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Karakterisasi Fatik dan Laju Korosi dari Lapisan Plasma DLC (Diamond-Like Carbon) Dan Shot Peening
Pada Machinery Steel HQ (High Quality) 805
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INTISARI

Machinery steel HQ (*High Quality*) 805 *series* merupakan kelompok baja permesinan. Bahan ini banyak digunakan sebagai komponen permesinan seperti poros, pin dan roda gigi mesin. Namun baja HQ 805 sangat sensitif terhadap kerusakan yang disebabkan oleh fatik dan korosi yang dalam aplikasi berdampak pada kerusakan benda. Ketahanan fatik, kekerasan dan ketahanan korosi baja HQ 805 perlu ditingkatkan agar umur komponen dapat bertahan lama. Sifat-sifat yang dikehendaki dapat diperoleh dengan melakukan perlakuan permukaan yang sesuai terhadap material tersebut. *Surface treatment* DLC (*Diamond-Like Carbon*), *shot peening* dan kombinasi perlakuan DLC dan *shot peening* dipilih sebagai teknik perlakuan permukaan agar diperoleh kekuatan fatik dan ketahanan korosi yang tinggi. Penelitian ini bertujuan untuk mengkaji pengaruh parameter proses pelapisan DLC, *shot peening* dan kombinasi perlakuan DLC dan *shot peening* terhadap kekuatan fatik, kekerasan dan ketahanan korosi baja HQ 805.

Pelapisan DLC merupakan salah satu metode perlakuan yang digunakan pada penelitian ini. Lapisan DLC bersumber dari campuran gas argon (Ar) dan metana (CH_4). Pelapisan DLC menggunakan variasi lama pelapisan 2, 4 dan 6 jam pada masing-masing variasi tekanan 1,2; 1,4; 1,6 dan 1,8 mbar. Proses *shot peening* dilakukan terhadap baja HQ 805 dengan variasi lama proses 10, 20 dan 30 menit.

Ada empat jenis spesimen uji yang digunakan pada penelitian ini yaitu: 1. Spesimen tanpa perlakuan/ *raw material* (RM), 2. Spesimen lapisan DLC tekanan 1,2 mbar (DLC-12), 1,4 mbar (DLC-14), 1,6 mbar (DLC-16) dan 1,8 mbar (DLC-18). 3. Spesimen proses *shot peening* dengan lama proses 10 menit (SP-10), 20 menit (SP-20) dan 30 menit (SP-30), dan 4. Spesimen kombinasi perlakuan DLC (parameter optimum uji fatik), yang dilanjutkan dengan proses *shot peening* 10 menit (DLC-SP10), 20 menit (DLC-SP20) dan 30 menit (DLC-SP30).

Dari tiga jenis perlakuan permukaan diharapkan dapat memberikan pengaruh terbaik terhadap kekerasan, kekuatan fatik dan ketahanan korosi baja HQ 805. Pengujian fatik dengan metode *rotary bending* dimaksudkan untuk mengetahui kekuatan fatik dari spesimen RM, DLC, SP dan DLC-SP. Pengujian kekerasan dengan metode *micro Vickers hardness* menggunakan beban 10 gram dan lama indentasi 10 detik untuk spesimen DLC, dan beban 50 gram untuk spesimen RM, SP dan DLC-SP. Uji kekerasan dilakukan untuk mengetahui nilai kekerasan permukaan material. Uji korosi dengan sel tiga elektroda dalam larutan 3,5% NaCl dilakukan untuk mengetahui laju korosi baja HQ 805. Analisis unsur dan struktur mikro dilakukan dengan alat uji SEM-EDS.

Hasil penelitian menunjukkan bahwa perlakuan DLC, *shot peening* dan kombinasi perlakuan DLC dan *shot peening* meningkatkan kekerasan permukaan, kekuatan fatik dan ketahanan korosi baja HQ 805. Kekerasan permukaan meningkat sebesar 103% setelah perlakuan DLC tekanan 1,4 mbar, kekuatan fatik meningkat sebesar 42,64% pada spesimen DLC-SP10 dan laju korosi terendah menurun 94% pada spesimen DLC dengan tekanan 1,4 mbar. Peningkatan kekerasan, kekuatan fatik dan penurunan laju korosi material dipengaruhi oleh metode dan parameter proses perlakuan.

Kata kunci : HQ 805, DLC, *Shot Peening,* Fatik, Korosi.

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ABSTRACT

HQ (High Quality) 805 steel series are included in machinery steels. These materials are widely used in machine components such as shafts, pins, and gears. However, HQ 805 steel is very sensitive to damages which are caused by fatigue and corrosion. In the application it has impacts on the damage of the material. The fatigue resistance, the hardness, and the corrosion resistance of HQ 805 steel need to be increased so that the components life could be longer. The desired characteristics can be achieved by surface treatment which is suitable with the material. DLC (Diamond-Like Carbon) surface treatment, shot peening and combination of DLC and shot-peening treatment were chosen as the surface treatments to achieve high fatigue strength and corrosion resistance. This research aims to study the effects of DLC coating, shot peening and combination of the process parameters of DLC coating and shot peening process parameters on the fatigue strength, the hardness and the corrosion rate of HQ 805 steel material.

DLC coating was one of the surface treatment methods used in this research. DLC layers were formed from the mixture of Argon (Ar) and methane (CH_4) gas. The duration variations of DLC coating were 2, 4 and 6 hours with pressure variations 1.2; 1.4; 1.6; and 1.8 mbar for each. Shot peening process was applied to HQ 805 with duration variations of 10, 20 and 30 minutes. There are four test specimens used in this study: 1. Specimen without treatment (RM), 2. DLC coating specimen with 1.2 mbar pressure (DLC-12), with 1.4 mbar pressure (DLC-14), with 1.6 mbar pressure (DLC-16) and with 1.8 mbar (DLC-18), 3. Shot peening specimen with 10 minutes (SP-10), 20 minutes (SP-20), and 30 minutes (SP-30) treatment durations, and 4. Combination of DLC (optimum parameter of fatigue test), continued by shot peening specimen with 10 minutes (DLC-SP10), 20 minutes (DLC-SP20) and 30 minutes (DLC-SP30) treatment durations. The three types of surface treatment were expected to have good impacts on the hardness, the fatigue strength and the corrosion resistance of HQ 805 material. Fatigue test by using rotary bending was aimed to identify the fatigue strength of RM, DLC, SP and DLC-SP specimens. The hardness test using Vickers microhardness method used Buehler Micromet 2100 series with indenter load 10 gr for DLC and DLC+SP specimens, and 50 gr for SP specimens with 10 seconds indentation. Hardness test was conducted to identify the hardness value of the material surface. Corrosion test by using three-electrode cell in 3.5% NaCl solution was conducted to identify the corrosion rate of HQ 805 steel. SEM (Scanning Electron Microscopy) and EDS (Energy Dispersive X-Rays Spectroscopy) test equipments were used to analyze the element and microstructure.

The results of the research show that DLC coating, shot peening and the combination of DLC coating and shot peening increase the surface hardness, the fatigue strength, and the corrosion resistance of HQ 805 steel. The highest surface hardness increases 103% on DLC 14 specimen, the optimum fatigue strength increases 42.64% on DLC-SP specimen and the lowest corrosion rate decreases 94% on DLC14 specimen. The increases of the hardness, the fatigue strength and corrosion resistance are affected by the method and the parameter of the treatment process.

Keywords : HQ 805, DLC, Shot Peening, Fatigue, Corrosion.