation
   - Three staged condensation
   - Creation of Value

3. Summary

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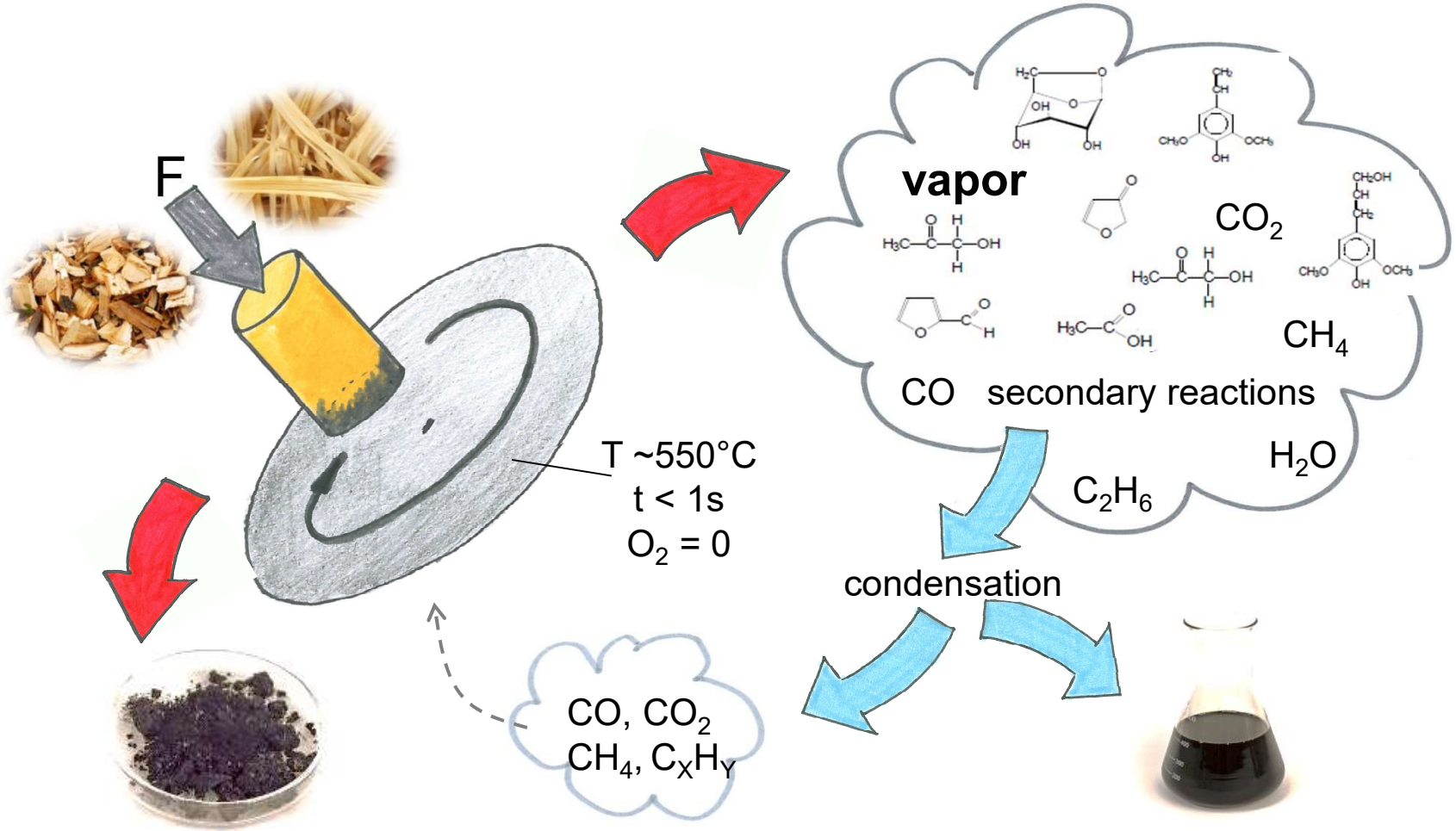
Ablative Flash Pyrolysis – Principle



