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Effects of Electron Beam Irradiation on Tribological and Physico-chemical Properties of Polyoxymethylene (POM-C) copolymer

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Polyoxymethylene copolymer (POM-C) is an attractive and widely used engineering thermoplastic across many industrial sectors owing to outstanding physical, mechanical, self-lubricating and chemical properties. In this research work, the POM-C blocks were irradiated with 1 MeV electron beam energy in five doses (100, 200, 300, 500 and 700 KGy) in vacuum condition at room temperature. The tribological and physico-chemical properties of electron beam irradiated POM-C blocks have been analyzed using Pin on disk tribometer, Raman spectroscopy, SEM-EDS, Optical microscopy, 3D Nano surface profiler system and Contact angle analyzer. Electron beam irradiation at a dose of 100 kGy resulted in a decrease of the friction coefficient and wear loss of POM-C block due to well suited cross-linking, carbonization, free radicals formation and energetic electrons-atoms collisions (physical interaction). It also shows lowest surface roughness and highest water contact angle among all unirradiated and irradiated POM-C blocks. The irradiation doses at 200, 300, 500 and 700 kGy resulted in increase of the friction coefficient as compared to unirradiated POM-C block due to severe chain scission, chemical and physical structural degradation. The electron beam irradiation transferred the wear of unirradiated POM-C block from the abrasive wear, adhesive wear and scraping to mild scraping for the 1 MeV, 100 kGy irradiated POM-C block which is concluded from SEM-EDS and Optical microscopic observations. The degree of improvement for tribological attribute relies on the electron beam irradiation condition (energy and dose rate).

Keywords: POM-C; Electron Beam Irradiation; Friction Coefficient; Wear; Raman Spectroscopy; Water Contact Angle