

The Influence of Hydrogen Addition to Natural Gas Networks on Gas Appliances

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Abstract : Injecting hydrogen, a competitive carbon-free energy carrier, into existing natural gas networks has become a promising step toward alleviating global warming. Considering the differences in properties of hydrogen and natural gas, there is very little evidence showing how many degrees of hydrogen admixture can be accepted and how to adjust appliances to adapt to gas constituents' variation. The lack of this type of analysis provides more uncertainty in injecting hydrogen into networks because of the short the basis of burner design and adjustment. First, the properties of methane and hydrogen were compared for a comprehensive analysis of the impact of hydrogen addition to methane. As the main determinant of flame stability, the burning velocity was adopted for hydrogen addition analysis. Burning velocities for hydrogen-enriched natural gas with different hydrogen percentages and equivalence ratios were calculated by the software CHEMKIN. Interchangeability methods, including single index methods, multi indices methods, and diagram methods, were adopted to determine the limit of hydrogen percentage. Cooktops and water heaters were experimentally tested in the laboratory. Flame structures of different hydrogen percentages and equivalence ratios were observed and photographed. Besides, the change in heat efficiency, burner temperature, emission by hydrogen percentage, and equivalence ratio was studied. The experiment methodologies and results in this paper provide an important basis for the introduction of hydrogen into gas pipelines and the adjustment of gas appliances.

Keywords : hydrogen, methane, combustion, appliances, interchangeability

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