

Impact of steam and oxygen injection on two-stage downdraft wood gasification

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EXPERIMENTAL CONDITIONS

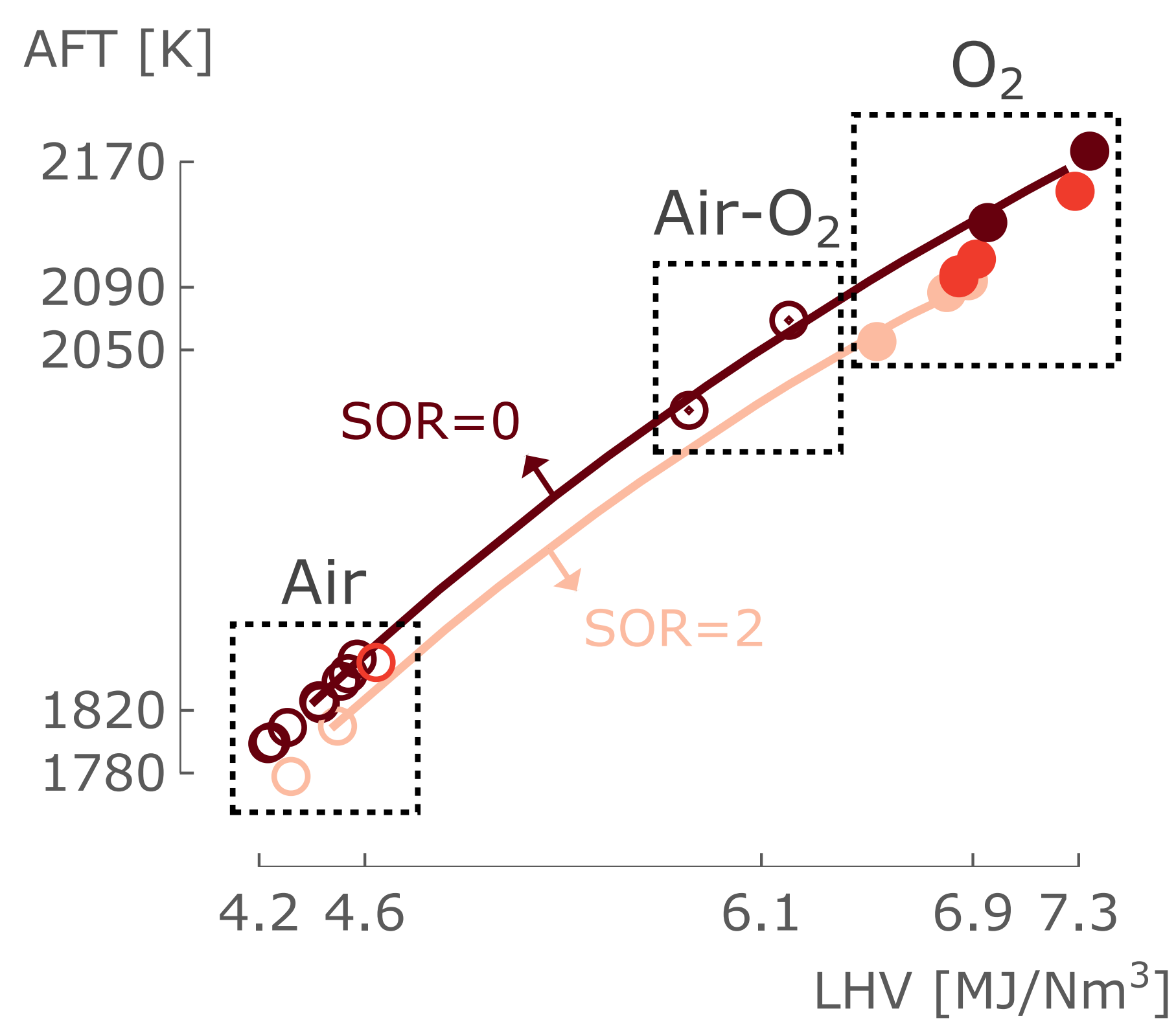
Experiments of oxy-steam wood chips gasification in a pilot two-stage downdraft gasifier of 200 kW_{th}.

Secondary air was up to completely replaced by oxygen. Steam was injected at the 2nd stage, with a Steam-to-Oxygen molar ratio (SOR) up to 2.

