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ABRASION WEAR BEHAVIOR OF HYPOEUTECTIC 16 MASS% CHROMIUM CAST
IRON CONTAINING MOLYBDENUM

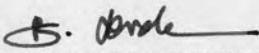
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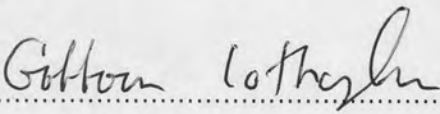
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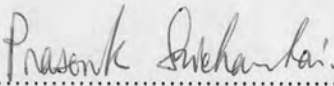
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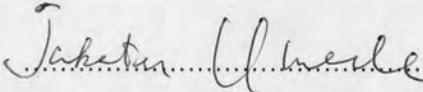

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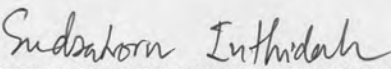
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พลิชรุ อังศุไพฑูรย์ : พฤติกรรมการสึกหรอแบบขัดสีของเหล็กหล่อ ไฮโปยูเทคติก 16
เปอร์เซ็นต์โดยมวลโครเมียม ที่เติมโมลิบดีนัม. (ABRASION WEAR BEHAVIOR OF
HYPOEUTECTIC 16 MASS% CHROMIUM CAST IRON CONTAINING MOLYBDENUM)
อ.ที่ปรึกษาวิทยานิพนธ์หลัก : รศ.ดร. ประสงค์ ศรีเจริญชัย, อ.ที่ปรึกษาวิทยานิพนธ์ร่วม :
Professor Yasuhiro Matsubara , 122 หน้า.

เหล็กหล่อ ไฮโปยูเทคติก 16 เปอร์เซ็นต์โดยมวลโครเมียมที่เติมและไม่เติม โมลิบดีนัมถูกเตรียม
ขึ้นมาเพื่อศึกษาพฤติกรรมการสึกหรอแบบขัดสี หลังจากอบอ่อนเหล็กหล่อถูกชุบแข็งจาก 1323 K
และอบคืนตัวที่อุณหภูมิต่างกันสามค่าคือ ก่อน H_{Tmax} , ที่ H_{Tmax} และ หลัง H_{Tmax} วัดความต้านทานการ
สึกหรอแบบขัดสีโดยการทดสอบการสึกหรอแบบขัดสี Suga (SAT) และการทดสอบการสึกหรอ
แบบขัดสีด้วยล้อยาง (RWAT)

กราฟความแข็งในสภาพอบคืนตัวแสดง Secondary hardening เนื่องจากการตกตะกอนของคาร์
ไบด์ทุติยภูมิ และการเปลี่ยนแปลงเฟสของออสเตนไนท์ที่เหลือค้างหลังการชุบแข็งเป็นมาร์เทนไซต์ คีกรี
ของ Secondary hardening ของชิ้นงานที่ผสมโมลิบดีนัมมีค่าสูง สัดส่วนโดยปริมาตรของออสเตน
ไนท์ที่เหลือค้าง (V_γ) ลดลงมากเมื่ออุณหภูมิอบคืนตัวเพิ่มขึ้น และค่า V_γ ของชิ้นงานที่มีค่าความแข็ง
สูงสุดมีค่าต่ำกว่า 6 เปอร์เซ็นต์

