

Gasification of sewage sludge in the Freiberg COORVED lab scale unit for in-situ recovery of Phosphorus

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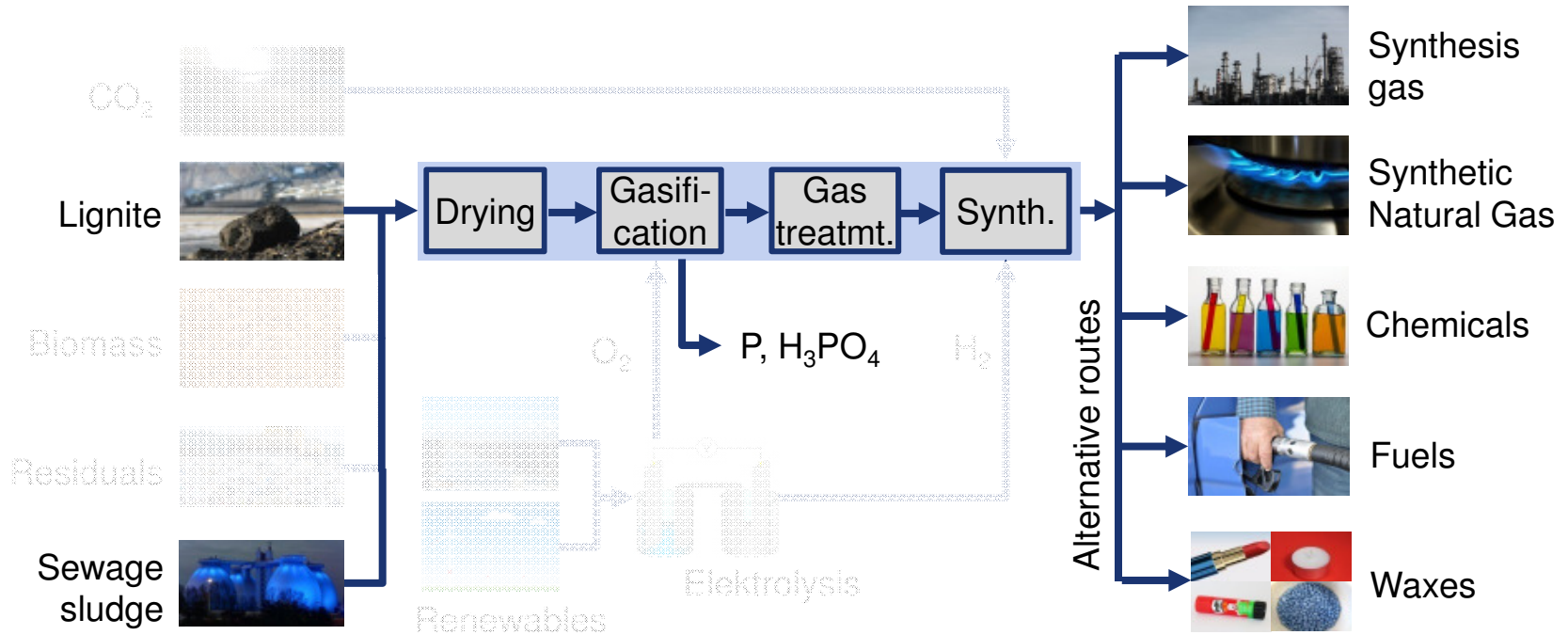
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CtP @ RWE – New options from alternative feed streams

> RWE develops innovative Coal-to-Products process chains (CtP)^[1]