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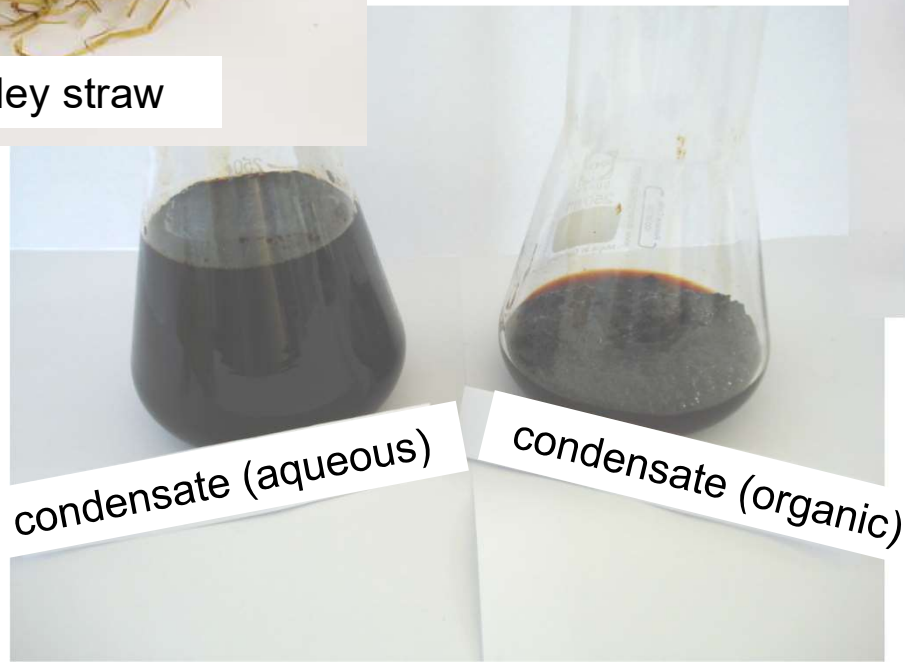
Ablative Flash Pyrolysis – Products



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Ablative Flash Pyrolysis – Laboratory Plant

Input:

< 10 kg/h

Heating:

electrical

Cooling:

indirect

Aerosol sep.:

ESP

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Ablative Flash Pyrolysis – Quality of Condensates

	aqueous	organic
mass ratio	67.5 %	32.5 %
total Water	61.7 %	25.3 %
nonaromatic Acids	7.4 %	5.9 %
nonaromatic Alcohols	1.5 %	0.3 %
nonaromatic Aldehydes	0.0 %	1.1 %
nonaromatic Ketones	5.9 %	7.1 %
Phenols	1.2 %	12.0 %
Sugars	1.6 %	1.5 %
Heterocyclic Sub.	1.4 %	2.9 %
not GC-detectable Sub.	19.1 %	42.4 %
lower Heating value	7.9 MJ/kg	22.3 MJ/kg