ความสัมพันธ์ระหว่างน้ำหนักที่สูญเสียและระยะทางเป็นเส้นตรง อัตราการสึกหรอ (R_w) ค่า
ที่สุดเกิดขึ้นในชิ้นงานที่ H_{Tmax} สำหรับ SAT และในชิ้นงานชุบแข็งสำหรับ RWAT ค่า R_w สูงที่สุด
เกิดขึ้นในชิ้นงานที่หลัง H_{Tmax} ในเงื่อนไขเดียวกันของกรรมวิธีทางความร้อน ค่า R_w ของ SAT มีค่าสูง
กว่าของ RWAT มาก ค่า R_w มีค่าสูงขึ้นตามน้ำหนักที่สูญเสียที่เพิ่มขึ้น และลดลงตามความแข็งมาโครที่
เพิ่มขึ้น โดยค่า R_w ค่าที่สุดของ SAT ปรากฏที่ปริมาณ V_γ 15 เปอร์เซ็นต์และของ RWAT ปรากฏที่
ปริมาณ V_γ 10 ถึง 15 เปอร์เซ็นต์ ใน SAT ค่า R_w ลดลงตามปริมาณโมลิบดีนัมที่เพิ่มขึ้นและค่า R_w
ค่าที่สุดของแต่ละส่วนผสมปรากฏที่ค่า V_γ สูงขึ้นตามปริมาณโมลิบดีนัมที่เพิ่มขึ้นและปริมาณ V_γ ที่
ปรากฏค่า R_w ค่าที่สุดเลื่อนไปฝั่งที่ V_γ มีค่าสูง ใน RWAT ค่า R_w ไม่แสดงความแตกต่างอย่างชัดเจน
การเพิ่มอัตราการเย็นตัวโดยชุบแข็งในน้ำมันเพิ่มความต้านทานการสึกหรอแบบขัดสีโดยการชุบแข็ง
อย่างสมบูรณ์

กลไกการสึกหรอระหว่างการทดสอบระหว่าง SAT กับ RWAT ค่อนข้างแตกต่างกัน ใน SAT
บริเวณเนื้อพื้นถูกขูดและหลุดออกมากกว่ายูเทคติกคาร์ไบด์ในช่วงแรก เมื่อปรากฏการณ์นี้ดำเนิน
ต่อไปรอยแตกเริ่มเกิดที่ยูเทคติกคาร์ไบด์ จึงทำให้คาร์ไบด์หลุดออกจากผิวชิ้นงาน ใน RWAT ผิวที่
ค่อนข้างเรียบในช่วงแรกของการสึกหรอ เมื่อการสึกหรอดำเนินต่อไปผิวขรุขระจากการสึกหรอจาก
ตัวขัดสี เนื้อพื้นถูกขูดมากกว่าบริเวณยูเทคติก จากนั้นบริเวณยูเทคติกได้ผิวที่สึกหรอจึงหลุดไป

ภาควิชา.....วิศวกรรมโลหการ.....ลายมือชื่อนิสิต.....อังศุ ไพฑูรย์.....
สาขาวิชา.....วิศวกรรมโลหการ.....ลายมือชื่อ อ.ที่ปรึกษาวิทยานิพนธ์หลัก.....
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KEY WORD : HYPOEUTECTIC 16% CHROMIUM CAST IRON / HEAT TREATMENT / MOLYBDINUM EFFECT / ABRASION WEAR TEST / WEAR MECHANISM

PHASIT AUNGSUPAITOON : ABRASION WEAR BEHAVIOR OF HYPOEUTECTIC 16 MASS% CHROMIUM CAST IRON CONTAINING MOLYBDINUM. ADVISOR : ASSOC. PROF. PRASONK SRICHAREONCHAI, CO-ADVISOR : PROF. YASUHIRO MATSUBARA, 122 pp.

Hypoeutectic 16 mass%Cr cast irons without and with Mo were prepared in order to investigate the abrasion wear behavior. After annealing, the cast irons were hardened from 1323 K and tempered at three levels of temperatures, before $H_{T_{max}}$ (B- $H_{T_{max}}$), at $H_{T_{max}}$ and over $H_{T_{max}}$ (O- $H_{T_{max}}$). The abrasion wear resistance was evaluated using Suga abrasion wear test (SAT) and Rubber wheel abrasion wear test (RWAT).

In the tempered state, hardness curve showed a secondary hardening due to the precipitation of secondary carbides and the transformation of destabilized austenite retained after hardening into martensite. The degree of secondary hardening was high in Mo containing specimen. The volume fraction of retained austenite (V_{γ}) decreased remarkably as the tempering temperature was increased. The V_{γ} value at $H_{T_{max}}$ was less than 6%.

