

Comparative assessment of biomass and furnace oil fired boilers' flue gas emission and its environmental impacts

G. K. A. D. Silva¹, K. T. Jayasinghe², H. M. P. I. K. Herath¹
and G. Y. Jayasinghe^{1*}

¹Department of Agric. Engineering, Faculty of Agriculture, University of Ruhuna, Mapalana, Kamburupitiya, Sri Lanka.

²Energy & Environmental Management Centre, National Engineering Research and Development Centre, Ekala, Ja-Ela, Sri Lanka

*Email: jayasinghe@ageng.ruh.ac.lk

Boilers are the significant energy users of industrial production processes where it generates emissions of different air pollutants. This study assessed the comparison between biomass fired and furnace oil fired boiler emissions in the industrial sector of Sri Lanka with the objective of estimating and analyzing the CO₂ and the other toxic gaseous emissions (SO₂, NO₂, CO *etc.*) released by both boilers. Emission samples from selected different industries have been undertaken by using "In-stack Filtration Method" with Stack Monitoring Kit-Envirotech APM 621. Eight boilers per each boiler types were used for the study and three replicate samples from each boiler were collected. In this method, particulate matter (PM) was withdrawn isokinetically from the source and collected on a glass fiber filter maintained at 105–140°C. The Flue Gas Analyzer –KM 9106 was used to examine the gaseous emissions of nitrogen dioxides (NO₂), sulfur dioxides (SO₂), carbon monoxides (CO) and carbon dioxides (CO₂) by extractive sampling method. Conditioned gas was passed through different chemical sensors (in built sensors) for required reactions. The composition of particular gaseous components were measured based on the number of electrons emitted by different chemical reactions according to International Standards Organization's (ISO) standard methods. Results from two sampled t-test revealed that furnace oil fired boilers were significantly higher (P<0.05; P=0.02 and 0.001, respectively) in emitting SO₂ (1536.25 mg/Nm³) and NO₂ (228 mg/Nm³) gases compared to biomass fired boilers (i.e. SO₂=410 mg/Nm³ and NO₂ =175 mg/Nm³). Carbon monoxide (42.875 mg/Nm³) and PM (58.55 mg/mg/Nm³) concentrations were significantly higher in biomass fired boilers than that of furnace oil fired boilers (i.e. CO = 12 mg/Nm³ and PM =33.625 mg/Nm³). CO₂ emission was also significantly higher in biomass fired boilers than furnace oil boilers (i.e.in biomass CO₂= 13.5 and in furnace oil CO₂=8.5 mg/Nm³ respectively). It can be suggested that extra precautions should be taken to reduce concentrations of CO and PM from biomass fired boilers and SO₂ and NO₂ from furnace oil fired boilers.

Keywords: Biomass boilers, Environmental impacts, Flue gas emission, Furnace oil boilers