CFD Modelling of Accidental Hydrogen Release from Pipelines

Abstract:
Although today hydrogen is distributed mainly by trailers, in the long terms pipeline distribution will be more suitable if large amounts of hydrogen are produced on industrial scale. Therefore from the safety point of view it is essential to compare hydrogen pipelines to natural gas pipelines, which are well established today. Within the paper we compare safety implications in accidental situations. We do not look into technological aspects such as compressors or seals. Using a CFD (Computational Fluid Dynamics) tool, it is possible to investigate the effects of different properties (density, diffusivity, viscosity and flammability limits) of hydrogen and methane on the dispersion process. In addition CFD tools allow studying the influence of different release scenarios, geometrical configurations and atmospheric conditions. An accidental release from a pipeline is modelled. The release is simulated as a flow though a small hole between the high-pressure pipeline and the environment. A part of the pipeline is included in the simulations as high-pressure reservoir. Due to the large pressure difference between the pipeline and the environment, the flow conditions at the release become critical. For the assumed scenarios larger amount of flammable mixture could be observed in case of hydrogen release. On the other hand, because of buoyancy and a higher sonic speed at the release, the hydrogen clouds are farther from the ground level or buildings than in case of the methane clouds, decreasing the probability of ignition and reducing the flame acceleration due to obstacles in case of ignition. Results on the effect of wind in the release scenarios are also described.

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