

## **Ambient measurement of ammonia and formaldehyde: Open path vs. extractive approach.**

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Ammonia  $\text{NH}_3$  and formaldehyde  $\text{CH}_2\text{O}$  are some of the most critical chemicals for air quality. Reliable online measurement of these gases is one of the key operations for air quality and safety monitoring, in indoor, outdoor and process applications alike. Ammonia and formaldehyde are reactive compounds and they are harmful, even in very low ppb level concentrations. This means challenges for measurement system in all of its critical aspects: sampling, calibration and sensitivity.

We are applying techniques so far successfully used to measure reactive inorganic compounds like ammonia  $\text{NH}_3$  and hydrogen fluoride  $\text{HF}$  to tackle these challenges. Now a novel setup based on direct laser absorption with cavity enhancement employing fundamental vibration level excitations of ammonia and formaldehyde molecules is constructed in connection with new mechanics and algorithms optimized for gas exchange and sampling in the case of these reactive molecules easily sticking to surfaces. An aberration corrected multipass sample cell in vacuum pressure is used in parallel with an open path multipass setup. The  $\text{CH}_2\text{O}$  and  $\text{NH}_3$  calibration gases necessary for system calibration are dynamically generated using traceable standards and components. We compare these two approaches with special emphasis on the system's response time, robustness, sensitivity, usability in field conditions, maintenance need and long term stability. A further goal is to enable the use of the same setups also for simultaneous measurement of other reactive compounds often encountered in air quality monitoring. This would make possible more comprehensive and also economic monitoring of these compounds with a single device.