A linear relation was obtained between wear loss and wear distance. The lowest wear rate (R_w) was obtained in the $H_{T_{max}}$ specimen for SAT and in the as-hardened (As-H) specimen for RWAT. The highest R_w was obtained in the O- $H_{T_{max}}$ specimen. Under the same heat treatment condition, the R_w in SAT was much larger than that in RWAT. The R_w increased proportionally with an increase in the applied load and it decreased with an increase in the macro-hardness. The lowest R_w seems to be obtained in the specimen with certain amount of retained austenite, 15% V_{γ} for SAT and 10 to 15% V_{γ} for RWAT, respectively. In SAT, the R_w was lowered with increasing of Mo content, and the V_{γ} at the lowest R_w shifted to the high V_{γ} side. In RWAT, however, the R_w did not show a clear difference. An increase of cooling rate in the hardening by oil quench led to improve the wear resistance due to the perfect hardening.

The wear mechanism was quite different between SAT and RWAT. In SAT, at the early state, the matrix was preferably cut off or worn and removed more than the eutectic carbides. After this phenomenon continued, cracks occurred in the eutectic carbides and resultantly, spalling of carbides could take place. In RWAT, the surface was quite smooth at the beginning of wear. When wearing proceeded, the surface got uneven by wearing with abrasives. At this point, the primary matrix was worn more than the eutectic region. Then the eutectic areas projected from the worn surface were taken away.

Department : Metallurgical Engineering Student's Signature : *Wit Sornthum*
 Field of Study : Metallurgical Engineering Advisor's Signature : *Prasonk Srichareonchai*
 Academic Year : 2008 Co-Advisor's Signature : *Y. Matsubara*

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Contents

	Page
Abstract (Thai).....	iv
Abstract (English).....	v
Acknowledgements.....	vi
Contents.....	vii
List of Tables.....	x
List of Figures.....	xi
Chapter I Introduction.....	1
1.1 Background.....	1
1.2 Objective of Research.....	6
1.3 Advantages of Research.....	7
Chapter II Literature Survey.....	8
2.1 Solidification and Microstructure of High Chromium Cast Iron.....	8
2.2 Heat Treatment of High Chromium Cast Iron.....	16
2.2.1 Destabilization.....	17
2.2.2 Tempering.....	22
2.3 Abrasion Wear Resistance.....	23
Chapter III Experimental Procedure.....	39
3.1 Preparation of Test Specimens.....	39
3.2 Heat Treatment Procedure.....	41
3.2.1 Hardening.....	41
3.2.2 Tempering.....	41
3.3 Observation of Microstructure.....	42
3.3.1 Optical microscopy (OM).....	42
3.3.2 Scanning electron microscopy (SEM).....	43

	Page
3.3.3 Electron probe microanalysis (EPMA).....	43
3.4 Measurement of Hardness.....	43
3.5 Measurement of Volume Fraction of Austenite.....	44
3.5.1 Theory for measurement of austenite by X-ray diffraction method.....	44
3.5.2 Equipment and measuring condition.....	46
3.5.3 Calculation of volume fraction of retained austenite (V_{γ}).....	49
3.6 Abrasion Wear Tests.....	51
3.6.1 Suga wear test (Two-body-type abrasion wear).....	51
3.6.2 Rubber wheel wear test (Three-body-Type abrasion wear).....	51
3.7 Abrasives.....	53
3.7.1 Abrasive paper for Suga wear test.....	53
3.7.2 Silica sand for Rubber wheel wear test.....	53
3.7.3 Comparison of abrasive particle between Suga and Rubber wheel Abrasion wear tests.....	56
Chapter IV Experimental Results.....	58
4.1 Microstructure of Test specimens.....	58
4.1.1 As-cast state.....	58
4.1.2 Alloy distribution in as-cast specimens.....	60
4.1.3 As-hardened state.....	62
4.2 Effect of Heat Treatment Condition on Macro-hardness, Micro-hardness and Volume Fraction of Retained Austenite (V_{γ}).....	64
4.2.1 Characterization of as-cast specimens.....	64
4.2.2 Characterization of test pieces.....	64
4.3 Effect of Heat Treatment Condition and Mo Content on Wear Rate.....	65
4.3.1 Suga abrasion wear test (Two-body-type abrasion wear).....	67
4.3.2 Rubber wheel abrasion wear test (Three-body-type abrasion wear)....	72

