

Journal of Remanufacturing

Selection of wear-resistant materials and implementation framework for remanufacturing ground exploring tools (GETs) for coal mining applications: case-study of continuous miner cutter (CMC's) components

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Abstract: Ground exploring tools (GETs), used in coal mining industries, encounter severe failure due to their continuous pressing and scratching against the coal seam embedded with hard bands and impurities. Failure of GETs lead to direct cost expenditure due to replacement of worn-out components; besides, significant indirect cost resulting from machine down time when they are removed, and new ones are reinstalled. Mining businesses replace worn GETs with new parts at an exorbitant cost at a great risk to their sustainability. Replacement goes against the ethos of the circular economy (CE) philosophy which aims at ensuring highest value of resource utilisation while eliminating waste by improving the design of materials, products, and systems. A critical analysis of the approaches of CE for restoring damaged GETs reveals remanufacturing is the best option to adopt to keep GETs in good working conditions. Meanwhile, there is scanty literature to guide remanufacturing practitioners on materials selection and framework for implementing remanufacturing of damaged GETs. This review addresses this challenge by identifying appropriate wear-resistant materials and the most economically feasible remanufacturing technology which restores the performance of GET's components to at least as new upon remanufacturing. Using the components of continuous miner (CM) as a case study, the operating environments in which GETs function are described to gain insight into the modes of failure encountered. Information gathered from the operation environments of the GETs and their failure modes assisted in selecting appropriate wear-resistant materials. Techno-economic analysis of the remanufacturing of various modes of failure of the components of GETs was carried out to ascertain the economic feasibility of remanufacturing various failure modes. Future perspectives of failure analysis, material selection, and framework for implementing remanufacturing of various failure modes (based on severity of damage) in GETs are presented. This review extends the frontier of knowledge in the fields of GETs remanufacturing and potential wear-resistant materials for GETs to academic researchers and industrial practitioners