wheat / barley straw, 549 °C

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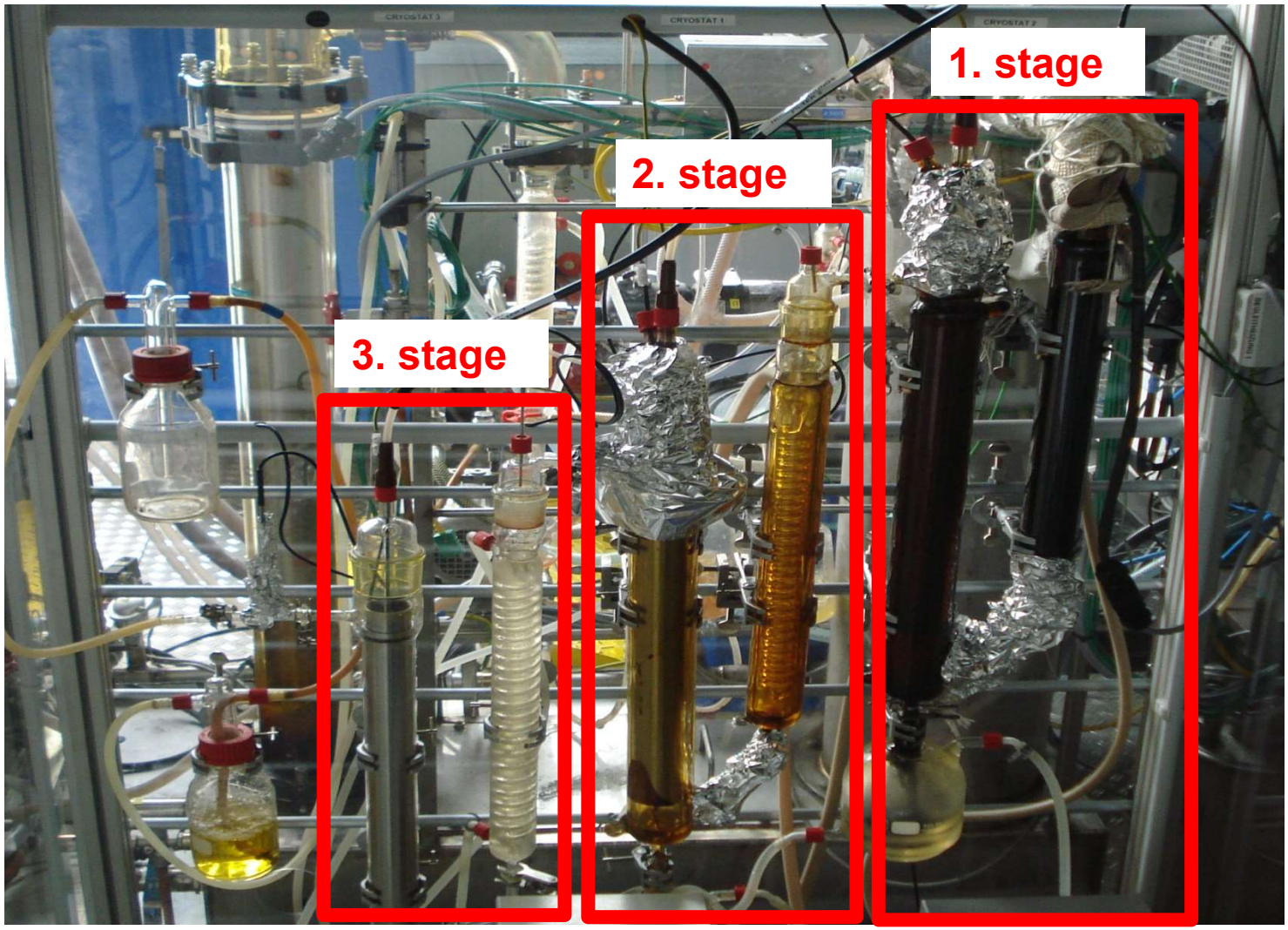
Staged condensation – Approach



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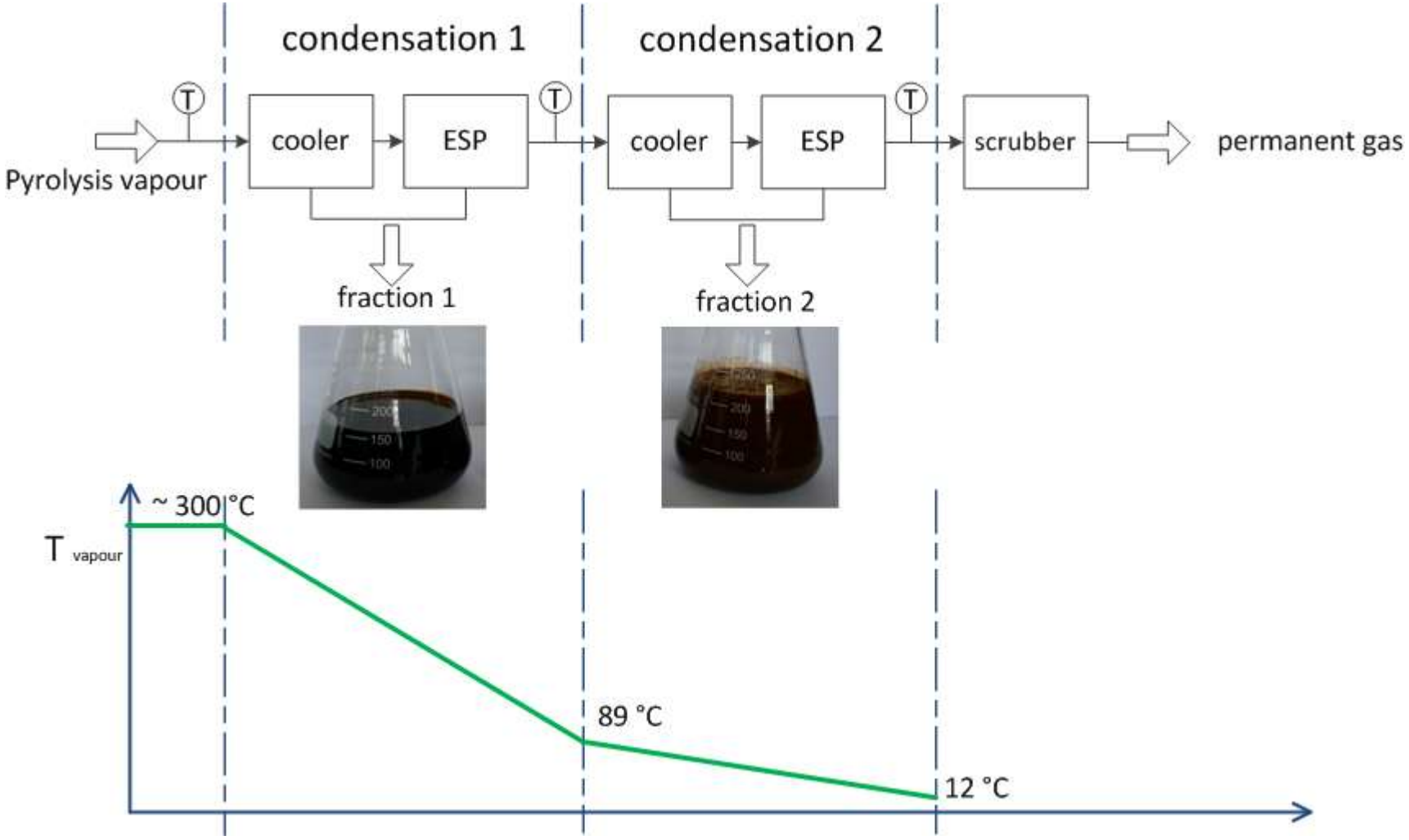
Staged Condensation – Two stages experiment



