Validation of HYGN Diesel-Hydrogen Hybrid LHD conducted at the NORCAT Underground Centre

Introduction

HYGN recently conducted a comprehensive validation study of HYGN Energy's Diesel-Hydrogen Hybrid technology on a LHD underground mining vehicle, specifically a Tamrock JS 285 Loader equipped with a 1989, 413 Deutz inline 5-cylinder engine, at the NORCAT Underground Centre in Sudbury, Ontario Canada.

NORCAT is the only regional innovation centre in the world that has an operating mine designed to enable start-ups, small / medium enterprises, and international companies to develop, test, and demonstrate emerging technologies in an operating mine environment. Using this asset, NORCAT helps to connect and broker relationships between mining technology companies (the “builders” of innovation) and global mining companies (the “buyers” of innovation) creating an ecosystem like no other in the world.

The HYGN project aimed to assess the efficacy of converting a diesel LHD into a Diesel-Hydrogen Hybrid while operating in real-world mining conditions. This report outlines the successful validation process and highlights the significant reductions in emissions achieved through HYGN's innovative technology.

Methodology

Baseline emissions data was initially collected during real-world driving applications of the Diesel LHD. The vehicle was then swiftly converted into a Diesel-Hydrogen Hybrid using HYGN technology, taking only an hour. Subsequently, the vehicle continued its operations in the active mining environment while emissions data was gathered over 11 hours across 2 days. All testing procedures were conducted on-site at the NORCAT Underground Centre engaging NORCAT support services, programs, and resources.

Results

The emissions reduction data showcased notable improvements, with up to a 33% decrease in CO and a maximum reduction of 15% in NO2 observed at idle. Additionally, the driver reported a decrease in diesel smell from the exhaust, indicating improved air quality. However, it was noted during emissions testing that the hydrogen system was intermittently turning on and off on occasion. To help address this, it is recommended that the hydrogen system be checked

periodically to ensure operation. Another variable that could have influenced emissions test results was whether the vehicle was in motion or idling before testing. Furthermore, the next test will incorporate a second emissions test system to track particulate matter (PM) emissions from the exhaust, providing a more comprehensive assessment of emissions reductions.

Key Features of HYGN Technology

The hydrogen kit utilized in the Diesel-Hydrogen Hybrid LHD features an onboard electrolyzer and a fuel tank designed to hold enough water for a two-week duration. Crucially, the hydrogen kit operates without storing hydrogen or subjecting it to pressure; hydrogen production occurs exclusively when the engine is running, ensuring safety. Minimal amounts of hydrogen are introduced into the engine's air intake, facilitating more complete combustion of diesel, thereby reducing emissions and enhancing engine cleanliness.

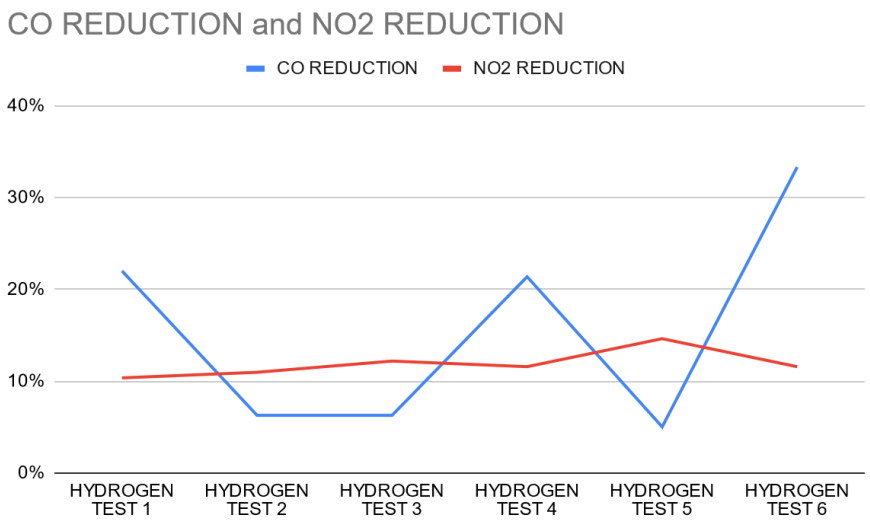
Recommendations for Further Optimization

To optimize engine performance further, it is recommended to introduce additional hydrogen kits to align hydrogen flowrate with higher RPM speed. A track driving and idling schedule will also help ensure more consistent emissions test results.

Extending the duration of the testing period would also allow the engine and fuel management system more time to adapt to hydrogen, likely yielding even more impressive results.

Conclusion

The validation study of HYGN Diesel-Hydrogen Hybrid LHD conducted at the NORCAT Underground Centre underscores the effectiveness of HYGN Energy's Diesel-Hydrogen Hybrid technology in significantly reducing emissions while simultaneously improving performance in underground mining operations. The success of this validation warrants serious consideration for adopting hydrogen systems in mining equipment, promising not only environmental benefits but also substantial operational advantages.



	CO REDUCTION (PPM)	NO2 REDUCTION (PPM)
BASELINE	159	23
HYDROGEN TEST 1	124	17
HYDROGEN TEST 2	149	18
HYDROGEN TEST 3	149	20
HYDROGEN TEST 4	125	19
HYDROGEN TEST 5	151	24
HYDROGEN TEST 6	106	19