Performance test of a mobile fossil fuel CO\textsubscript{2} monitoring station developed in ATOMKI

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Mixing ratio of CO\textsubscript{2} is measured at 3 m above the ground by the monitoring station. Air is pumped through a 9.5-mm-diameter plastic tube (PFA, Swagelok) to a CO\textsubscript{2} analyser located in a container box. Container box (Containex) is 1.5 m wide, 1.2 m deep and 2.2 m high, designed as a mobile measuring room which is field deployable, only electric power is required. A 15 micron pore-size stainless steel Teflon\textsuperscript{®} Type (Swagelok) particle filter is located at the inlet of the sampler tube. Diaphragm pump (KNF) is used to draw air continuously through the sampling tube from monitoring level at flow rate of ~3 L/min.

The air at 5 psig overpressure enters a glass trap for liquid water that is cooled in a regular household refrigerator. The water and entrained dust are filtered out through a stainless steel mesh (200 microns). The air exiting the water filter is passed through a 23 cm long heat exchanger, which cools the air to keep it at 20°C. The dry air is then passed through a 25 cm long Tridac air filter (1 micron), followed by a 25 cm long 5A molecular sieve filter, which removes traces of water vapor and other humidity components. The air is then passed through a 25 cm long Nafion drier (Permapure), so that the water vapor interference and dilution effect are <0.1 ppm equivalent CO\textsubscript{2}.

Analysis is carried out using a non-dispersive infrared gas analyser (IRGA Ultramat 6F) which is a specialised model for fossil fuel applications by Sercon. A constant sample flow rate of 300 cm\textsuperscript{3}/min is maintained by a mass flow controller (MFC, Aalborg). The reference cell of the CO\textsubscript{2} analyser is continuously flushed with a compressed reference gas of 350 ppm CO\textsubscript{2} in synthetic air (Messer Hungarogáz). The typically used calibration cycle is 2 hours, consisting of a zero-point calibration and a span calibration. Each calibration is consisting of 2 min flushing and 20 sec signal integration. The maximum change of the response function is below 0.2 ppm after 2 hours following a previous calibration.

The analyser measures the CO\textsubscript{2} mixing ratio in the sample gas every 3 seconds. Output data are registered by a data logger developed for the data application (SCD data logger, Special Control Devices). The overall uncertainty of our atmospheric CO\textsubscript{2} mixing ratio measurements is < 1 ppm (< 0.3 % of measured level). This level of error is acceptable for fossil fuel CO\textsubscript{2} calculations as the uncertainty of the other required parameter radiocarbon content of atmospheric CO\textsubscript{2} is usually 0.3-0.5%.

Figure 2. shows a photo of the developed field deployable fossil fuel CO\textsubscript{2} monitoring station in the backyard of Atomki.