The Impact of Selected Bio-Based Carburising Agents on Mechanical and Tribocorrosion Behaviour of Medium Carbon Steel

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Abstract

Carburisation is a surface engineering method exploited for low/medium carbon steels to achieve blended funtionalisations in tribological and corrosion-resistant properties. However, much work has not been carried out to study the reaction of carburised medium carbon steel to combined actions by abrasion and electrochemical wear. This paper focuses on investigating the corrosion polarisation tendency of the various blends of the solution on carburised and as-received medium carbon steel using potentiodynamic polarisation tests and weight loss analysis. Hence, palm kernel oil (PKO) and sodium chloride (NaCl) of 20.475 g prepared with 100 ml of distilled water as a control medium were employed for this study. The corrosion susceptibility of the as-received medium carbon steel (uncarburised and carburised) materials, in differing concentrations as 0 ml, 0.2 ml, 0.4 ml, 0.6 ml, and 0.8 ml test solution under differing applied potentials were evaluated employing a polarisation tool. The corrosion susceptibility of the as-received medium carbon steel (uncarburised and carburised) materials, in differing concentrations as 0 ml, 0.2 ml, 0.4 ml, 0.6 ml, and 0.8 ml test solution under differing applied potentials were evaluated employing a polarisation tool. Particularly, in the pitting environment containing 0.20475 M NaCl, numerous corrosion pits are formed inside the wear track on the untreated specimen at potentials much lower than the pitting potential, while no corrosion pits are observed inside the wear track on the carburized specimen at anodic potentials as high as 1000 mV(SCE). The SEM/EDS also demonstrated the microstructural behavior of the surface oxides, spots, fractures, and corrosive pits at contact with the palm kernel oil (PKO) and sodium chloride (NaCl) solution environment. Comparatively, the result showed that there was a significant improvement in the mechanical properties of the carburised medium carbon steel material used to develop the hammers in this study.

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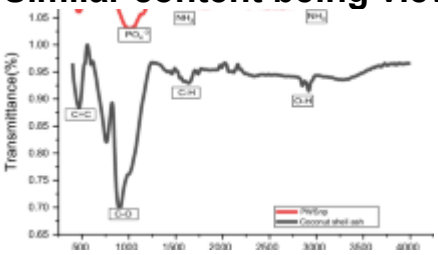

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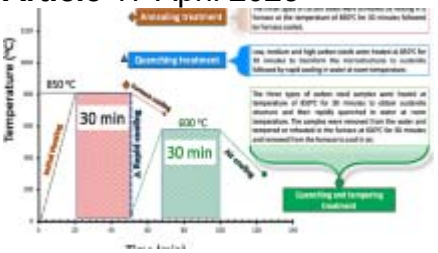

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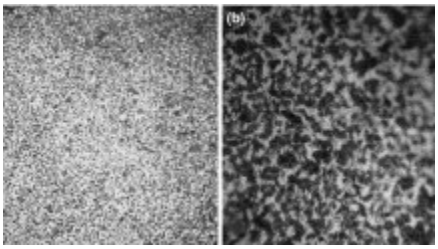

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Data availability

Upon request the corresponding author [B.M. Edun], will provide the data supporting the study's findings. Restrictions, such as the data's potential to endanger research participants' privacy, prevent the data from being made publicly available.

Abbreviations

PKO:

Palm kernel oil

CSS:
Coconut shell-composition

SD:
Saw dust-composition

NaCl:
Sodium Chloride

ASTM:
American Society for Testing and Materials

HCL:
Hydrogen chloride

SES:
Spark emission spectrometer

SEM:
The Scanning electron microscope

EDS:
The Energy Dispersive Spectrometer

TEM:
The Transmission Electron Microscope

SSP:
Surface shot peening

3D:
3 Dimension surface plot

Hr:
Hours

Mins:
Minutes

wt%:
Weight percentage

µm:
Micron

Rpm:
Revolution per minute

C:
Carbon

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Contributions

Individual authors have contributed to the paper in the following areas: Bose M. Edun: Conceptualized and designed the experiment, execute the experiment, materials, analysis tools or data and review. Wrote the original draft. Oluseyi O. Ajayi and Phillip O. Babalola: Conceptualized and designed the experiment, and supervision. Olufunmilayo O. Joseph: Materials, analysis tools or data and review All authors reviewed the manuscript.

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Ethics declarations

Conflict of interest

Authors declares that have no conflict of interest.

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