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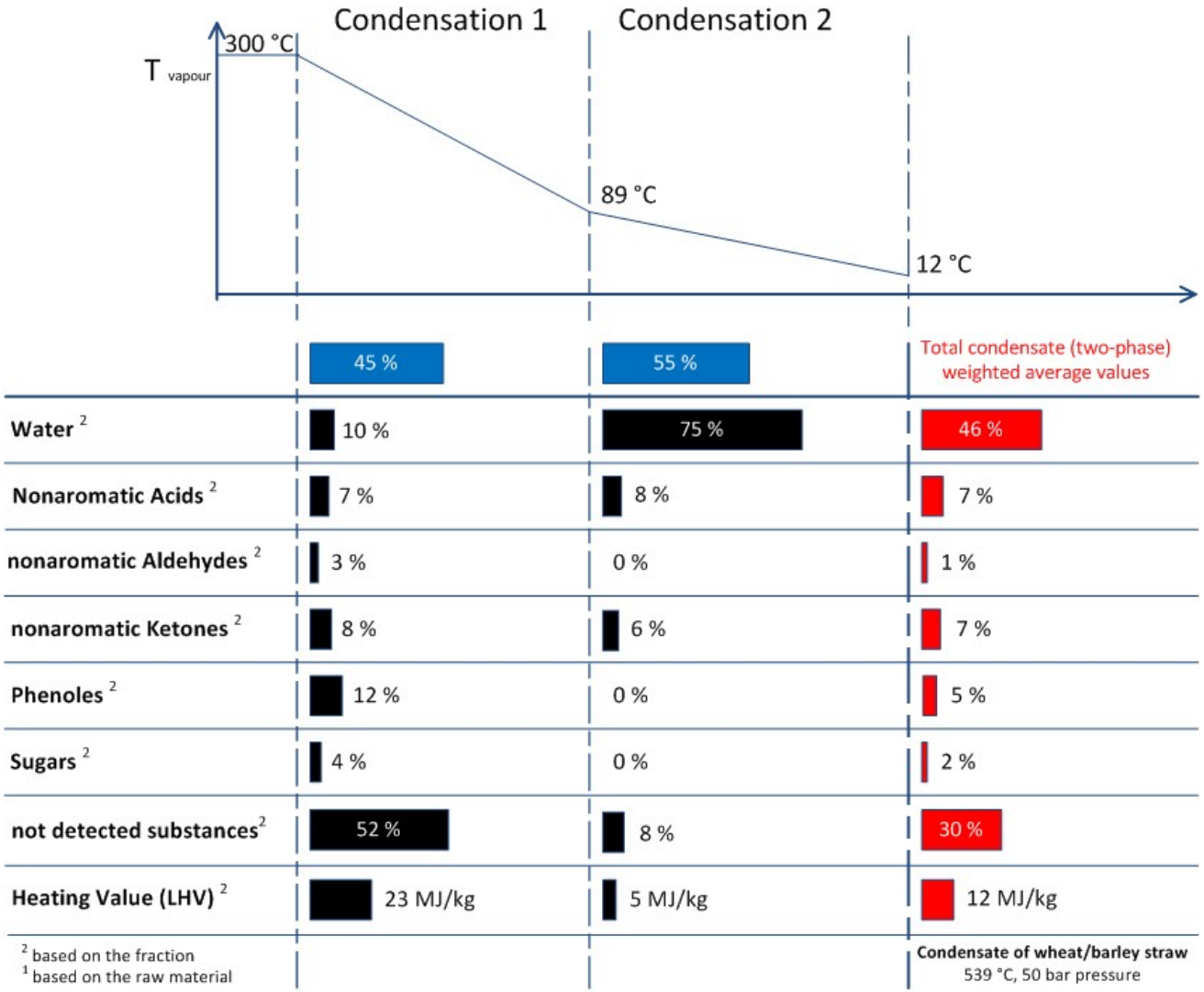
Staged Condensation – Two stages experiment



