Hydrogen-natural gas: A transitional fuel

The CNG programme in Delhi provides the immediate bridge for transitioning to hydrogen in India. In a major initiative to bridge the gap between hydrogen and CNG, the Indian Oil Corporation Limited commissioned a hydrogen-compressed natural gas (H-CNG/hythane) dispensing station at Dwarka in January. The company initiated this project in order to diversify the energy mix of the country which ultimately will result in energy security in the future. This dispensing station will make H-CNG available for three-wheelers and cars. The project is funded jointly by the Ministry of New and Renewable Energy and the Ministry of Petroleum and Natural Gas with an investment of Rs. 5 crore. The first experimental H-CNG dispensing station was commissioned at the IOC-R&D center campus, Faridabad in October 2005 for conducting studies on emission and performance characteristics on three and four-wheelers using various blends of hydrogen in CNG. Since then field trials have been underway on three-wheelers and passenger cars.

The CNG blended hydrogen fuel produced at the dispensing station will be used to fuel vehicles. The ratio of natural gas to hydrogen in H-CNG is 80 per cent natural gas and 20 per cent hydrogen by volume. This has been determined to be the best ratio when all factors such as emissions reduction, cost, and storage capacity are considered.

Production of hydrogen

H-CNG requires blending of hydrogen and natural gas. While CNG is available in the city, hydrogen has to be produced. The cost of hydrogen production is high. There are various processes by which hydrogen can be produced. At the Dwarka station, hydrogen for H-CNG fuel is being produced through electrolysis. Electrolysis is the decomposition of water into hydrogen and oxygen. The hydrogen produced is blended with CNG to fuel vehicles. In addition to the electrolyser, the station has a compressor along with a buffer storage facility. The station which will enable the IOC to continue its R&D for use of hydrogen as a transport fuel has capacity to fuel nearly fifteen three-wheelers. Initially, CNG vehicles will be targeted which will run on a mixture of hydrogen fuel with little modification.

Reduces NOx emissions

H-CNG can use the existing natural gas infrastructure. This fuel has many benefits. Addition of hydrogen to CNG improves efficiency, while retaining the low emission characteristics of CNG. Its use in vehicles leads to 50 per cent reduction in NOx emissions. Reduction of CO emissions has also been reported. In addition to emission reduction, engine power is maintained along with fuel mileage efficiency. It is important to note that an engine must be calibrated to achieve emissions reductions when running on hythane.

Hythane meets from Euro I to Euro V emission standards. Says John Nadeau, business development manager, Hythane company, 'Regarding the engine modifications, the electronics in the engine will have to be re-tuned to take advantage of the lower emissions of hythane. This is only a software modification, and does not require any change in hardware to an existing natural gas engine.'

Progress so far

Not only dispensing station, progress is being made in developing H-CNG engines also. One of the bus manufacturers, Ashok Leyland has developed a 6-cylinder, 6-litre 92 kW BS-4 engine for operation with H-CNG, in association with Eden Energy, Australia. A 4-cylinder 4-litre 63 KW engine is also being developed for H-CNG blend in a joint R&D programme with MNRE and IOC. Standards for H-CNG are being developed by the Oil Industry Safety Directorate. Safety standards are being worked upon.

Challenges

There is no doubt that H-CNG will prove beneficial for vehicle use in India. The country already has a huge fleet of CNG vehicles plying in Delhi. Many other cities such as Ahmedabad, Lucknow, Kanpur etc have CNG run vehicles. Several other cities are in the pipeline. According to the Petroleum and Natural Gas Regulatory Board, the number of cities where vehicles ply on CNG will increase more than eight times from current 30 to 250 by 2018.

One of the key challenges is high cost of hydrogen production. In electrolysis, the electricity cost is about three to five times more as compared to the cost of fossil fuel feed stock. There is a need to look at other options which would reduce the cost of hydrogen production. Mass production of the fuel will further lower the cost.

India has an ambitious plan to have one million hydrogen fuelled vehicles by 2020 mostly two and three-wheelers. A total investment requirement of Rs. 25,000 crores has been projected in the Road Map for creating the required hydrogen supply infrastructure to realize the goals of one million vehicles and 1,000 MW power generation capacity by 2020. It will take some time when hydrogen fuelled vehicles will ply in India, H-CNG is being promoted as the fuel of the future. There have been a number of projects in the US involving hythane.