	Page
Chapter V Discussions.....	78
5.1 Explanation of Abrasive wear.....	78
5.1.1 Mechanism of abrasion wear by a simple model.....	78
5.1.2 Comparison of abrasion wear tests.....	80
5.1.3 Effect of applied load on wear rate (R_w).....	85
5.2 Correlations between Wear Rate (R_w), Hardness, V_γ and Mo content.....	87
5.2.1 Relationship between wear rate (R_w) and hardness.....	87
5.2.2 Relationship between wear rate (R_w) and V_γ	88
5.2.3 Relationship between wear rate (R_w) and Mo content.....	90
5.3 Effect of Oil-quenching on Macro-hardness, Micro-hardness, V_γ and Wear rate (R_w) of Specimens with H_{Tmax}	93
5.4 Mechanism of Abrasive Wear.....	97
5.4.1 Suga wear test (Two-body-type abrasion wear).....	97
5.4.2 Rubber wheel wear test (Three-body-type abrasion wear).....	103
 Chapter VI Conclusions.....	 109
 References.....	 113
Appendix.....	118
Biography.....	122

List of Tables

Table	Page
3-1 Chemical composition of specimens.....	39
3-2 Heat treatment condition.....	41
3-3 Tempering temperature.....	41
3-4 List of etchants.....	43
3-5 Condition of X-ray diffraction method to measure the volume fraction of retained austenite.....	47
3-6 Comparison of size and angularity (aspect ratio) of the abrasive particles between 180 mesh SiC abrasive paper and SiO ₂ sand with AFS 60 grade...	57
4-1 Macro-hardness, micro-hardness and volume fraction of retained austenite (V_{γ}) in as-cast specimens.....	64
4-2 Macro-hardness, micro-hardness and volume fraction of retained austenite (V_{γ}) in heat-treated specimens for abrasion wear test.....	66
4-3 Total wear loss at 192 m of Suga abrasion wear test with a load of 1kg, for specimens with and without Mo.....	67
4-4 Wear rate (R_w) of Suga abrasion wear test with a load of 1kg for specimens with and without Mo.....	71
4-5 Total wear loss at 3143m of Rubber wheel abrasion wear test with a load of 8.7kg, for cast irons with and without Mo.....	76
4-6 Wear rate of Rubber wheel abrasion wear test with a load of 8.7kg, for cast irons with and without Mo.....	76
5-1 Comparison of absolute wear rate per unit area (mg/m^2) and the ratio of R_w between Suga abrasion wear test and Rubber wheel abrasion wear test. 1% Mo specimen.....	85
5-2 Heat treatment conditions of oil-quenched specimens.....	93

