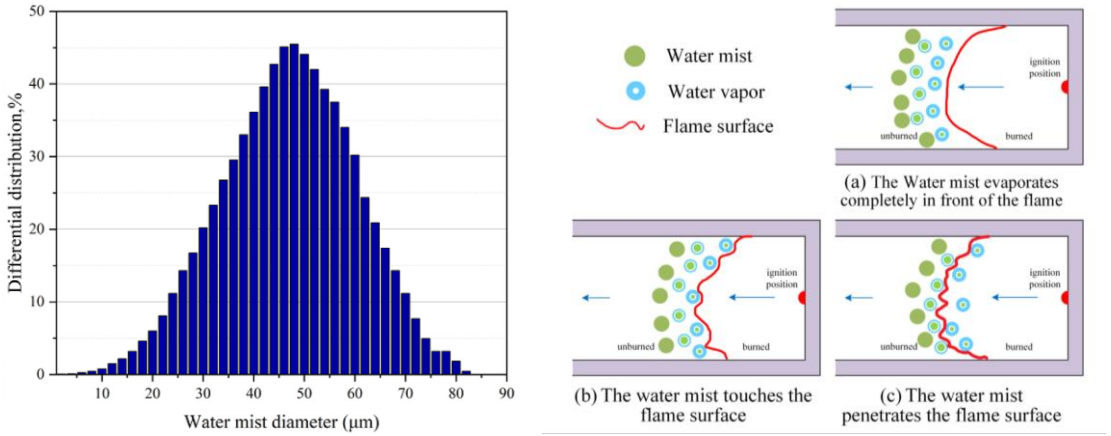
Mitigation of hydrogen explosions

Introduction

Hydrogen is considered to be an important part of the energy supply of the future and a major driver of the green shift. However, hydrogen is a highly explosive gas. Therefore, safe use of hydrogen is an important research topic.

Water spray systems are a possible active fire protection method for mitigation of hydrogen explosions. If water spray is released when leakage of hydrogen is detected, it might prevent explosion pressure build-up. However, models of this are generally not validated, and more research should be conducted. Studies have shown divergent results because of the complex flow of gas explosion interacting with water droplets.



Y. Xia et al., "Experimental research on combined effect of obstacle and local spraying water fog on hydrogen/air premixed explosion," International Journal of Hydrogen Energy, vol. 47, no. 94, pp. 40099-40115

The nozzle of a regular water spray system produces a distribution of water droplet sizes, a *polydisperse* spray. The droplet size is one parameter that affects whether the spray will have a mitigating or increasing effect on a gas explosion.

Objectives and Methods

- The main objective is to determine the effect of a distribution of water droplet sizes (polydisperse) on a hydrogen explosion in a computational fluid dynamics (CFD) simulation compared to a monodisperse assumption.
- The Open-Source CFD software OpenFOAM and the chemical kinetics software Cantera will be used.

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- BSc in Mechanical Engineering from Høgskulen på Vestlandet (HVL)
- MSc in Process Technology from USN
- Experience with CFD on both Master's Thesis and Research Project

Estimated progress of the PhD project:

Just started ...	< 50 %	> 50 %	Almost done ☺

Publications

- A. M. Lande and J. Lundberg, "Summary of mechanisms of water droplets in hydrogen deflagration," Nordic Flame Days 2023, Trondheim, Norway, 2023
- J. Lundberg, K. Vågsæther, R. Sikka, and D. Bjerketvedt, "Water Mist Characteristics for Explosion Mitigation," in Tenth International Seminar on Fire and Explosion Hazards, Oslo, Norway, 2022

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