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GREEN HYDROGEN SUPPLY TO URBAN INFRASTRUCTURE AND BUILDINGS THROUGH BLENDING INTO THE EXISTING GRID

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ABSTRACT

Hydrogen's abundance on earth and its great potential to reduce the greenhouse gas (GHG) emission renders it an interesting topic for researchers to investigate further. Hydrogen can be used for storing surplus electricity from the grid during periods of low demand for electrical energy. It can also be used to carry the electrical energy generated from renewable energy sources such as solar and wind farms that are not connected to the grid. For these applications, electrical power is consumed to generate hydrogen through electrolyzers. That is to say, the electrical energy is converted to hydrogen as a gaseous substance, which is referred to as the power-to-gas (P2G) technology. As a result, hydrogen is used as a green energy carrier due to its zero emissions.

Hydrogen generated from these power-to-gas applications has to be transported to the end-users. The most cost-effective hydrogen delivery solution is to use the existing gas network by injecting hydrogen into methane, in which the two gaseous substances are transmitted as a mixture. Due to the different thermodynamic properties of the two gases, the new mixture has significant changes in the delivery network as compared to pure gas transmission. These changes are associated with pressure drop and temperature profiles along the operating line. The changes also vary with the high-pressure, medium-pressure, and low-pressure grids. Overall, hydrogen-enriched-methane has beneficial influence on the conditions of its transmission. However, the molar fraction of hydrogen in the mixture should not exceed 15%–20% due to the drop-in heating value. Differences between transporting hydrogen-enriched-methane and pure methane also take place at compression and decompression stations.

This talk aims to provide some results of our investigations on the transmission of hydrogen-enriched-methane in the distribution network, as discussed above. It will also focus on the research on hydrogen injection into local gas infrastructure or even in the hydrogen and hydrogen-enriched-methane supply to a single building from CFD and thermodynamics insight. Compared to the transmission in main and regional networks, the injection into the local grid features low pressure and is subject to dynamically changing demand, which might affect end-use appliances. Experimental and analytical studies are required to understand how a dynamically changing supply of this mixture can be implemented with steady energy quality in the operating grid for varied demand functions.