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Laboratory measurements of Photochemical Properties of Atmospheric Pollutants.

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One of the most important parameters in estimating the environmental impact due to emission of a compound is its residence time in the atmosphere, which is driven by the reaction of a compound with hydroxyl radicals (OH) for many atmospheric trace gases. The atmospheric lifetime is important for estimating ozone depletion potential (ODP) and global warming potential (GWP) of industrial compounds which are needed for evaluation of their environmental impact and regulatory purposes.

The sources of critically evaluated photochemical data for atmospheric modeling, NASA/JPL Publications and IUPAC Publications, recommend uncertainties within 10%-60% for the majority of OH reaction rate constants with only a few cases where uncertainties lie at the low end of this range. These uncertainties can be somewhat conservative because evaluations are based on the data from various laboratories obtained during the last few decades. Nevertheless, even the authors of the original experimental works rarely estimate the total combined uncertainties of the published OH reaction rate constants to be less than ca. 10%. Thus, uncertainties in the photochemical properties of potential and current atmospheric trace gases obtained under controlled laboratory conditions still constitute a major source of uncertainty in estimating the compound's environmental impact.

One of the purposes of the present work was to illustrate the potential for obtaining accurate laboratory measurements of the OH reaction rate constant over the temperature range of atmospheric interest. We provide a detailed inventory of accountable sources of instrumental uncertainties related to our FP-RF experiment to prove a total uncertainty of the OH reaction rate constant to be ca. 2%.

The results of accurate measurements of photochemical properties of industrial and natural atmospheric pollutants will be presented.