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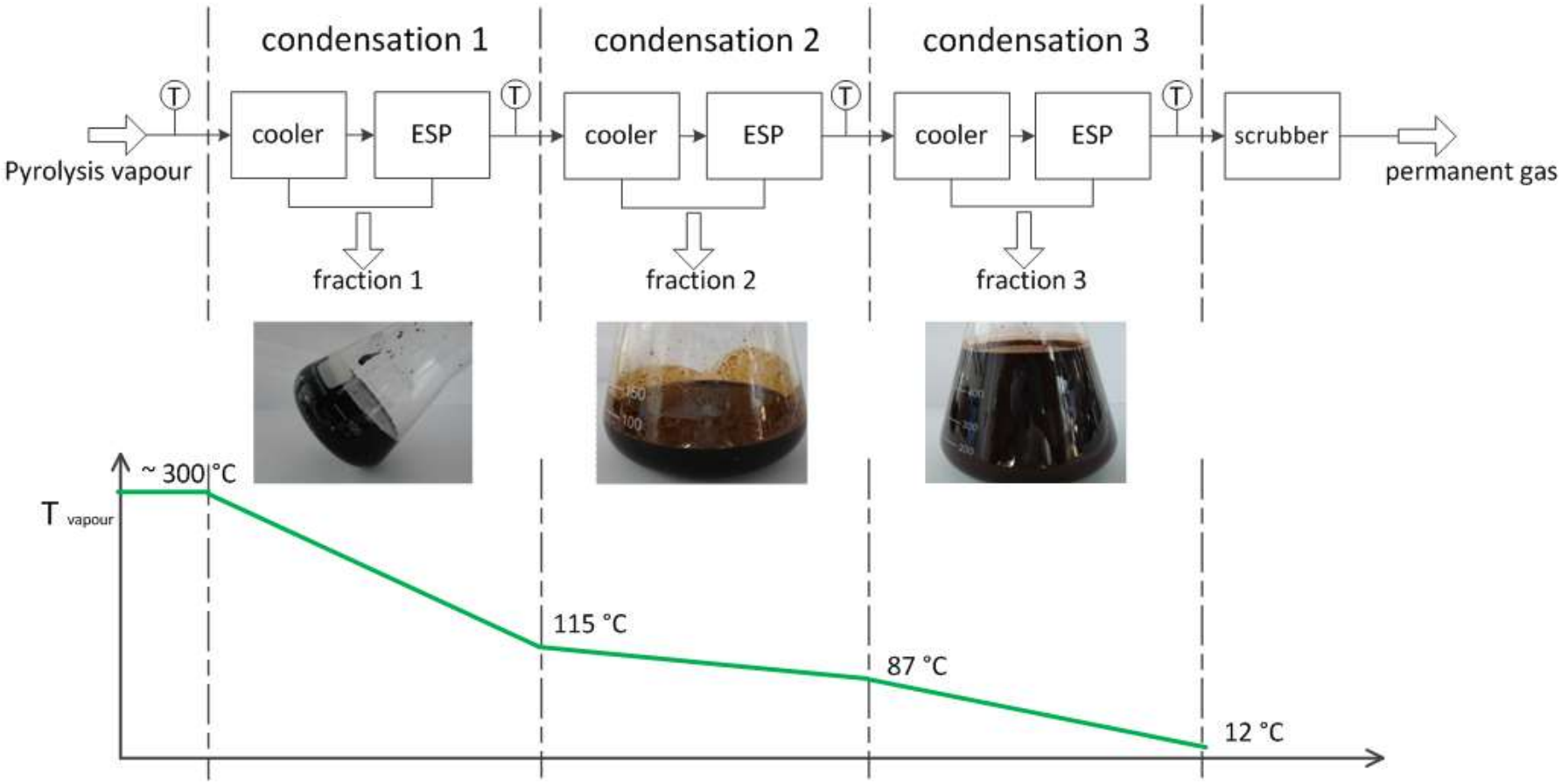
Staged Condensation – Three stages experiment