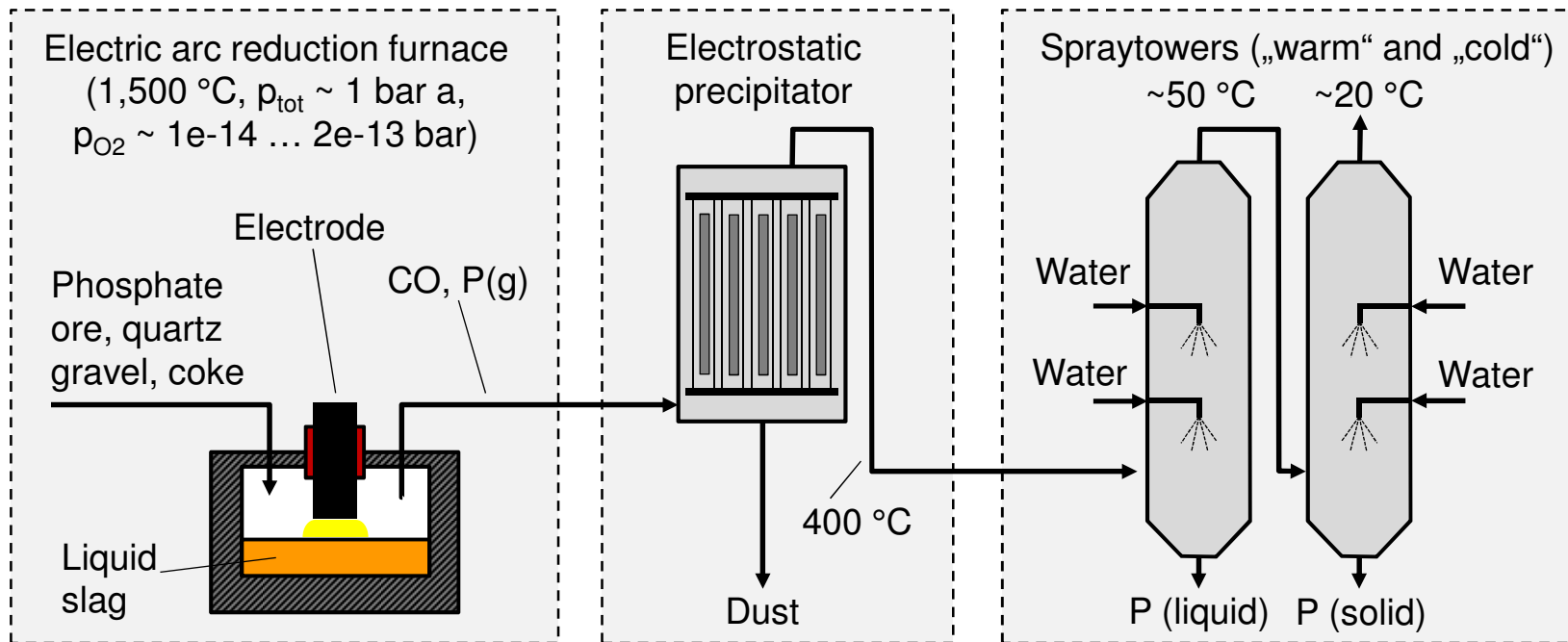


Phosphorus from Sewage Sludge – Circular Economy going live

- > Sewage sludge production and treatment in Germany^[2]
 - Production (2016): 1.8 Mt (wf) \Rightarrow ~130 kt P_2O_5
(Germany: ~288 kt P_2O_5 applied as fertiliser 2015/16)^[3]
 - Agricultural use decreasing due to heavy metals and drug residues contained (2016: 35%)
 - Combustion steadily increasing (2016: 64%)
- > New German Sewage Sludge Ordinance (AbfKlärV, 2017)
 - Phosphorus to be recovered from sewage sludge from 2029 and 2032 on, respectively (depending on sewage plant capacity)

