Pembuatan Grinding Ball dari Material White Cast Iron dengan penambahan chromium, molybdenum, vanadium, dan Boron, sebagai unsur paduan pembentuk Karbida = The manufacture of Grinding Ball from White Cast Iron Material with The Addition of Chromium, Molybdenum, Vanadium, and Boron as The Carbide Forming Elements.

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Abstrak

ABSTRAK
Grinding ball merupakan salah satu komponen dalam mesin ball mill yang berfungsi untuk menggerus batuan mineral menjadi partikel yang sangat halus (100-300 mesh). Penelitian ini bertujuan untuk mempelajari pengaruh penambahan unsur paduan berupa khromium, molibdenum, vanadium, dan boron terhadap sifat-sifat mekanik grinding ball terbuat dari material high chromium white cast iron, serta pengaruh volume karbida primer, karbida sekunder, dan austenit sisa terhadap ketahanan aus produk grinding ball.

Pembuatan grinding ball berukuran Ø50 mm dilakukan dengan menggunakan teknik pengecoran logam dengan menggunakan tungku induksi. Berikut ini adalah komposisi kimia dari masing-masing grinding ball dalam penelitian ini: 2,18C - 13Cr - 1.38Mo; 1.94C - 13.1Cr - 1.29Mo - 1.307V; 1.89C - 13.1Cr - 1.32Mo - 1.361V - 0.00051B; 2.12C - 16.5Cr - 1.55Mo. Proses perlakuan panas dilakukan terhadap material tersebut berupa: (1) subcritical heat treatment (700oC, 1 jam) dengan pendinginan udara atmosfer, (2) hardening (950oC, 5 jam) dengan pendinginan udara paksa, (3) tempering (250oC, 1 jam) dengan pendinginan udara atmosfer. Karakterisasi untuk mengetahui sifat-sifat mekanik dan struktur mikro dari material tersebut dilakukan melalui beberapa pengujian diantaranya adalah analisa komposisi kimia (Optical Electron Spectroscopy/OES), uji kekerasan (Brinell/ASTM E-10), uji impak (Charpy/ASTM E-23), analisa struktur mikro (mikroskop optik, SEM, XRD), dan uji ketahanan aus/wear rates (laboratory ball mill unit).

Dari hasil penelitian diperoleh bahwa penambahan khromium, molibdenum, vanadium, dan boron memberikan peningkatan yang signifikan terhadap nilai kekerasan dan ketahananan aus pada material high chromium white cast iron. Nilai ketahanan aus grinding ball yang tinggi dimiliki oleh material dengan komposisi 1.89C - 13.1Cr - 1.32Mo - 1.361V - 0.00051B (as-cast) dan 2.12C - 16.5Cr - 1.55Mo (as-tempered), dimana nilai ketahanan aus material tersebut lebih baik dibandingkan dengan grinding ball impor asal China dan India. Ketahanan aus yang tinggi pada material tersebut diakibatkan oleh nilai kekerasan

dan ketangguhan yang berimbang, besarnya kandungan volume karbida primer dan sekunder dalam matriks martensit, rendahnya kandungan austenit sisa, serta morfologi karbida primer dan sekunder yang halus.

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Abstract
Grinding ball is one of the components in the ball mill unit to grind the minerals rock into very fine particles (100-300 mesh). The purpose of this research are to investigate the effect of alloying elements, such as chromium, molybdenum, vanadium, and boron on the mechanical properties of grinding ball which is made from high chromium white cast iron, and to investigate the effect of primary and secondary carbide volume fraction and also retained austenite volume on the wear resistance of grinding ball.

The manufacturing of Ø50 mm grinding ball was conducted by using the iron casting process. The following are the chemical composition of the grinding ball?s materials in this research: 2.18 C-13 Cr- 1.38 Mo; 1.94 C-13.1 Cr-1.29Mo-1.307 V; 1.89 C-13.1Cr-1.32 Mo-1.361 V-0.00051B; 2.12 C-16.5 Cr-1.55 Mo. The heat treatment process were conducted into those materials include: (1) Subcritical heat treatment (700 ° C, 1 h) with atmospheric air cooling , (2) Hardening (950oC, 5 hours) with forced air cooling, and (3) Tempering (250oC, 1 hour) with atmospheric air cooling. Materials characterization was conducted to find out the mechanical properties and micro structure of those materials by using a few testing methods, there were: chemical analysis (Optical Electron Spectroscopy/OES), hardness testing (Brinell/ASTM E-10), impact testing (Charpy/ASTM E-23), micro structure analysis (optical microscope, SEM, XRD), and wear resistance/wear rates testing (laboratory ball mill unit).

From the results, the addition of alloying elements, such as chromium, vanadium, molybdenum and boron provided a significant improvement on the hardness and wear resistance of high chromium white cast iron. The high wear resistance was owned by the material with 1.89 C-13.1Cr-1.32 Mo-1.361 V-0.00051B (as-cast) and 2.12 C-16.5 Cr-1.55 Mo (as-tempered), which were better than grinding ball?s material from China and India. It was caused by a good combination between hardness and toughness, higher primary and secondary carbide volume fraction in martensitic matrix, lower retained austenite volume, and finer structure of primary and secondary carbide.