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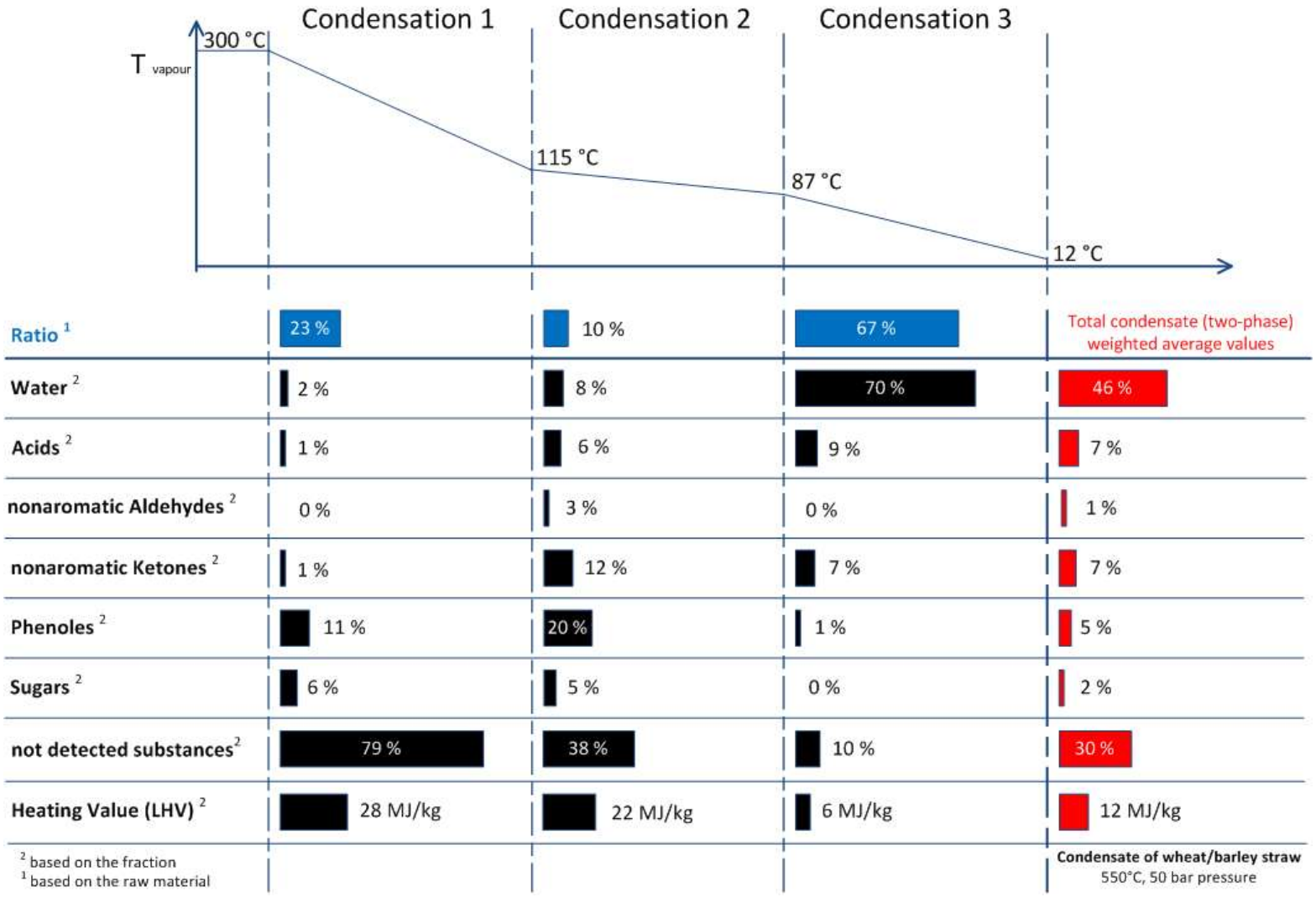
Staged Condensation – Three stages experiment



