UNIVERSITI TEKNOLOGI MARA

EFFECT OF SURFACE ATTRITION TREATMENT TOWARDS THE BORON DIFFUSIVITY AND WEAR MECHANISM OF BORONIZED COMPACTED GRAPHITE IRON

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PhD

September 2020

AUTHOR'S DECLARATION

I declare that the work in this thesis was carried out in accordance with the regulations of Universiti Teknologi MARA. It is original and is the results of my own work, unless otherwise indicated or acknowledged as referenced work. This thesis has not been submitted to any other academic institution or non-academic institution for any degree or qualification.

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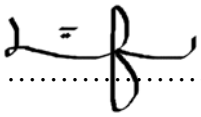
Signature of Student	:	 ……..
Date	:	September 2020

ABSTRACT

Nowadays, applications of metallic material are facing higher performance requirements due to constant exposure to the friction and wear, adversely affecting global manufacturing productivity performance and high maintenance costs. This study focused on the effect of surface attrition treatment towards the boron diffusivity and the wear mechanism of boronized compacted graphite iron. The research was conducted by introducing paste boronizing to replace conventional powder boronizing medium to produce better boron atom diffusion. Boronized samples with thicker boride layer and better hardness were thus selected to undergo surface attrition using the shot blasting method. The optimization of boronizing parameters between 800℃ to 950℃ and 4 to 10 hours after the surface attrition method were selected by using the Taguchi Method. Finally, the wear characterization of the optimized boronizing process parameter was studied. Analysis of the microstructure and thickness of the boride layer was performed using optical microscopy, scanning electron microscopy (SEM) analyzer and energy dispersive X-Ray (EDX) spectrometry. Other tests such as density, microhardness, Rockwell adhesion, pin on disk, slurry erosion and surface roughness were conducted. As a result, applying boronizing paste as the medium with paste thickness range within 3 to 7 mm resulted in improvement in boride layer thickness and microhardness compared to powder boronized samples. The application of surface attrition with 5 bar blasting pressure increased the boride layer thickness and microhardness up to 63% and 24% respectively, compared to boronized samples without surface attrited. The value of boron activation energy of boronized compacted graphite iron after surface attrited is 240.82 kJ mol^{-1} and the frequency factor is 3 x 10^2 (cm^2/s). The adhesion strength quality of samples surface attrited with paste boronized at 800℃, 900℃, 950℃ for 6 hours and 850℃ for 8 hours were sufficient as it fits HF1 to HF4 category. Samples with the highest boronizing temperatures of 950℃ for 6 hours lead the superior wear resistance and microhardness properties. The result was mainly because of the implementation of surface attrition treatment that resulted in the grain refinement that allowed a deeper boride layer to be diffused into the surface of the as-cast sample. The developed boronizing methods lead to the improvement of properties such as hardness and wear resistance of compacted graphite iron. The established of an empirical model from this study make it possible to predict the boride layer thickness for industrial application include drive shafts, piping components, pulleys, braking disc, metal stamping machines and other machines parts.

ACKNOWLEDGEMENT

Firstly, I wish to thank Allah for giving me the opportunity to embark on my Ph.D. and for completing this long and challenging journey successfully. My gratitude and thanks go to my supervisor Associate Professor Ir. Ts. Dr. Bulan Abdullah, Professor Ts. Dr. Nor Hayati Saad (Co-Supervisor) and Professor Dr. Mariyam Jameelah (2nd Co-Supervisor).

My appreciation goes to the Faculty of Mechanical Engineering, UiTM Shah Alam, Fakulti Alam Bina dan Kejuruteraan UKM and staff who provided the facilities and assistance during the research project. Special thanks to my spouse Mr. Mohd Helmi, my parents Hj. Muhammad Yusof and Hjh. Khadijah, my daughter Qisya Arissa, my family members and friends for their encouragement and support towards the completion of this project. Alhamdulillah.

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