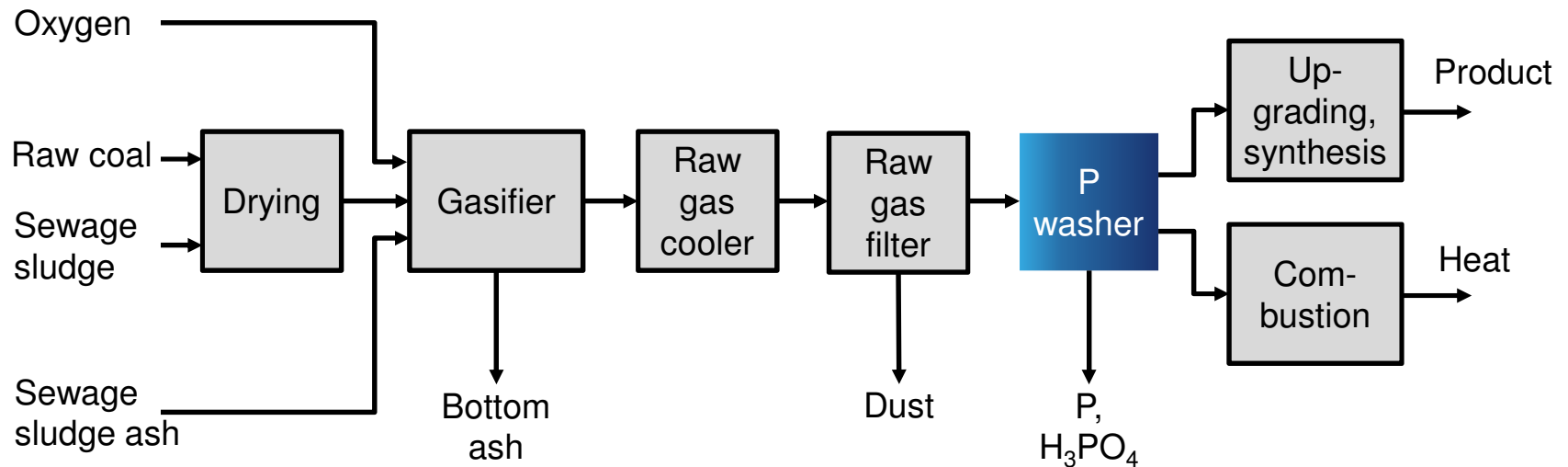


Phosphorus production, the thermal way – The Wöhler process^[5]



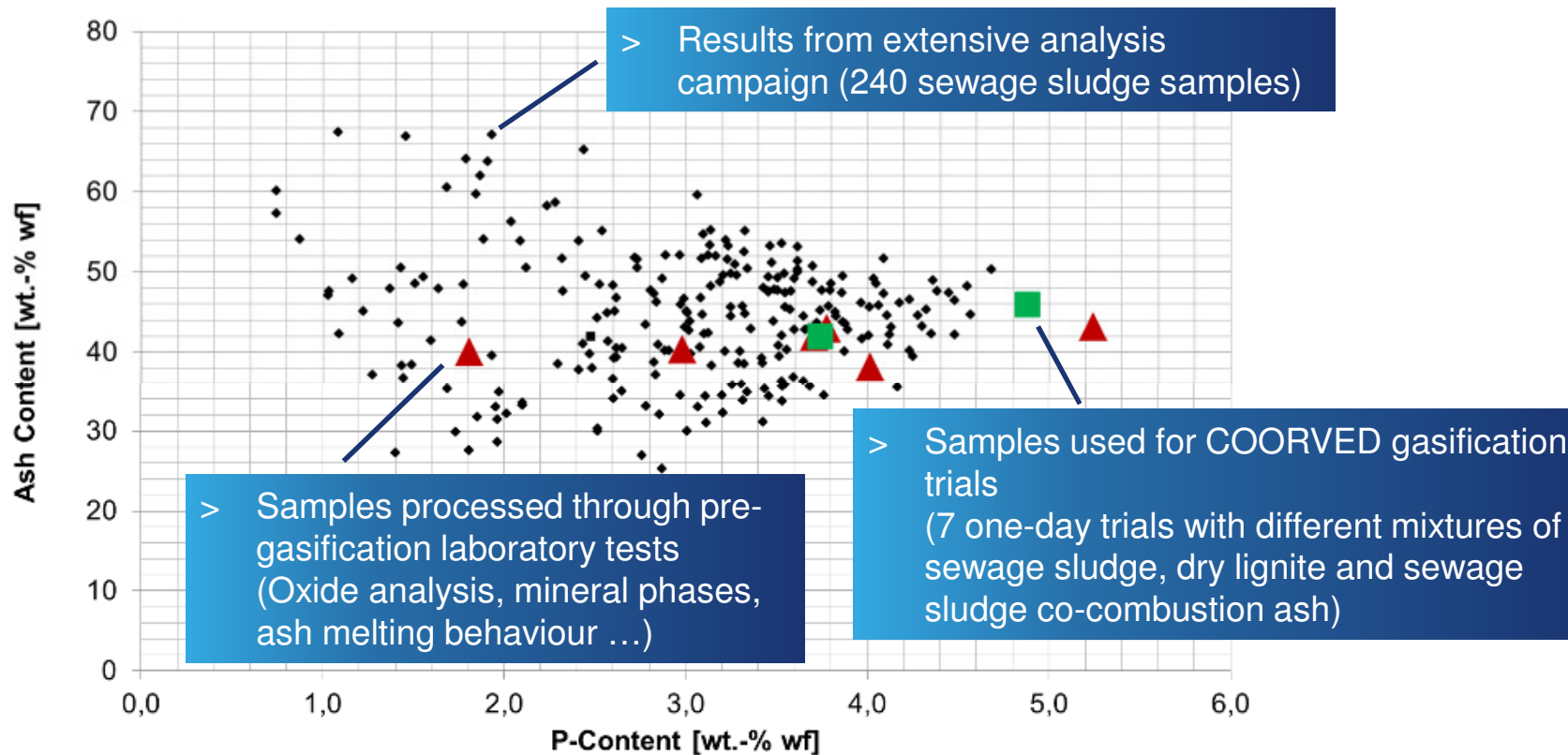
- > P is released from mineral Phosphates at high temperature and strongly reducing conditions
- ⇒ Transfer to gasifier possible?

