

Supplementary materials

Kinetic parameters of petroleum coke gasification for modelling chemical-looping combustion systems

Agnieszka Korus^{a,1}, Adam Klimanek^a, Sławomir Śladek^a, Andrzej Szlęk^a, Airy Tilland^b, Stéphane Bertholin^b, Nils Erland L. Haugen^c

^a Department of Thermal Technology, Silesian University of Technology, Gliwice, Poland

^b IFP Energies nouvelles, BP3, 69360 Solaize, France

^c SINTEF Energy Research, Trondheim N-7465, Norway

The supplementary materials for this paper comprise:

Figures:

S1. Mass loss curves of petcoke gasification (gravimetric method) registered for two different fractions with particle size of 100 – 300 and 300 – 500 μm

- Batches of 100 – 300 and 300 – 500 μm petcoke were devolatilised at 600 °C in N₂, then cooled to ambient in N₂.
- 300 mg of each the petcoke sample was gasified in the main test rig using gravimetric method with the heating rate of 20 °C/min

S2. Mass loss during 2h gasification in CO₂ at 800 °C registered during the preliminary TGA tests with the non-devolatilised petcoke as well as petcoke heated up to 500 °C or 600 °C for 1h or 900 °C for 15 min and cooled to ambient in nitrogen flow (Δm – mass loss)

- 5 mg of the original 100 – 300 μm petcoke sample was placed in the in TGA and heated up to 800 °C in N₂ flow with the heating rate of 10 °C/min, after the 15 min isotherm the gas was switched to 90/10 vol.% of CO₂/N₂ and the sample was gasified at 800 °C for 120 min
- 5 mg of the original 100 – 300 μm petcoke sample was placed in the in TGA and heated up to 500 °C in N₂ flow with the heating rate of 10 °C/min, after the 1 h isotherm it was cooled down to ambient in N₂ flow, then the sample was heated up to 800 °C in N₂ flow with the heating rate of 10 °C/min, after the 15 min isotherm the gas was switched to 90/10 vol.% of CO₂/N₂ and the sample was gasified at 800 °C for 120 min
- 5 mg of the original 100 – 300 μm petcoke sample was placed in the in TGA and heated up to 600 °C in N₂ flow with the heating rate of 10 °C/min, after the 1 h isotherm it was

¹ Corresponding author, E-mail: agnieszka.korus@polsl.pl (Agnieszka Korus)

cooled down to ambient in N₂ flow, then the sample was heated up to 800 °C in N₂ flow with the heating rate of 10 °C/min, after the 15 min isotherm the gas was switched to 90/10 vol.% of CO₂/N₂ and the sample was gasified at 800 °C for 120 min

- 5 mg of the original 100 – 300 µm petcoke sample was placed in the in TGA and heated up to 900 °C in N₂ flow with the heating rate of 10 °C/min, after the 15 min isotherm it was cooled down to ambient in N₂ flow, then the sample was heated up to 800 °C in N₂ flow with the heating rate of 10 °C/min, after the 15 min isotherm the gas was switched to 90/10 vol.% of CO₂/N₂ and the sample was gasified at 800 °C for 120 min

S3. Mass loss curves for gasification of a pre-treated petcoke and the original, non-devolatilised material

