The Influence of 90 Degree Bends in Closed Pipe System on the Explosion Properties Using Hydrogen-Enriched Methane

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ABSTRACT

This work sought to evaluate the explosion severity on hydrogen enrichment in methane-air mixture explosion. For this purpose, different hydrogen mixture compositions ranges between 4 to 8% v/v were considered. This work was performed using CFD tool FLACS that has been well validated for safety studies on both natural gas/methane and hydrogen system. FLACS is used to validate the maximum pressure and flame speed predicted by the CFD tool for combustion of premixed mixtures of methane and hydrogen against the experimental data. Experimental work was carried out in a closed pipe containing 90- degree bends with a volume of 0.41 m3 , operating at ambient conditions. From the experiment observation, it shown that the coupling effect of bending and thermal diffusivity gave the dramatic influent on explosion severity in hydrogen-methane/air at very lean concentration. However, simulation results showed that FLACs is under-predicting the overpressure at very lean concentration of hydrogen in methane/air mixtures. It can be said that lower hydrogen content in methane/air mixture limits the hydrogen diffusivity, leading to the decrease of the burning rate and flame speeds. It is also demonstrated that the presence of 90-degree bend in closed pipe system increases the simulated flame speeds to the factor of 2-3, as compared to the experimental data. There are significant discrepancies between experimental and simulation, however, the results seem conservative in general.

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