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Staged Condensation – Creation of Value

- **Higher boiling fraction (2 staged condensation)**
  black viscous liquid, high heating value
  - Sugars, Phenolics ➡ raw material for rigid PU foams
  - Fraction as a whole ➡ Gasification (Synthesis gas)
  - ➡ energetic utilization (heat, bunker fuel)

substitution rate of polyalcohol: 0 % 50 % 80 %

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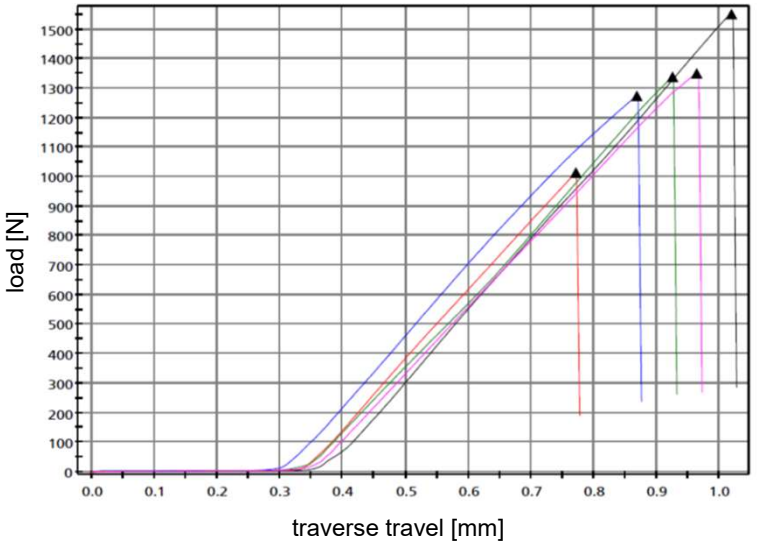
Staged Condensation – Creation of Value

- **Highly viscous fraction (3 staged condensation)**
  black pasty liquid, high heating value
  - Sugar (Levoglucosan) ➡ raw material for chem. Industry
  - Fraction as a whole ➡ Gasification (Synthesis gas)
    ➡ energetic utilization (heat)

- **Medium viscous fraction (3 staged condensation)**
  dark brown, honey-like liquid, medium heating value
  - Phenols (Syringols) ➡ raw material for Phenoplastic
  - Aldehydes (Acetaldehyde) ➡ raw material for Phenoplastic
  - Fraction as a whole ➡ Refinery (transportation fuels)
    energetic utilization (power, heat)

Staged Condensation – Creation of Value

- **Medium viscous fraction (3 staged condensation)**
  dark brown, honey-like liquid, medium heating value



specimen	max. load [N]	area [mm²]	tensile strength [N/mm²]
1	1551	221	7,02
2	1274	255	5,00
3	1015	221	4,59
4	1338	187	7,16
5	1350	170	7,94

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Staged Condensation – Creation of Value

- **Aqueous fraction (2 and 3 staged condensation)**
  reddish brown aqueous liquid, low heating value
  - Water
  - org. acids (acetic acid) ➡ pure acid (raw material for chem. Industry)
  - Alcohols, Ketones (Acetol) ➡ Solvents
  - Fraction as a whole ➡ Fermentation (biogas)

