

Waste to energy: air pollutant emissions from the steam boilers using recycled waste wood

ABSTRACT

In Taiwan, combustible wood mostly comes from waste pallets and scrap packaging materials discarded by factories, which produced a total of 278,067 tons of waste wood in 2019. In this study, the heat value of waste wood was 18.3 ± 1.07 MJ kg⁻¹. The measured volatile fraction was $76.5 \pm 7.34\%$, the fixed carbon was $15.7 \pm 3.19\%$, the ash content was $2.96 \pm 2.45\%$, and the moisture content was $21.6 \pm 10.2\%$. The proportions of the elemental constituents in the waste wood were $45.3 \pm 4.95\%$, $46.9 \pm 3.94\%$, $5.9 \pm 0.44\%$, $0.21 \pm 0.17\%$, $0.29 \pm 0.26\%$, and $0.02 \pm 0.02\%$ for carbon, oxygen, hydrogen, sulfur, nitrogen, and chlorine, respectively. The average boiler capacity was 11.5 ± 6.84 ton hr⁻¹, the average fuel consumption of the boilers was 1.47 ± 1.81 ton hr⁻¹, the average operating temperature of the boilers was $853 \pm 228^\circ\text{C}$, the average steam generation of the boilers was 7.63 ± 5.97 ton hr⁻¹, and the average exhaust flow rate was 246.6 ± 200.9 m³ min⁻¹. The main air pollution control systems used in the waste wood combustion boilers were systems combining a cyclone, a baghouse and a scrubber (37.8%), a cyclone and a baghouse (28.4%), a cyclone and a scrubber (10.2%), and systems using a baghouse only (9.8%). Based on our fuel consumption data, the air pollutant emission factors were 0.71 ± 1.44 kg per ton of wood for PM, 0.86 ± 1.47 kg per ton of wood for SO_x, and 5.24 ± 9.56 kg per ton of wood for NO_x. In July 2022, new emission standards for boilers will be implemented, and emission reductions of at least 30% for PM, 35% for NO_x and 7% for SO₂ will be required.

Keyword: Waste wood; Boiler; Air pollution control system; Emission factor