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Supplementary Material

Development of a Catalytic Fuel Processor for a 10 kW Combined Heat and Power System: Experimental and Modeling Analysis of the Steam Reforming Unit

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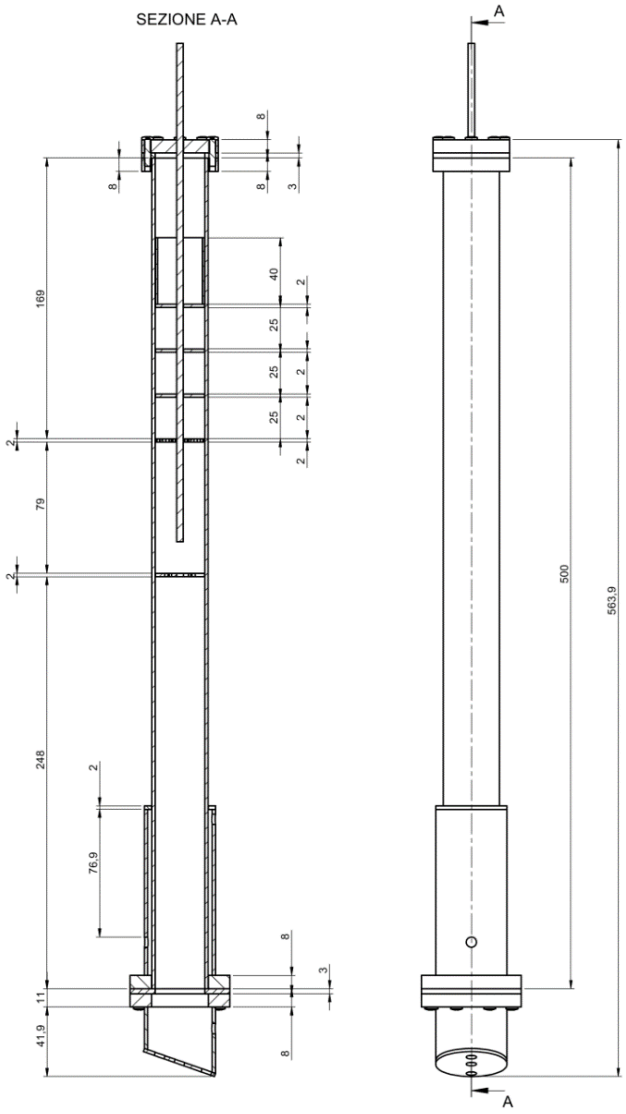

Figure S1. Drawing of the reactor for long term SR tests, unit: mm.

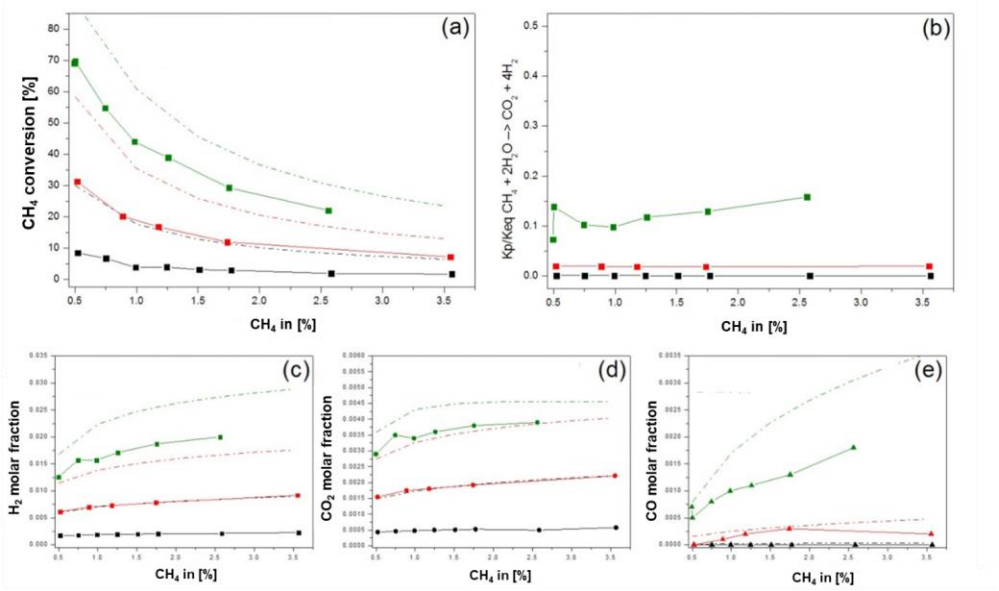

Figure S2. Kinetic investigation: isothermal effect of input CH_4 concentration. Symbols = experiments, dotted lines = equilibrium calculations. Temperatures: 300°C (black); 375°C (red); 450°C (green). H_2O = 1.75%. GHSV = 100,000 h^{-1}. (a) CH_4 conversion; (b) approach to equilibrium evaluated by the ratio between the reaction quotient K_P and the equilibrium constant K_{eq} (the stoichiometry considered at this scope is: $CH_4 + 2H_2O \rightarrow CO_2 + 4H_2$, that is the combination of steam reforming and water gas shift); (c-e) molar fractions of H_2, CO_2 and CO.

