

Spectral Analysis of Flame Emission

Combustion processes play an important role in the energy efficiency worldwide. From a simple burner to a complete heating system, combustion is present in everyday life. In industry, especially, flame monitoring is crucial for quality control and safety checks.

The spectral analysis of flame emission is widely used for the investigation of the **equivalence ratio** and its close-loop control. A high equivalence ratio value corresponds to a rich flame, where there is an excess of fuel that cannot be totally consumed during the combustion process. Furthermore, the molecular species involved in the combustion process can often contribute significantly to the understanding of the flame behavior.

Molecular spectroscopy is regularly used for the identification of the molecules that are present in the reaction zone of the flame. Each molecule emits electromagnetic radiation at specific wavelengths, which is called **chemiluminescence** and is unique for a certain molecule.

Chemiluminescence

Molecules that obtain energy through chemical reactions emit the excess energy with the form of electromagnetic radiation and return to a more stable condition, i.e. ground state. This chemiluminescent emission is divided into different components, depending on their wavelength, by a spectrometer and can be detected with special cameras like the Intensified Charge-Coupled Device camera.

In this thesis, the chemiluminescent emission of the flame was investigated in various burners in order to use the results for combustion control in **steam generator** systems for **marine propulsion**. This project was performed in collaboration with **Kockumation**, a leading company in this niche. Moreover, the performance of the current flame detection system of the company was studied and a new one was suggested. Further investigation could be contacted for the **optimization** of the existing **combustion devices** on **marine vessels**.



Fig: Pictures of a premixed flame in various equivalence ratios

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