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Tribological Response of Self-Mated Zircaloy-4 under Varying Conditions

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Abstract : Zirconium alloys are widely used for the core components of a pressurized heavy water reactor (PHWR) or Canada deuterium (CANDU) reactor due to their low neutron absorption cross-section and excellent mechanical properties. The components made of Zirconium alloys are subjected to flow-induced vibrations, resulting in fretting wear at the interface of; pressure tubes and bearing pads, pressure tubes and calandria tubes, and calandria tubes and Liquid injection shutdown system (LISS) nozzles. There is a need to explore the tribological response under such conditions. Present work simulates the contact between calandria tube and LISS nozzle of PHWR/CANDU reactor as cylinder-on-cylinder contact configuration. Reciprocating tribo-tests were conducted on Zircaloy-4 (Zr-4) under the self-mated condition at varying amplitude, frequency, and sliding time. To understand the active wear mechanism, worn surfaces were analyzed using Scanning Electron Microscopy (SEM) and Energy Dispersive Spectroscopy (EDS). The change in amplitude severely affects the wear than other factors. The wear mechanism transits from adhesion to abrasion with increasing test amplitude. The dominant wear mechanisms are micro-cutting and micro-plowing followed by delamination in some areas. However, the coefficient of friction has indifferent behaviors.

Keywords : zircaloy-4, tribology, calandria tube, LISS nozzle, PHWR
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