1. SYNGAS COMPOSITION, LHV AND AFT

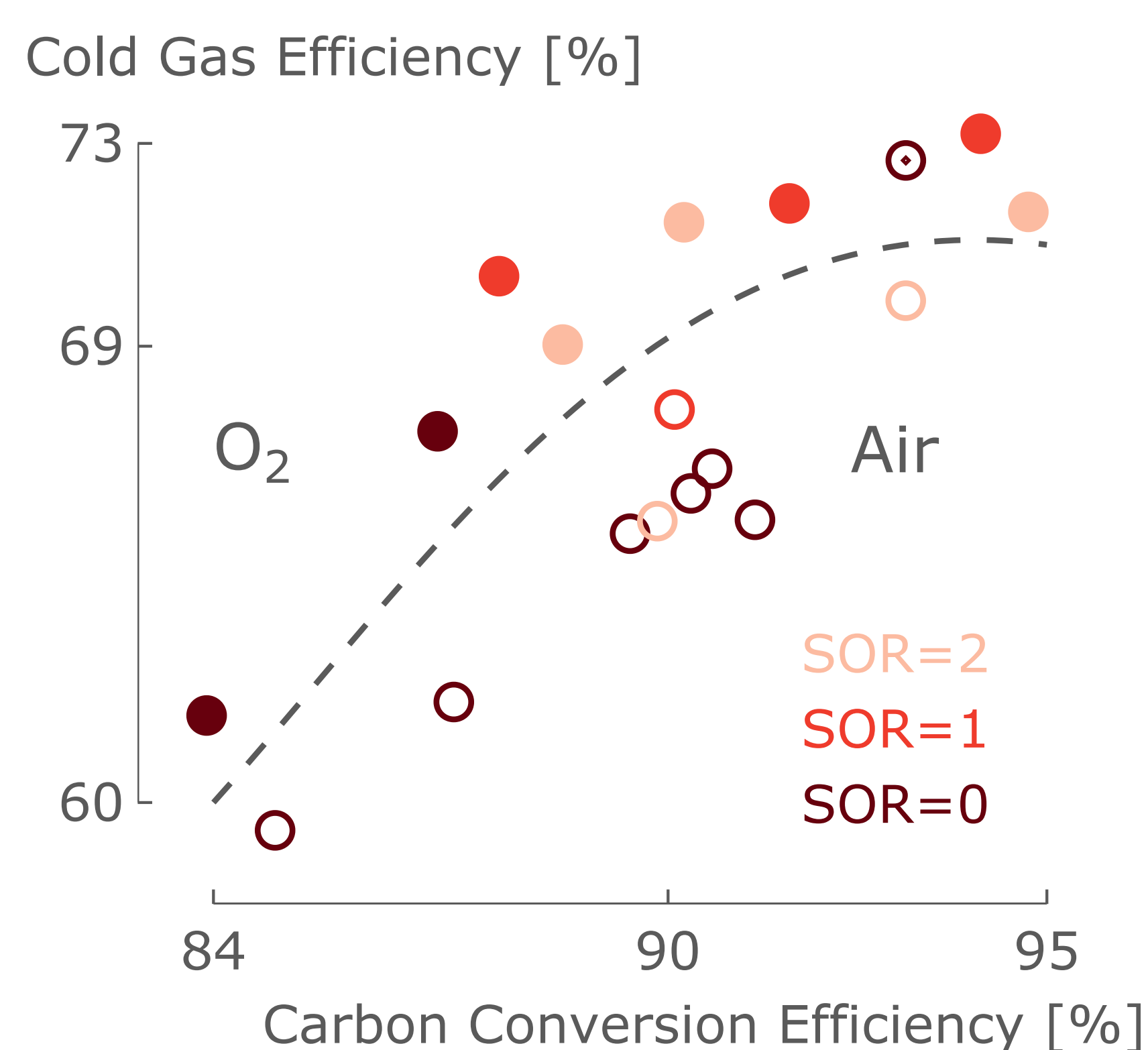
LHV increases +65% using O₂ at the 2nd stage, enhancing the Adiabatic Flame Temperature (AFT).

Steam shifts syngas composition from CO to H₂, increasing the H₂/CO ratio from 0.9 up to 2.0.

