SUPPLEMENTARY MATERIAL

Thermal characterization, kinetic analysis and co-combustion of sewage sludge coupled with high ash Ekibastuz coal

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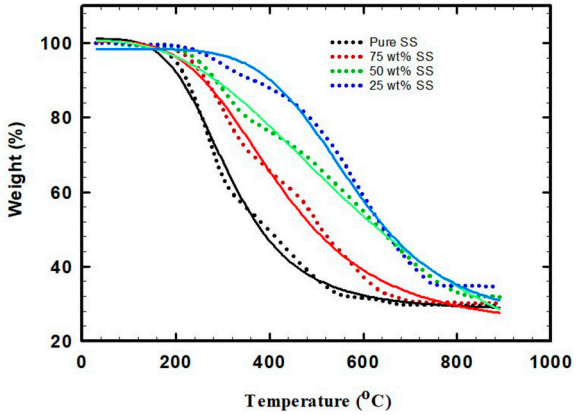

Figure S1: Regression analysis for the TGA curves for SS and bituminous coal at different blend ratios at heating of 15 °C/min in air.

Regression models:

$$Pure\ SS\ weight\ (\%) = -10^{-9}T^4 + 3 * 10^{-6}T^3 - 0.0018T^2 + 0.2414T + 93.356 \quad (E1)$$
$$R^2 = 0.9935$$

$$75\ wt\%\ SS\ weight\ (\%) = -5 * 10^{-10}T^4 + 10^{-6}T^3 - 0.001T^2 + 0.1707T + 93.846 \quad (E2)$$
$$R^2 = 0.9970$$

$$50\ wt\%\ SS\ weight\ (\%) = 2 * 10^{-7}T^3 - 0.0003T^2 + 0.0496T + 98.541 \quad (E3)$$
$$R^2 = 0.9969$$

$$25\ wt\%\ SS\ weight\ (\%) = 10^{-9}T^4 - 10^{-6}T^3 + 0.0006T^2 - 0.0825T + 98.541 \quad (E4)$$
$$R^2 = 0.9970$$

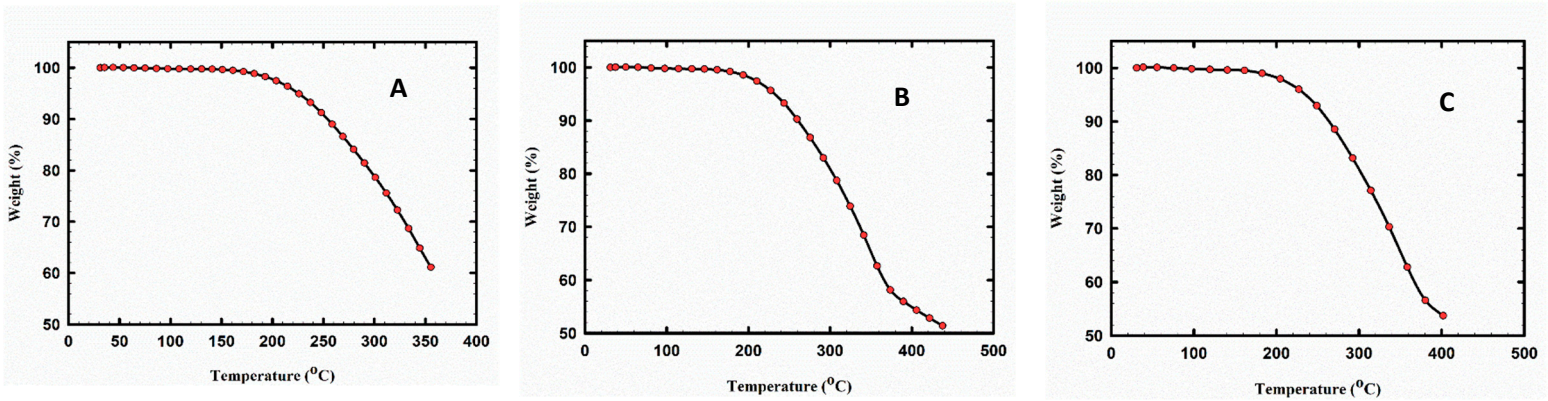

Figure S2: The thermographs of sewage sludge as obtained from the TGA experiments in nitrogen environment at A) 10 B) 15 C) 20 °C/min