Staged Condensation – Creation of Value

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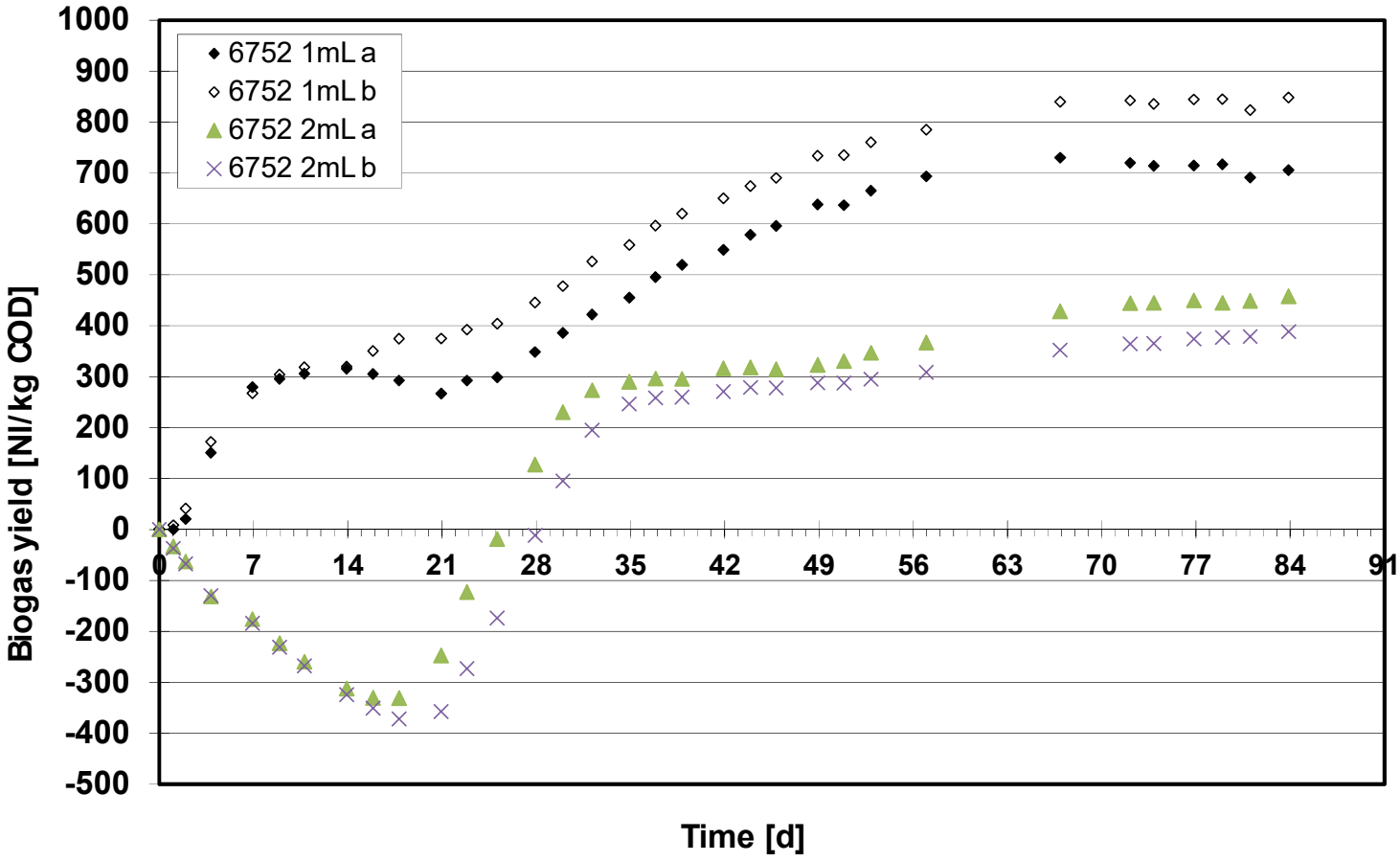
  reddish brown aqueous liquid, low heating value



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1. **Summary**

Summary

Flash pyrolysis …

- makes biomass available in liquid form
- makes material use possible
  - the pyrolysis temperature has influence on the formation of individual substances

Staged condensation of pyrolysis vapors …

- represents an uprading-method
  - Preliminary separation of material groups
  - Enrichment of material groups with similar characteristics
  - enables an efficient processing of the fractions

Target

- Comprehensive (economic) value creation from the individual fractions

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Department Biorefinery & Biofuels

Thank you for your kind attention!

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