List of Figures

Figure	Page
2-1 Liquidus surface phase diagram of Fe-Cr-C system.....	9
2-2 Microphotographs of as-cast hypoeutectic high chromium cast irons.....	11
2-3 Deep-etched microstructures. a) M_3C carbides in 5% Cr and b) M_7C_3 carbides in 17% Cr cast irons, respectively.....	11
2-4 DTA cooling curves of 3% C-20% Cr cast iron with different Mo content....	14
2-5 Isothermal transformation diagrams of high Cr cast iron with 2.5%C-20%Cr-1%Mo; a) before and b) after destabilizing austenite: A= austenite; C= pearlite; F= ferrite; Ms= martensite start; Cs= secondary carbide.....	19
2-6 Solid-state isotherms of C-C-Fe system at 1000 °C.....	19
2-7 Influence of Cr content on the optimum hardening temperature in high chromium cast irons.....	20
2-8 Relationship among hardness, volume fraction of retained austenite and tempering temperature of 16% Cr cast irons with Mo. a) 1% Mo and b) 3% Mo.....	24
2-9 Effect of volume fraction of carbide on the overall hardness of white cast irons with different matrix structures.....	27
2-10 Effect of volume fraction of carbide on the abrasion rate of high chromium cast irons.....	27
2-11 Relationship between abrasion resistance and hardness of the two high chromium white cast irons.....	28
2-12 Relationship between mean jaw-plate weight loss(g) and volume fraction of retained austenite.....	31
2-13 Relationship between Jaw-plate weight loss and hardness.....	31
2-14 Relationship between mean high-stress abrasion pin weight loss (mg) and austenitizing temperature (°C) of 27%Cr cast iron. Data are also shown in the as-cast and as-tempered condition.....	32

2-15	Relationship between mean high-stress abrasion pin weight loss(mg) and tempering temperature($^{\circ}$ C) of 27%Cr cast iron.....	32
2-16	Relationship between pin weight loss and hardness.....	34
2-17	The relationship between wear rate and volume fraction of retained austenite (V_{γ}) of hypoeutectic 26% Cr cast irons.....	34
2-18	Weight loss after the wear test 773 K of 3%C-20%Cr cast irons with various Mo contents.....	35
2-19	Comparison of the abrasion performance results of specimens with different cooling method, fan-air-cooling(1A), oil-quenching(1B) and water-quenching(1C) on Pin-on-disc and Rubber abrasion wear tests. Pin-on-disc: 80 grit SiC abrasive paper, 53.7N load, 5.95m sliding distance; Rubber wheel abrasion wear test: 60 grit SiC abrasive particles, 56N load, 1270 revolutions test duration.....	35
2-20	Relationship between hardness, retained austenite, wear resistance and the austenitized temperature of specimen with cryogenic treatment and with non-cryogenic treatment.....	37
2-21	Accumulated ball mass losses under (a) dry-grinding condition and (b) wet-grinding condition.....	38
3-1	Process of making test pieces.....	40
3-2	Schematic drawing to select tempering temperatures.....	42
3-3	Photograph of special sample stage for retained austenite measurement by X-ray diffraction method.....	47
3-4	Effect of sample stage usage on diffraction pattern and volume fraction of retained austenite (V_{γ}) calculated.....	48
3-5	X-ray diffraction patterns of specimens with different volume fraction of retained austenite (V_{γ}): (a) 14.8%, (b) 20.8%, (c) 41.0%.....	50
3-6	Schematic drawing of Suga abrasion wear tester.....	52
3-7	Schematic drawing of rubber wheel abrasion wear tester.....	52
3-8	SEM microphotographs of abrasives for Suga abrasion wear test (180 mesh SiC abrasive paper).....	54

3-9	SEM microphotograph of silica sands of AFS 60 grade for Rubber wheel abrasion wear test.....	55
3-10	Schematic illustrations showing method to measure the aspect ratios of the abrasive particle of Suga and Rubber wheel wear tests.....	56
4-1	Microphotographs of as-cast specimens, without and with Mo by OM and SEM.....	59
4-2	SEM microphotographs and distribution of alloying elements by characteristic X-ray. As-cast state of specimens without and with Mo (By EPMA analysis).....	61
4-3	Microphotographs of as-hardened specimens without and with Mo, by OM and SEM.....	63
4-4	Relationship between wear loss and wear distance by Suga abrasion wear test with 1 Kg load. Specimen No.1 (0% Mo).....	68
4-5	Relationship between wear loss and wear distance by Suga abrasion wear test with 1 Kg load. Specimen No.2 (1% Mo).....	69
4-6	Relationship between wear loss and wear distance by Suga abrasion wear test with 1 Kg load. Specimen No.3 (3% Mo).....	70
4-7	Relationship between wear loss and wear distance by Rubber wheel abrasion wear test with 8.7 kg load. Specimen No.1 (0% Mo).....	73
4-8	Relationship between wear loss and wear distance by Rubber wheel abrasion wear test with 8.7 kg load. Specimen No.2 (1% Mo).....	74
4-9	Relationship between wear loss and wear distance by Rubber wheel abrasion wear test with 8.7 kg load. Specimen No.3 (3% Mo).....	75
5-1	Schematic drawing of model of abrasive wear by single grit.....	78
5-2	Schematic drawing of worn area by 1 stroke, forth and back (Suga abrasion wear test).....	81
5-3	Photograph of main portion wear testing by Rubber wheel abrasion wear tester.....	83
5-4	Schematic drawing showing Rubber wheel for Rubber wheel abrasion wear test.....	83