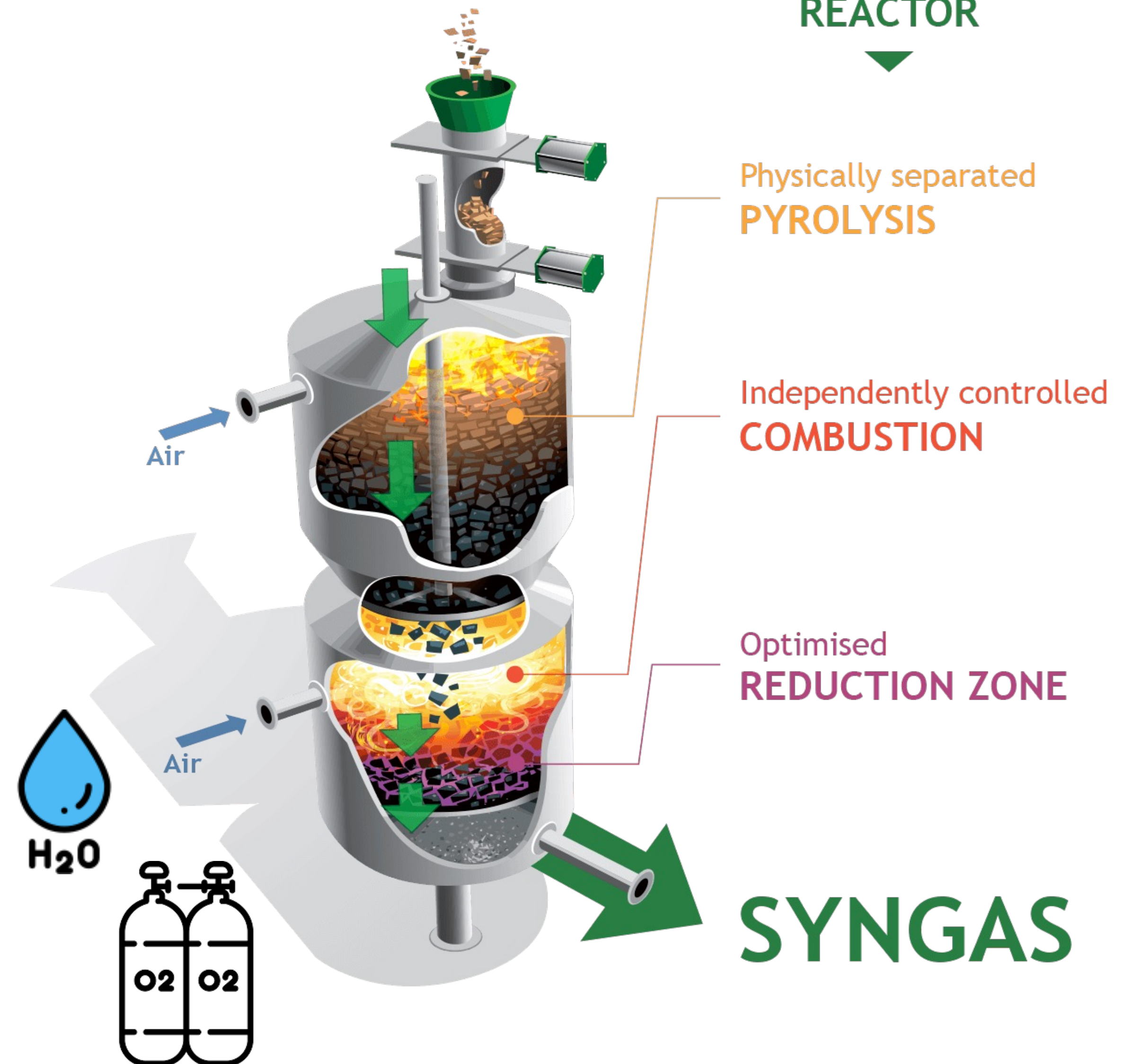


2. CONVERSION EFFICIENCY

Steam enhances the Carbon Conversion Efficiency (CCE). Steam and oxygen both increase the Cold Gas Efficiency (CGE).