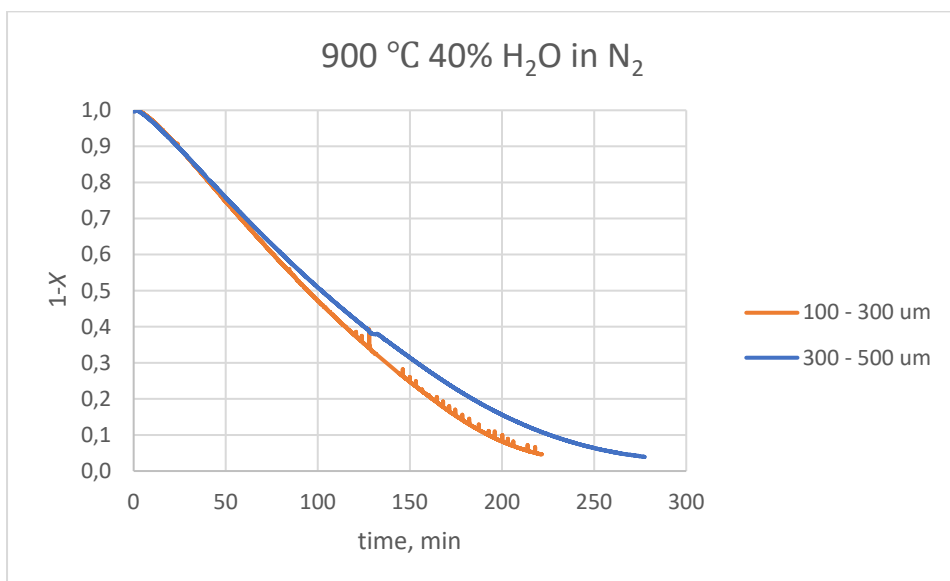
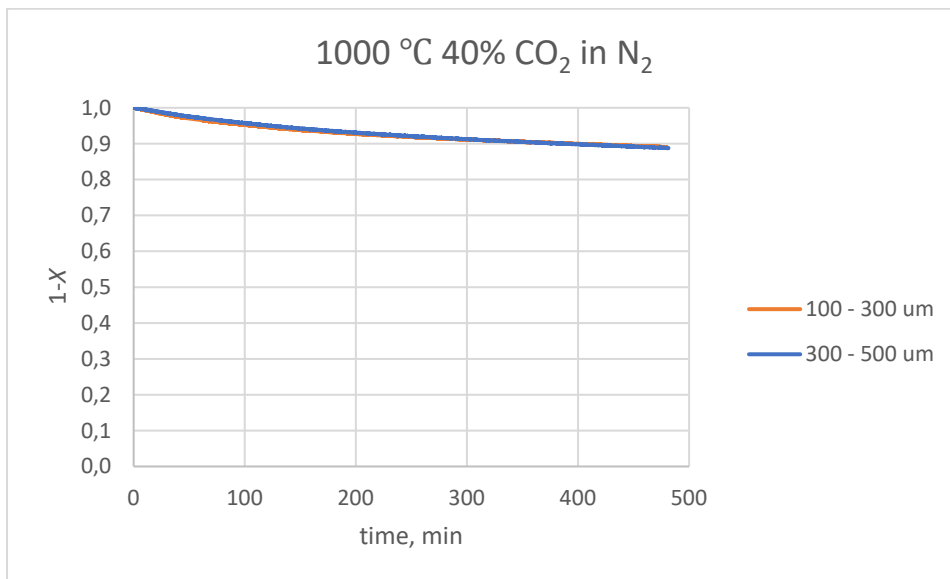
- 300 mg of 100 – 300 µm petcoke, previously devolatilised at 600 °C in N₂ and then cooled to ambient in N₂, was gasified in 40 vol.% of steam at 1000 °C in the main test rig using the gravimetric method with the heating rate of 20 °C/min
- 300 mg of the original 100 – 300 µm petcoke was gasified in 40 vol.% of steam at 1000 °C in the main test rig using the gravimetric method with the heating rate of 20 °C/min

