Supplementary Material

Stefan flow in char combustion: A critical review of mass transfer and combustion differences between air-fuel and oxy-fuel conditions

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Table S1 Summary of comparative studies on the combustion characteristics between air-fuel and oxy-fuel combustion

Researcher	Combustion device	Coal rank (Particle size)	Operating temperature [K]	Combustion atmosphere; O_2 mole fraction [%]	Combustion region	Main conclusions	Discussion and analysis
Liu (2009)	TGA[a]	A bituminous coal; An anthracite coal; (mean 70μm)	Up to 1163	N_2/O_2: O_2:3, 6, 10, 21, 30; O_2/CO_2: O_2: 3, 6, 10, 21, 30	KC[b]	● Replacing the inert N_2 with CO_2 has little influence on the combustion rates of coal chars.	● The char-CO_2 gasification reaction has little effect on the combustion rate.
Liu (2019)	TGA	A bituminous coal; An anthracite coal; (mean 70μm)	Up to 1173	N_2/O_2: O_2:3, 6, 10, 21, 30; O_2/CO_2: O_2: 3, 6, 10, 21, 30	KC	● Replacing the inert N_2 with CO_2 has little influence on the combustion rate of coal chars.	● The char-CO_2 gasification reaction has little effect on the combustion rate.
Bejarano and Levendis (2008)	DTF[c]	A bituminous coal; A lignite coal; A monodisperse synthetic char; (45-180μm)	1400 and 1600	O_2/N_2: O_2: 21-100; O_2/CO_2: O_2:21-100	K/DC[d] DC[e]	● Coal particles burn at higher mean temperature and shorter combustion time in O_2/N_2 than in O_2/CO_2 atmospheres at the same mole fraction of O_2.	● CO_2 has a larger specific heat than N_2.
Zhang et al. (2010)	DTF	A Victorian brown coal (106-153um)	1073 and 1273	Air; O_2/CO_2: O_2:21-36	K/DC; DC	● The temperature and combustion intensity of char particles are lower in O_2/CO_2 than those in air.	● CO_2 has a larger specific heat than N_2. ● A thick volatile cloud persisting on the char surface in O_2/CO_2 causes O_2 and fuel vapor depletion on the char surface.
Khatami,	DTF	A bituminous coal;	1400	O_2/N_2:	K/DC;	● The burnout time of char	● CO_2 has a larger specific heat

Stivers, Joshi (2012)		A sub-bituminous coal; Two lignites; A sugarcane-bagasse; (75-90um)		O_2:20-100; O_2/CO_2: O_2:20-100	DC	particles is longer and the char surface temperature is lower in O_2/CO_2 at the same mole fractions of O_2. ● The difference in combustion characteristics is related to the coal rank and combustion mode.	than N_2. ● The diffusion rate of O_2 in CO_2 is 0.8 times that in N_2.
Riaza, Khatami, Levendis (2014)	DTF	An anthracite coal; An semi-anthracite coal; A medium-volatile bituminous coal; A bituminous coal; (75-140um)	1400	Air; O_2/CO_2: O_2: 21, 30, 35, 50	K/DC; DC	● The combustion temperature of char in the air is higher than that of 21%O_2/79%CO_2. ● The coal char burns hotter and faster in O_2/N_2 than in O_2/CO_2 at comparable mole fractions of O_2. ● The difference in combustion characteristics is related to the coal rank and combustion mode.	● The volumetric heat capacity is larger and the diffusion coefficient of O_2 is lower in O_2/CO_2 atmosphere. ● The char-CO_2 gasification reaction on the char particle surface absorbs combustion heat. ● A persistent cloud around the char particle prevents the access of O_2 to the surface of the char particle.
Liu et al. (2015)	DFC [f]	A UK bituminous coal (Not mention)	1373-1630	Air; O_2/CO_2: O_2:21-35	K/DC; DC	● Replacing combustion air with 21%O_2/79%CO_2 significantly reduces the gas temperature and char burnout rate.	● CO_2 has a larger specific heat than N_2.

Rathnam, Elliott, Wall (2009)	TGA; DTF	Four Australian coal (63-90um)	DTF: 1673; TGA: 303-1473	O_2/N_2: O_2: 5-30; O_2/CO_2: O_2: 3-21	KC; K/DC; DC	● The char burnout rate in DTF at 1673 K in O_2/CO_2 is higher than O_2/N_2 at the same mole fraction of O_2. ● The reactivity at high temperatures in O_2/N_2 is higher than that in O_2/CO_2 at O_2 concentrations of 5% or above in TGA.	● The char-CO_2 gasification reaction increases the reactivity of char in O_2/CO_2 atmosphere.
Shen et al. (2018)	High-temperature stage microscope	A Chinese bituminous coal (200-500um)	1373	O_2/N_2: O_2:21-100; O_2/CO_2: O_2:21-100	K/DC; DC	● The burnout time of the char particle in the 21%O_2/79%CO_2 atmosphere is prolonged by about 20–25% compared to air. ● Replacing N_2 with CO_2 reduces the combustion temperature.	● The char-CO_2 gasification reaction absorbs combustion heat and thus reduces the char combustion temperature.

[a].TGA: Thermogravimetric analyzer
[b] KC: Kinetic-controlled
[c] DTF: Drop tube furnace
[d] K/DC: Kinetic/diffusion-controlled
[e] DC: Diffusion-controlled

[f] DFC: Down-fired combustor