DETECTION OF SO_2 AND NO_2 IN STACK PLUME BY RAMAN SCATTERING AND FLUORESCENCE

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ABSTRACT

We have been studying laser-Raman radar which can be used as the remote detector of SO_2 concentration in the stack plume of boiler exhaust gas, and some results have been published[1].

In this paper, we report the interference of NO_2 fluorescence against SO_2 Raman scattering and the measuring method of SO_2 and NO_2 concentration.

In a stack plume, high density dust and high concentration CO_2 are included, therefore very strong Mie back-scattering and CO_2 Raman scattering are observed. The separation of these scattering signals from SO_2 Raman signal was the first problem for the laser-Raman radar. But, this problem was solved by using the filter which have high resolving power.

It is well known that NO_2 can be excited to emit fluorescence of broad spectrum by blue-green light. The light source of the laser-Raman radar is SH of Nd:YAG laser, and boiler exhaust gas includes several tens ppm of NO_2, then the interference of NO_2 fluorescence brings the error to SO_2 measurement.

The rejection of the interference can be achieved by the subtraction of the NO_2 fluorescence contribution from detected signal at SO_2 Raman scattering wavelength. The NO_2 fluorescence contribution can be measured by two methods. The first is to convert the NO_2 fluorescence intensity which is measured at a different wavelength from SO_2 Raman line into the one at SO_2 Raman line. The second is to convert the detected signal intensity, which is obtained when the range gate is set just behind the plume, into the one obtained at the range of the plume using the difference of the time dependence between SO_2 Raman scattering and NO_2 fluorescence. NO_2 fluorescence has lifetime of about 300nS, while Raman scattering has none.

By either of the two methods, the contribution of NO_2 fluorescence is determined. Then, we can measure the NO_2 and SO_2 concentration.

The minimum detectable concentration and the experimental results of the remote sensing of SO_2 and NO_2 in stack plume will be discussed in detail.

Reference

1) S. Nakahara et al. Opto-Electronics 4(1972) 169~177.