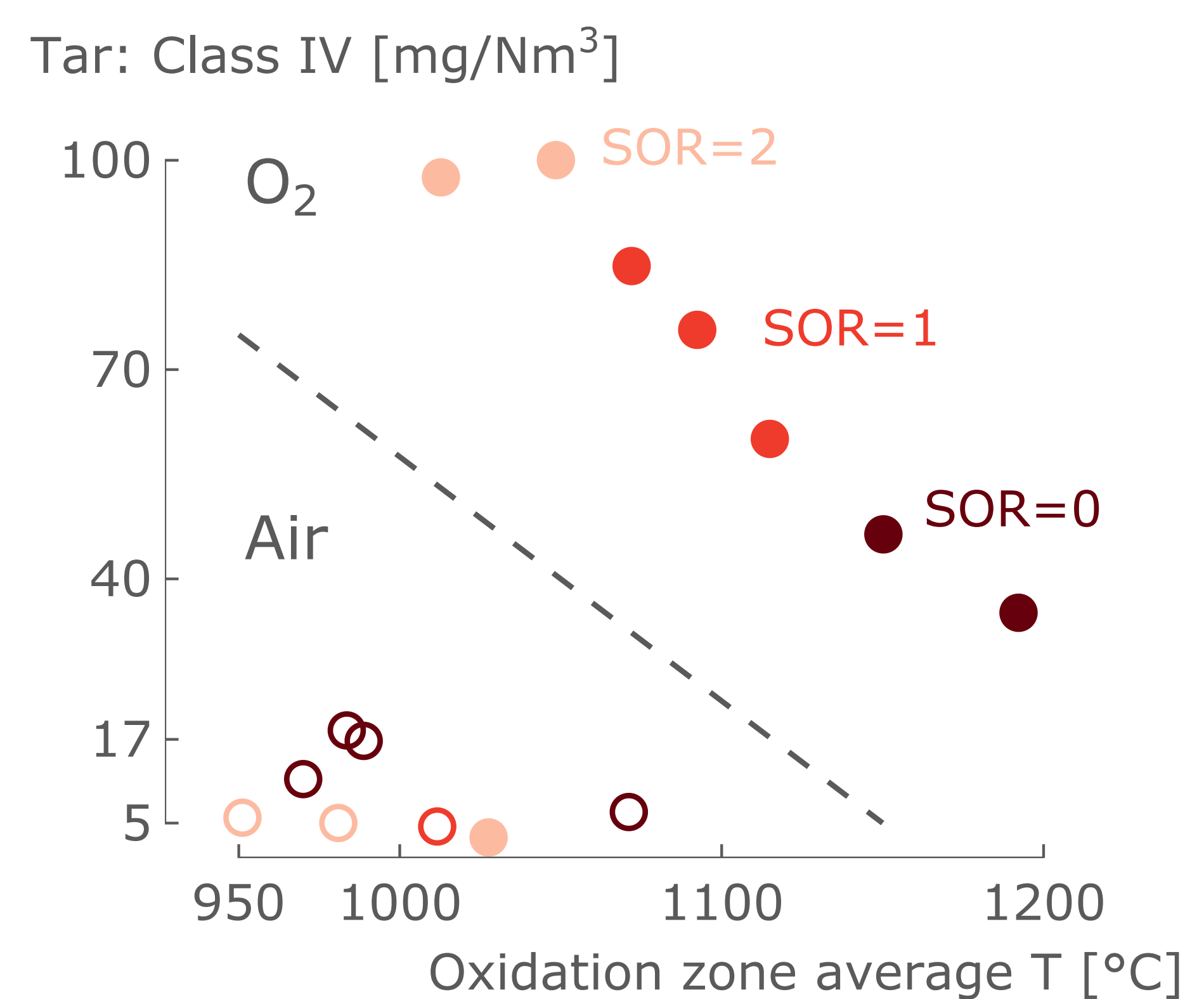
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3. TAR CONTENT AND COMPOSITION

The two-stage design yields a very low tar production in the raw syngas (<100 mg/Nm³)

Oxy-steam gasification increases the production of **Class III** tars (benzene, toluene, styrene) and **Class IV** tars (naphthalene and 3-ring PAHs).



4. OXIDATION ZONE TEMPERATURE

Oxygen raises the temperature in the oxidation zone, but steam partly compensates this effect.

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