INFLUENCE OF SIO_2 MICRO-PARTICLES ONTO MICROSTRUCTURE, MECHANICAL PROPERTIES AND WEAR RESISTANCE OF UHMWPE BASED COMPOSITE UNDER DRY SLIDING FRICTION

Noppanuch Puangmalee[1,a*], Narongrit Sonjaitham[2,b], Setthawit Saengthip[1,c], Noppanan mungnuae[1,d], Surachade Solklin[3,e] and Surat Wannasri[3,f]
[1]Faculty of Science and Technology, Bansomdejchaopraya Rajabhat University
1061 Isaraphab Rd., Dhonburi, Bangkok, Thailand, 10600
[2]Faculty of Industrial Technology and Management, King Mongut's University of Technology North Bangkok, Prachinburi Campus, 129, T. Noenhom, A. Muang, Prachinburi, Thailand, 25230
[3]Faculty of Engineering and Architecture, Rajamangala University of Technology Isan,
744 Suranarai Rd., T. Nai-muang, A. Muang, Nakhon Ratchasima, Thailand, 30000.
[a]p_puangmalee@hotmail.com, [b]narongrit.s@fitm.kmutnb.ac.th, [c]witkub@hotmail.com,
[d]down_31@hotmail.com, [e]surachade@hotmail.com and [f]swanasri_1@hotmail.com

Keywords: UHMWPE, SiO_2, microstructure, mechanical properties, wear resistance.

Abstract. This research investigated the influence of silicon dioxide (SiO_2) with particle size of 5 micron on microstructure, mechanical properties and wear resistance of UHMWPE polymeric composite materials under dry sliding friction that was tested by Block–on–ring technique according to ASTM G77. Bulk UHMWPE composite specimen was reinforced with SiO_2 particles by weight fraction of 0.1, 0.2, 0.3, 0.4, 0.5, 1, 2, 3, 4 and 5 wt.%. Specimen was performed by hot compression process with the compression forming conditions at the temperature of 202.11°C, pressure of 9.73 MPa and exposure time of 76.97 minutes. It was found that, SiO_2 has the potential to cause cross-linking in the molecular chain of polymers and affect in increased crystallinity and density. For the case of the microstructure, SiO_2 particle fraction in the range of not more than 0.5 wt.% did not effect to change microstructure of the specimen which Its microstructure did not significantly different from the pure UHMWPE specimen due to SiO_2 particle was dispersed uniformly in the UHMWPE matrix. Its microstructure appeared in a lamellar form or flake pattern. However, the increasing of SiO_2 more than 0.5 wt.% effect to changed microstructure due to the increased SiO_2 particles separated from the matrix and accumulation at the grain boundary of UHMWPE powder particles. For the case of mechanical and wear resistance properties, the increasing of SiO_2 particle of 1 wt.% affect to increased various mechanical properties to have a maximum value and decreased wear rate to minimum value of $5.10 \times 10^{-11} \pm 1.26 \times 10^{-11}$ mm^3/Nm. After that, the increasing of SiO_2 particle effect to decreased mechanical and wear resistance properties except for the hardness that continuously increased according to the increasing of SiO_2.