IN-SITU WEAR BEHAVIORS OF VARIOUS RUBBERS IN LOW-PRESSURE HYDROGEN ENVIRONMENT

Byeong-Lyul Choi, School of Mechanical Engineering, Korea University
qudfbf1801@korea.ac.kr
Un Bong Baek, Korea Research Institute of Standards and Science
Byoung-Ho Choi, School of Mechanical Engineering, Korea University

Hydrogen has been studied extensively as an environmentally friendly energy source. Hydrogen electric vehicles (HEV) have the advantage of having a longer driving distance and shorter fuel charging time compared to electric vehicles, so a lot of development and research of key components of HEV have been conducted. However, since high-pressure hydrogen is stored and used, valves and fittings must be airtight. Especially, seals like O-rings made of rubbers are one of important components for the safety of HEV. When a rubber is exposed to high-pressure hydrogen environments, the instability of the rubber such as swelling and explosive decompression may occur, resulting in the deterioration of mechanical properties. In addition, O-ring can slide repeatedly due to pressure change during the operation of HEV. It is known that friction and wear characteristics can be changed under high-pressure hydrogen environments. Tribological properties of engineering plastic were investigated and showed lower wear amount in hydrogen than ambient air due to transfer film formation [1], [2]. In-situ wear tests of acrylonitrile butadiene rubber (NBR) and ethylene propylene diene monomer (EPDM) were conducted in high-pressure hydrogen to observed the effect of filler and plasticizer [3]. However, the effect of hydrogen on the tribological durability of various rubber materials is not understood yet. In this study, the friction and wear characteristics of rubbers used as O-rings were analyzed through low-pressure hydrogen in-situ wear tests. Even for in-situ wear tests under low-pressure hydrogen environments, it was confirmed the tribological characteristics that were significantly different from those in ambient air depending on the type of rubber materials. In addition, rubbers with similar mechanical properties exhibited different tribological properties depending on the compositions of the rubber. By evaluating the friction coefficient, wear amount, and wear mechanism of various rubber materials under hydrogen environments, it will be helpful to find proper materials for seals of HEV which are more suitable for hydrogen environments.

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