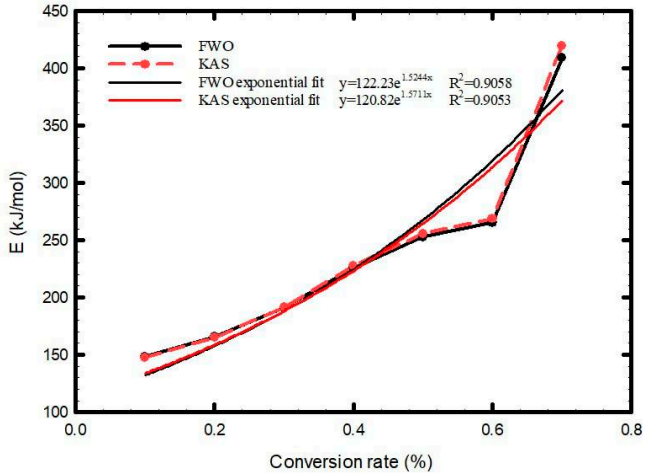

Figure S3: The exponential fit for both FWO and KAS models

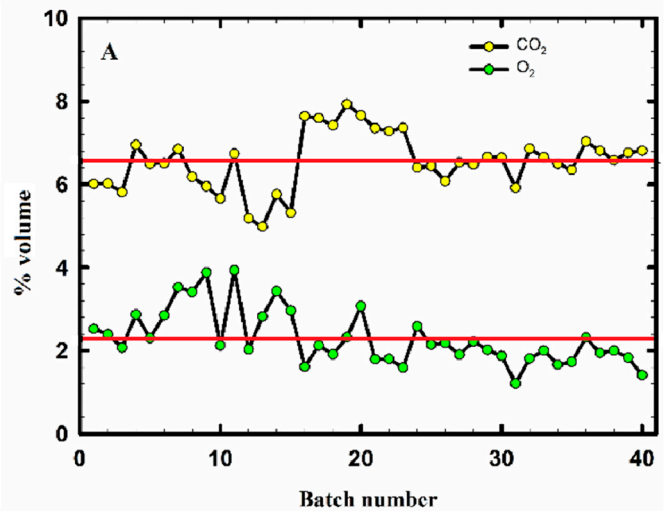

Figure S4: Analysis for O_2 and CO_2 concentrations emissions during the mono-combustion of SS in BFB rig.

In Figure S4, the average values for CO_2 emissions (6.55 % volume) and O_2 emissions (2.30 % volume) are shown. The standard deviations are ±0.69 % volume and ±0.66 % volume, respectively.

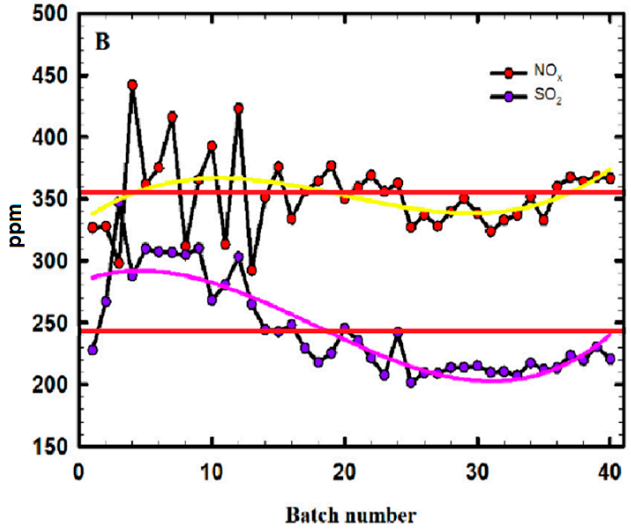

Figure S5: Analysis for SO_2 and NO_x concentrations emissions during the mono-combustion of SS in BFB rig.

In Figure S5, the average values for NO_x emissions (353.23 ppm) and SO_2 emissions (244.42 ppm) are shown. The standard deviations are ±30.85 ppm and ±38.44 ppm, respectively.

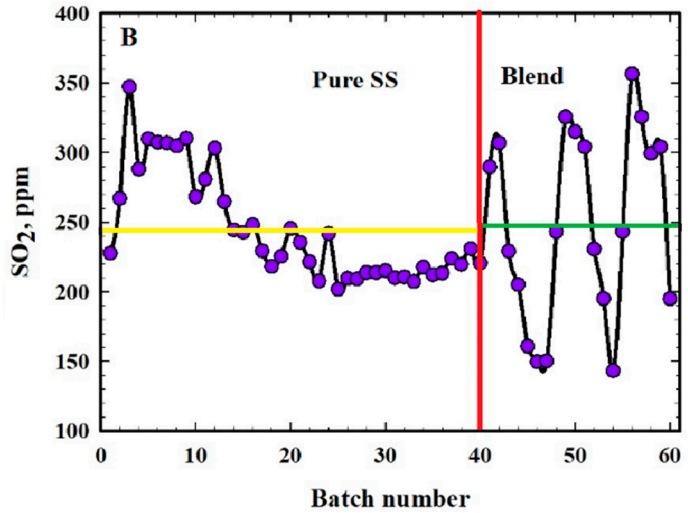

Figure S6: Analysis for SO_2 emissions

In Figure S6, the average values for SO_2 emissions for pure SS (244.42 ppm) and blend (248.65 ppm) are shown. The standard deviations are ±38.44 ppm and ±68.22 ppm, respectively.

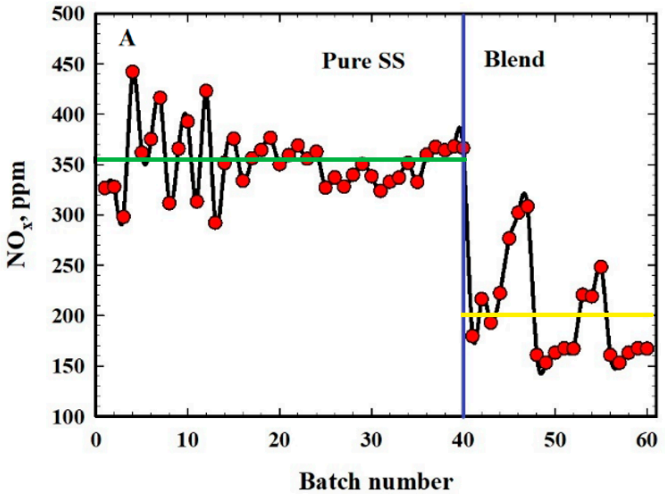

Figure S7: Analysis for NO_x emissions

In Figure S7, the average values for NO_x emissions for pure SS (353.23 ppm) and blend (200.53 ppm) are shown. The standard deviations are ±30.85 ppm and ±49.65 ppm, respectively.