Development of Stove Emission and Efficiency Testing Laboratory

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In this paper the stove emission and efficiency testing laboratory developed in Ulaanbaatar by the ADB[1] and WB[2] is described. The extremely high air pollution in Ulaanbaatar, the capital city of Mongolia often exceeds the WHO guidelines for respirable airborne particulate matter by a factor of 35. According to a pollution source apportionment study conducted by the National University of Mongolia it is mainly emitted by domestic cooking and heating stoves. More than 90% of the annual average PM2.5 is generated by simple wood stoves poorly suited to burning lignite, the preferred urban fuel.

The Stove Efficiency and Emission Testing (SEET) laboratory was established in Ulaanbaatar to develop, test and rate low emission, high efficiency stoves as part of an air pollution reduction program. The equipment includes an Emerson X-Stream dual channel gas analyser (CO, O_2, CO_2x2), Dusttrak DRX particle counter, 150 kg x 2 g Adam electronic mass balance monitored using novel desktop software and an Agilent 34972A multiplexer fitted with an Agilent 34901 thermocouple card. A novel particle dilution tunnel system avoids condensing water vapour from the stack. It is supplied with CO_2-free dry air from a Twin Towers Engineering cycling adsorber. Gas sample drying in achieved using a vortex tube chiller and Nafion dryers. The variable dilution of the particle concentration, including condensable volatiles, is factored to its undiluted state by continuously logging the ratio of the CO_2 concentration in the stack and that of the CO_2 at in the diluter. Dilution can be manually varied as required from 3:1 to 300:1 keeping the PM concentration within the particle counter's 150 mg/m^3 limit from a source as high as 45,000 mg/m^3.

Data analysis is performed using the SeTAR Centre's (University of Johannesburg, South Africa) Heterogeneous Test Protocol and analytical methods. More than 200 tests were carried out for development of new stoves and product selection for Ulaanbaatar's Clean Air Program (UBCAP). The laboratory shows this methodology can serve as important instrument for the development, testing and selection of improved stoves.

Keywords: Stove Testing, Efficiency, Emission, PM2.5, Heterogeneous Test Protocol, Ulaanbaatar, condensable volatile particles

[1] Asian Development Bank
[2] World Bank

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