5-5	Relationship between wear rate (R_w) and applied load in 1% Mo specimen by Suga abrasion wear test.....	86
5-6	Relationship between wear rate (R_w) and macro-hardness of specimens without and with Mo, Suga abrasion wear test with a load of 1kg.....	89
5-7	Relationship between wear rate (R_w) and macro-hardness of specimens without and with Mo, Rubber wheel abrasion wear test with a load of 8.7 kg.....	89
5-8	Relationship between wear rate (R_w) and V_γ of specimens without and with Mo. Suga wear test with a load of 1kg.....	91
5-9	Relationship between wear rate (R_w) and V_γ of specimens without and with Mo. Rubber wheel wear test with a load of 8.7 kgf.....	91
5-10	Relationship between wear rate (R_w) and V_γ of specimens No.1, No.2 and No.3. Suga wear test with a load of 1 kg.....	92
5-11	Relationship between wear rate (R_w) and V_γ of specimens No.1, No.2 and No.3. Rubber wheel wear test with a load of 8.7 kgf.....	92
5-12	CCT diagram for 3.81%C -14.75%Cr – 2.5%Mo.....	95
5-13	Effect of oil quenching on macro-hardness and micro-hardness of specimens tempered at temperatures which give H_{Tmax}	96
5-14	Effect of oil-quenching on V_γ of specimens tempered at temperatures which give H_{Tmax}	96
5-15	Effect of oil-quenching on R_w by Suga and Rubber wheel abrasion wear tests of specimens tempered at temperatures which give H_{Tmax}	97
5-16	Cross-sectional structure of SiC abrasive paper on aluminum wheel for Suga abrasion wear test.....	98
5-17	SEM microphotographs of worn surfaces of 1%Mo specimens (No.2) with difference heat treatment condition. Suga abrasion wear test with a load of 1kg. (a) As-H specimen and (b) B- H_{Tmax} specimen. S:Scratching, G:Grooving, T:Tearing and P:Pitting.....	99

5-18	Cross-sectional microstructure longitudinal to wear direction to explain the progress of abrasion wear by Suga. (a) Early stage and (b) Final stage.....	101
5-19	Correspondence and comparison of (a) SEM microphotograph of worn surface and (b) Cross-sectional microstructure by OM perpendicular to wear direction. $H_{T_{max}}$ test piece of specimen No.2.....	102
5-20	SEM microphotographs of worn surfaces of 1%Mo specimens (No.2) with difference heat treatment condition. Rubber wheel abrasion wear test with a load of 8.7kg. and rolling speed of 120rpm.(a) As-H specimen and (b) B- $H_{T_{max}}$ specimen.....	104
5-21	Correspondence and comparison of (a) SEM structure of worn surface and (b) OM microstructure of cross-sectional near worn surface, perpendicular to the wear direction of $H_{T_{max}}$ specimen in Rubber wheel abrasion wear test.....	106
5-22	Schematic explanation of wear Mechanism by Rubber wheel abrasion wear test using cross-sectional microstructures longitudinal to wear direction. (a) stage 1, (b) stage 2, (c) stage 3 and (d) stage 4.....	107