The idea – Gasification with in-situ recovery of Phosphorus

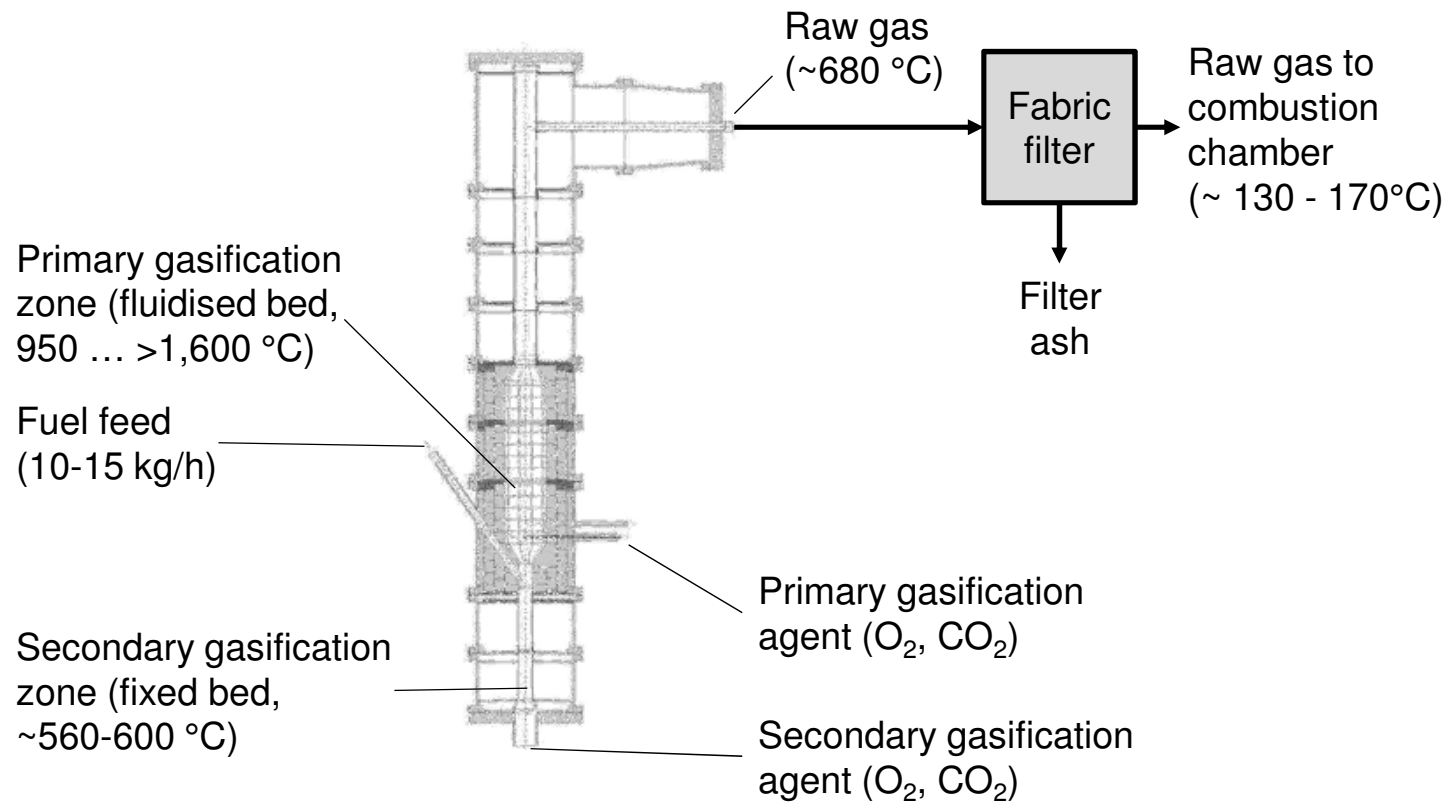


- > Thermal treatment of sewage sludge, recovery of Phosphorus and utilisation of carbon in form of synthesis gas in one process step
- > Phosphorus obtained in high quality form (yellow P or H₃PO₄)
- > Blends of ash from sewage sludge combustion and coal are suitable inputs as well