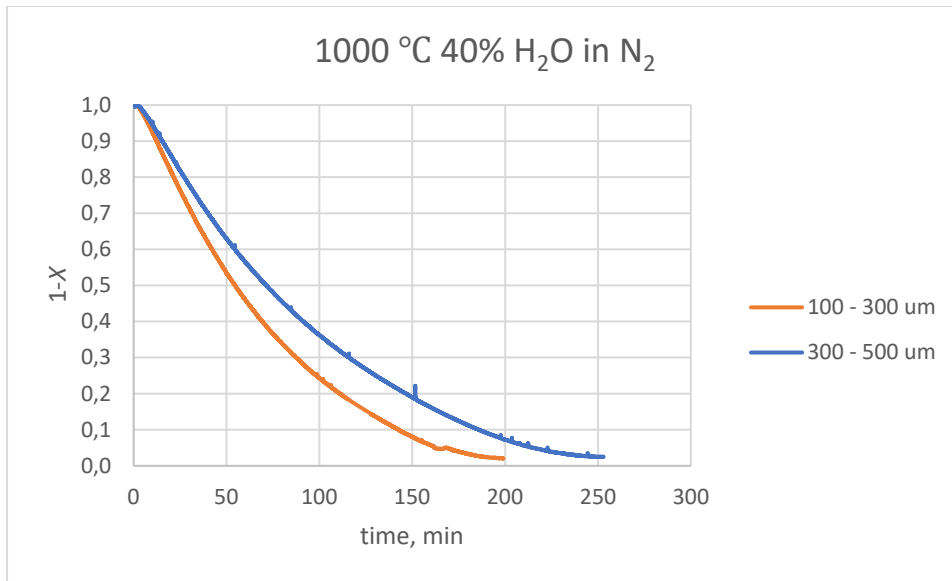
Table:

S4. Petcoke reactivity (R_{50}) at the 0.5 conversion in 40 vol.% of steam in N₂ during slow (SH) and fast heating (FH) experiments

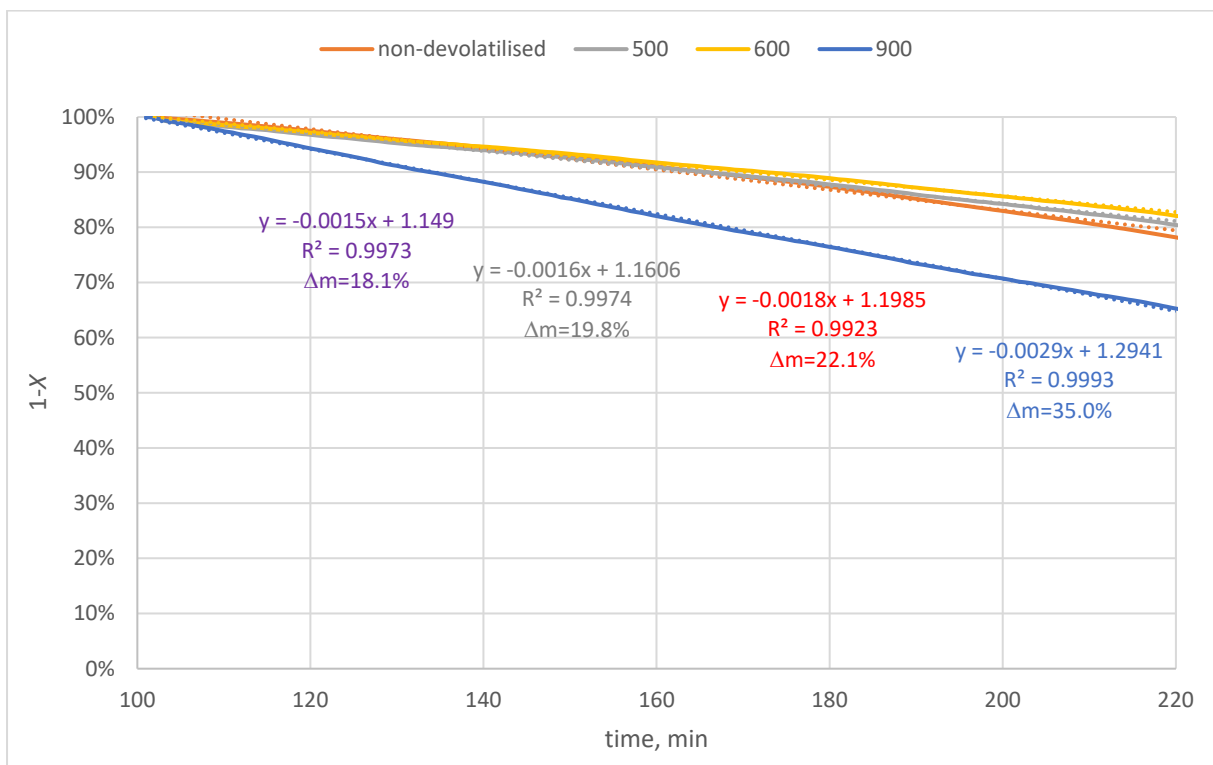
- 300 mg of 100 – 300 µm petcoke, previously devolatilised at 600 °C in N₂ and then cooled to ambient in N₂, was gasified in 40 vol.% of steam at the temperature between 850 °C and 1000 °C in the main test rig using the gravimetric method with the heating rate of 20 °C/min (SH)
- 300 mg of 100 – 300 µm petcoke, previously devolatilised at 600 °C in N₂ and then cooled to ambient in N₂, was gasified in 40 vol.% of steam at the temperature between 850 °C and 1000 °C in the main test rig using the gravimetric method with the heating rate of approximately 1700 °C/min (FH)
- The petcoke reactivity (R_{50}) at 0.5 conversion was calculated for each obtained mass loss curve

