Lower Detection Limit Enhancement for Low Concentration Ammonia Measurement.

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Abstract: This paper describes an optical sensor system for quantifying ammonia at low concentration. An open path optical technique is used to measure ammonia concentration within the Ultraviolet region. Experimental results describing the operation of the sensor with wavelengths combination technique to enhance the Lower Detection Limit is presented. The results show the sensor is best measuring ammonia concentration at combination wavelengths (around 212 *nm*) with the Lower Detection Limit of 4.31 *ppm* and 1 *s* response time is achieved.

Keywords: optical sensor; ammonia measurement; lower detection limit.

1. Introduction.

Ammonia gas is toxic to both human and animal life alike and its maximum safe level is 25 *ppm* for long term exposure (8 hour) and 35 *ppm* for short term exposure (15 min) [1]. According to the European Environment Agency, (EEA) report Jan 2014, ammonia (NH_3) emissions is primarily contributed by the agricultural sector. Only minimal amounts of ammonia emissions derived from other sectors such as industrial processes and road transport.

There are many types of ammonia sensors which have their own advantages and disadvantages and have been discussed in details in previous report [2]. However not many sensor can detect very low concentration within a short duration which is less than 3 s. This is particularly true in sensors based on solid state devices such as semiconductors. In addition, an optical fibre based gas sensor can have many advantages in terms of low weight and small size [3], resistance to high temperature [3-4], no electromagnetic interference, and can have distributed measurement rather than a point sensor [5].

Another advantage of this ammonia sensor is it uses Ultraviolet (UV) as a light source. Barber *et al* [6] have mentioned that UV absorption is merely affected by water content, which makes this sensor in UV range plausible for operation within moisture-saturated samples. Also, in other report [7] it has been shown that the absorption spectrum for water in the UV range exists between 183 *nm* to 193 *nm*. Hence, there should be no cross sensitivity issues with water content since ammonia absorption lines in this work have occurred between 200 *nm* to 225 *nm* and this has been proven and reported previously [8].

On top of these advantages, an optimization of the optical sensor system is also needed to enhance the sensor performance. In this paper, we report a few methods to increase the ammonia optical sensor performance by achieving a better Lower Detection Limit (LDL) of 4.31 *ppm*. We also manage to reduce the response time of the sensor system from 2 s to 1 s.