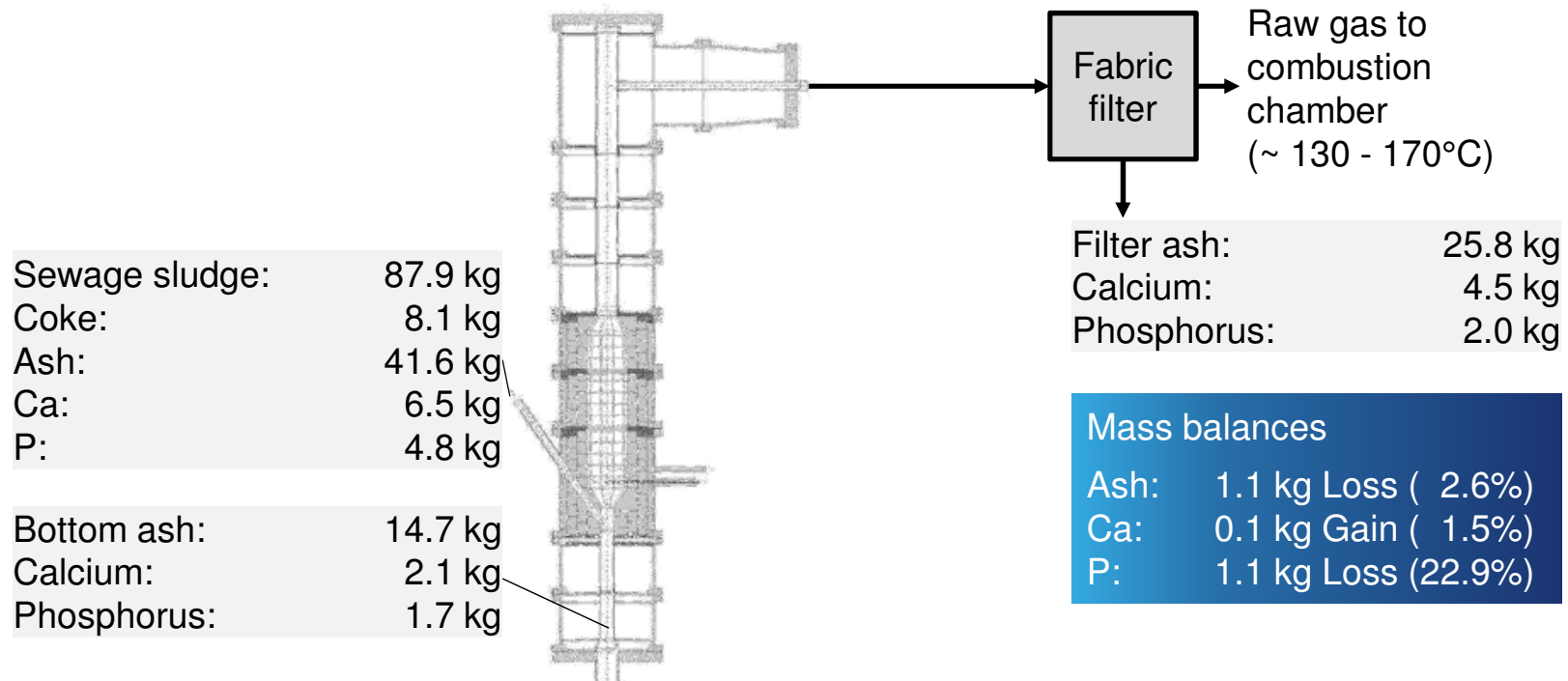
Sample selection for laboratory investigations and lab scale trials



The COORVED internal circulation (INCI) lab scale gasifier (60 kW_{th})^[4]

