# Pyrolysis Oil Combustion in a Horizontal Box Furnace with an Externally Mixed Nozzl

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**Abstract**

Combustion characteristics of neat biomass fast-pyrolysis oil were studied in a horizontal combustion chamber with a rectangular cross-section. An air-assisted externally mixed nozzle known to successfully atomize heavy fuel oils was installed in a modified 100 kW (350"000 BTU/h nominal capacity) burner to explore full utility for pyrolysis oil (bio-oil) combustion in a furnace. Combustion experiments were conducted at air/fuel equivalence ratios of 0.46, 0.53, and 0.68 (116, 88, and 47% excess air, respectively) and compared to diesel fuel flames (control) at the two higher air/fuel equivalence ratios. In these experiments, the fuel flow rate was maintained at a constant energy input (equivalent of 24 kWth). The results revealed that, while the externally mixed nozzle could effectively atomize and ensure stable combustion of neat bio-oil at the set heat rate, this comes with a penalty associated with a lower peak flame temperature and, hence, heat flux. The formation of carbon monoxide (CO) decreases with an increasing air/fuel equivalence ratio for bio-oil combustion. The levels of carbon dioxide (CO2) and nitrogen oxides (NOx) increase with an increasing air/fuel equivalence ratio for bio-oil combustion and were slightly higher than that generated by diesel. Hydrocarbon emissions do not follow any defined trend with an increasing air/fuel equivalence ratio for bio-oil, as typically observed for diesel fuels as a result of the oxygenated nature of bio-oil.