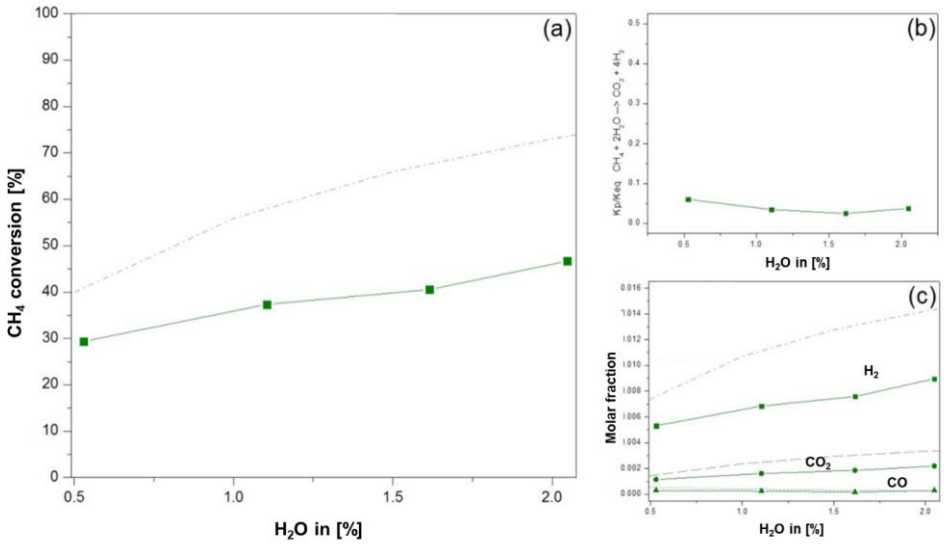

Figure S3. Kinetic investigation: isothermal effect of input H_2O concentration. Symbols = experiments, dotted lines = equilibrium calculations. Temperatures: 300°C (black); 375°C (red); 450°C (green). CH_4 = 0.5%. GHSV = 100,000 h^{-1}. (a) CH_4 conversion; (b) approach to equilibrium evaluated as in Figure S2; (c) molar fractions of H_2, CO_2 and CO.

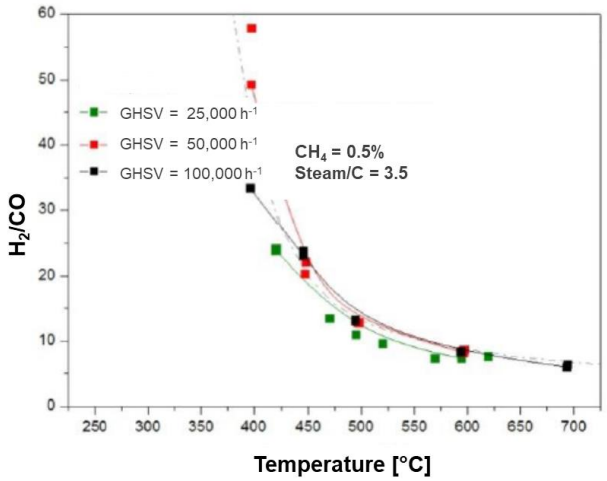

Figure S4. Effect of temperature and space velocity on H_2/CO ratio. Conditions as in Figure 2. Symbols = experiment; dotted line = thermodynamic equilibrium.

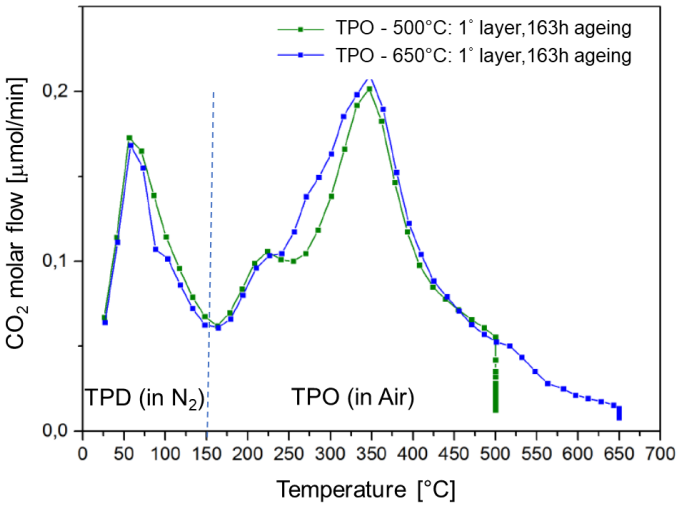

Figure S5. Examples of TPO analyses performed over two samples (150 mg each) taken from the top layer of the bed, after 163 hours of ageing. The procedure consisted in flowing 50 Ncm^3/min of N_2 while ramping the temperature from 25 to 150°C at the rate of 8 °C/min; this Temperature Programmed Desorption favored the release of physisorbed and chemisorbed CO_2. Starting from 150, air was fed and temperature was ramped at the rate of 2 °C/min; In this TPO phase CO_2 was produced by the oxidation of surface C species. The two TPO analyses herein reported were obtained by heating up to 500°C and to 650°C; the overimposition shows that CO_2 flow peaked at about 350°C, but very broad peaks were produced and the signal became negligible only above 600°C.

Table S1. CO_2 production, evaluated by integration of the TPO analyses.

Ageing	CO_2 [µmol] 1st layer	CO2 [µmol] 4th layer
163 h	14.5	6.6
336 h	27.3	20.0
720 h	31.3	28.6