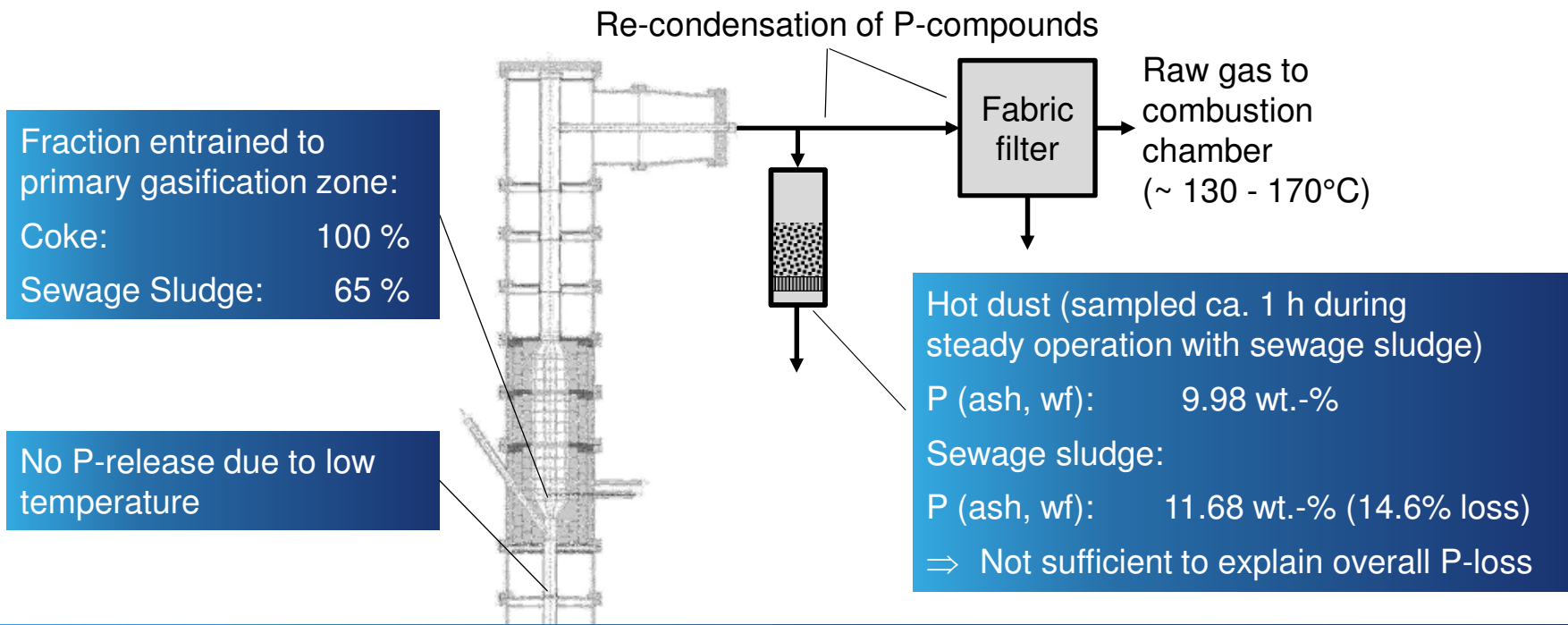


Gasification of pure sewage sludge – Overall balances (wf)



> Significant release of Phosphorus achieved

Gasification of pure sewage sludge – P-Release



- > P-loss of 36% achieved from sewage sludge entrained to primary gasification zone
- > Very high P-Loss probably during startup operation with coke

Sewage sludge gasification with P-recovery – An attractive CtP-approach

- > Large scale implementation of Phosphorus recovery from sewage sludge is required by German legislation
- > Sewage sludge gasification offers potential to
 - carry out thermal treatment, recovery of Phosphorus and recovery of Carbon in one process step
 - obtain Phosphorus in high quality form
 - treat mixtures of coal and sewage sludge combustion ash
- > Extensive laboratory tests and 7 one-day gasification trials carried out
 - ⇒ Promising P-release rates achieved temporarily
 - ⇒ Further optimisation required to operate gasifier in P-recovery-mode

Thank you for your attention!



References

- [1] Hannes J, Liese T: „Advanced CtL/CtG technologies for lignite”. Fuel 196, pp 543–549, 2017
- [2] DESTATIS (German Statistics Agency): „Sewage Sludge Disposal 2016”.
<https://www.destatis.de/DE/ZahlenFakten/GesamtwirtschaftUmwelt/Umwelt/UmweltstatistischeErhebungen/Wasserwirtschaft/Tabellen/TabellenKlaerschlammverwertungsart.html>, as of 27.5.2018
- [3] DESTATIS (German Statistics Agency): „Fachserie 4 Reihe 8.2, Fertiliser Supply 2015/16“, 2017
- [4] Schurz M, Laugwitz A, Krzack S, Meyer B: "Ash agglomeration in the modified COORVED gasifier". 8th International Freiberg Conference on IGCC & Xtl Technologies, 12th -16th June 2016, Cologne, Germany