

Study of Flammability Domain of H₂/CO Mixtures at Conditions Representative of the Late Phase of a Severe Accident in a PWR

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The aim of this experimental work is to study the influence of ignition energy, and oxygen starvation on the lower (LFL) and upper (UFL) flammability limits of H₂/CO mixtures, for conditions representative of the late phase of a severe accident in pressurized water reactors (PWR). The experimental facility consists on a stainless-steel vessel with an internal diameter of 250 mm for a total volume of 8L. This spherical bomb is equipped with two optical access. Ignition is performed using two tungsten arrow-shaped electrodes distanced by a gap of 3 mm connected to different ignition sources depending on the selected energy. The flammability limits are determined from a statistical study by considering, on one hand a visual criterion by using a schlieren coupled with a high-speed camera, and on the other hand pressure criterion by measuring the overpressure on the vessel with a Kistler sensor.

The experiments were conducted at an initial pressure of 1 bar and ambient temperature. The ignition energy was fixed at 1.6 ad 265 mJ. Finally, the O₂/N₂ ratio was fixed to 0.264 and 0.11. When comparing the experimental flammability limits to the Le Châtelier rule, one can see that the flammability range is larger when with Le Châtelier rule, than the measured one. The second conclusion we can draw from this study is that the higher the ignition energy, the wider the flammability range for the H₂/CO/Air mixture under the conditions studied (by 2.04%). This study has also shown that the flammability range is considerably reduced for an oxygen-depleted atmosphere (by 40.8%). Exploration for further oxygen starvation conditions will be performed to establish correlations. The impact of CO₂ and H₂O addition, and of initial temperature will be studied.

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