SI. Mass loss curves of petcoke gasification (gravimetric method) registered for two different fractions with particle size of 100 – 300 and 300 – 500 μm

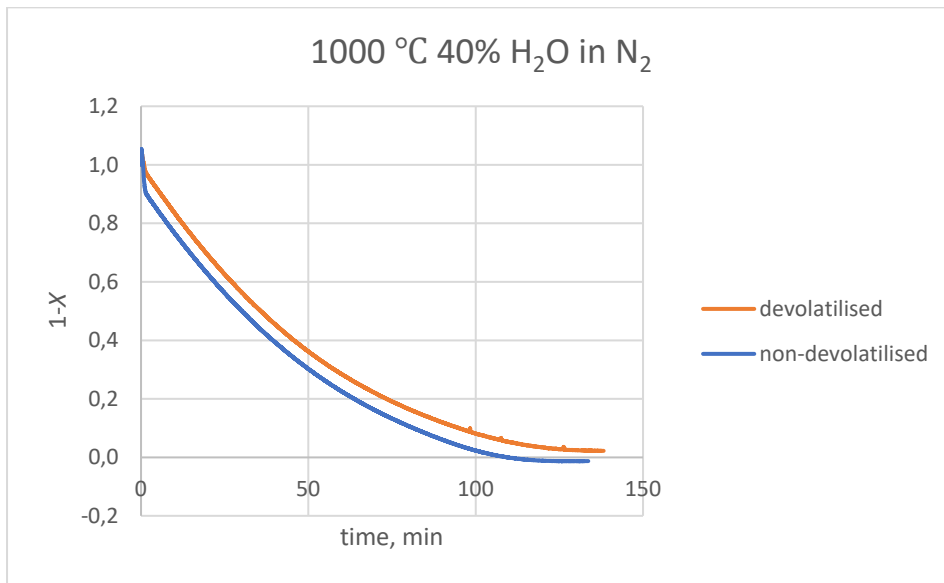




S2. Mass loss during 2h gasification in CO₂ at 800 °C registered during the preliminary TGA tests with the non-devolatilised petcoke as well as petcoke heated up to 500 °C or 600 °C for 1h or 900 °C for 15 min and cooled to ambient in nitrogen flow (Δm – mass loss)



S3. Mass loss curves for gasification of a pre-treated petcoke and the original, non-devolatilised material



S4. Petcoke reactivity (R_{50}) at the 0.5 conversion in 40 vol.% of steam in N₂ during slow (SH) and fast heating (FH) experiments

Reaction temperature, °C	Reactivity R_{50} (1/min)	
	Slow heating (20 °C/min)	Fast heating (ca. 1700 °C/min)
850	0.006	0.006
900	0.010	0.011
950	0.015	0.017
1000	0.015	0.022
1100	0.012	0.015