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The Influence of Temperature and Cooling Media on the Tempering Gear Chain Process of Honda Supra Fit 2004 Motorcycles

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ABSTRACT: TheHondaSuprafit brand motorcycle gear chain is often damaged. In this study, the gear chain is tempered with variations in temperature and cooling media todetermine the effect on the hardness number. The tempering process is carried out by preheating at a temperature of 930 °C, holding time of 60 minutes, dipping into air cooling media, SAE 40 oil, salt solution and then reheating at various temperatures of 250 °C, 400 °C, 600 °C. The specimens were tested for hardness using the Vickers method, microstructure observations and chemical composition tests.The conclusion of the study is that the tempering temperature, the cooling media affect the surface hardness number and the microstructure of the Honda Suprafit motorcycle gear chain.

KEYWORDS: Motorcycle gear chain, Tempering temperature, Cooling media, Surface hardness number, Microstructure.

I. INTRODUCTION

Motorcycle Automotive Technologyincreasing rapidly along with the increase in motorcycle sales. Indonesia is the largest motorcycle user country in the world after China and India.Based on data published by AISI (Indonesian Motorcycle Industry Association) the number of motorcycle sales in Indonesia in 2018 was 6.363.108 units, while in 2019 it increased to 6.487.460 units [1].

Motorcycles that use a manual transmission system, spare parts that must be replaced frequently are the gear chain or sprocket. Gear chain serves as a transfer of rotation from the engine to the wheels. Replacement is done because the end of the gear chain is worn out due to friction with the chain. Therefore, to extend the service life, a high hardness and ductiliity of the gear chain is required.

Many studies have been carried out to improve the performance of the gear chain..Comparative research on the physical and mechanical properties of carburized AHM and ASPIRA sprockets has been carried out by [2]Pack carbrizing using carburizing mediacoconut shell charcoal, at the temperature 900^{0}C, soaking time 1 hour andcooled in free air. The results of the hardness test on the AHM sprocket are 950.8 HVN atASPIRA sprocket of 927.0 HVN. The research [3] analyze the improvement of the mechanical properties of materials imitation Suzuki gear chain, after the carburizing process, temperature variation (850-950^{0}C) with soaking time 7 hours, quenching media SAE 40engine oil gear chains. The hardness number increased by 49.21% and 7.64% higher than the hardness value of genuine Suzuki gear chain parts.

In addition to carburizing, heat treatment to improve the mechanical properties of the gear chain is the tempering process. Tempering is reheating between 150 – 650 °C, which aims to reduce hardness. In the tempering process the atoms will change into a stable mixture of ferrite and cementite phases. Changes in mechanical properties after tempering are, the number of hardness and tensile strength will decrease, ductility and toughness will increase. After tempering, cooling is carried out in air, which will result in changes in the metal microstructure [5].Research [4] analyzed the effect of tempering time on the strength and toughness of commercial steel. Preheating at a temperature of 1000 ºC for 45 minutes, cooled into oil. The tempering process was continued at 300 C with time variations of 1, 2, 3 and 4 hours. The test results show that the number of hardness, tensile strength and toughness does not change significantly with variations in tempering time

The effects of the tempering time on the characteristics and growth of carbides were investigated [6]. The results indicated that carbides in the experimental steels were obviously coarsened when the tempering time exceeded 4 hours. The

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dimension of the carbides increased, while the volume fraction decrease .

However, the process of tempering the imitation motorcycle gear chain from the Honda Type Supra Fit has not been widely published.

II. MATERIAL AND METHODS

The research material is a 2004 Supra Fit motorcycle gear chain. The gear chain is cut according to the hardness test standard (ASTM E92). The main equipment used is an electric heater, a hardness tester, a Scaning Electron Microscope (SEM-EDX) for microstructural observations and composition testing.

Gear chain cutting for making specimens by hand grinding. Specimen size (length, width, thickness) is: 5 mm x 5 mm x 2 mm, then flattened to facilitate testing.Before the microstructuretesting, the specimen is etched. Etching is the application of 600 ºC..

chemical reagents/etching on a flat sample surface to give rise to special appearances such as phase, grain boundaries, and certain microstructures. The etching process is carried out by mixing 1–5 ml of HNO3 with 100 ml of 95% alcohol then used to dip the specimen for a few seconds or up to 1 minute.

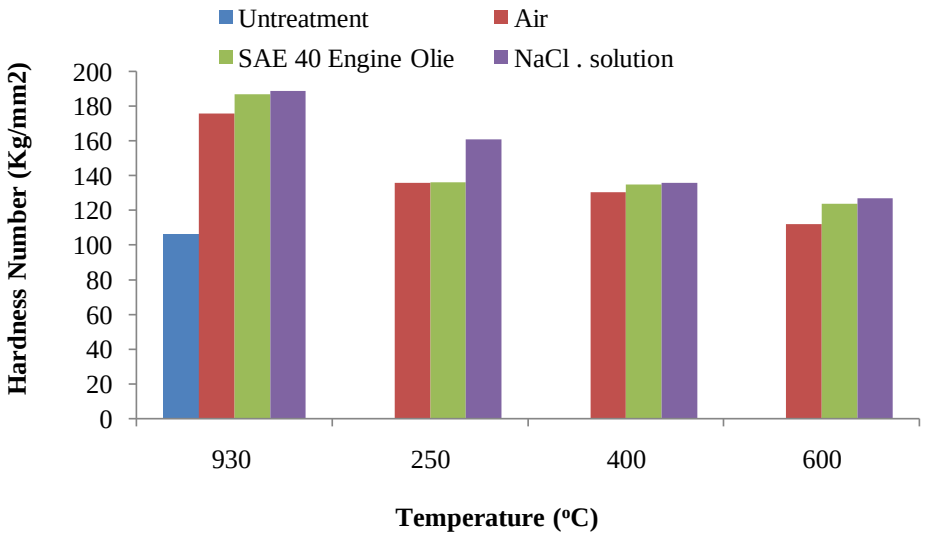
III. RESULTS AND DISCUSSIONS

The tempering process is carried out by preheating at a temperature of 900 °C, cooling with three variations of cooling media, namely: Air, SAE with temperature variations of 250 °C, 400 °C, and

THE HARDNESS OF GEAR CHAIN

Hardness test using the Vickers method.

In the Vickers hardness test, a diamond identor in the shape of a pyramid is used, with a load 10-100 Kg .



The hardness number of untreated specimens was 106, 27 Kg/mm². At the initial heating temperature of 930 ºC the hardness number increases according to the variation of the cooling medium. air cooling hardness number is 175, 85 Kg/mm², SAE 40 oil cooling medium 187.02 Kg/mm², salt solution cooling medium 188.84 Kg/mm².After the tempering process was carried out with three variations of temperature, the hardness number of the specimens decreased. The specimens were cooled using air cooling media, the hardness values were 135.93 Kg/mm², 130.32 Kg/mm², and 112.22 Kg/mm², respectively, according to the tempering temperatures of 250 ºC, 450 ºC, and 600 ºC. The specimens were cooled using cooling media oil SAE 40and then continued with the Tempering process using temperature variations, the higher hardness numbers were 136.07 Kg/mm², 134.95 Kg/mm², and 123.73 Kg/mm². Furthermore, cooling the specimens using a salt solution resulted in the highest hardness numbers, namely 160.82 Kg/mm², 135.81 Kg/mm² and 126.97 Kg/mm², respectively, corresponding to the tempering temperatures of 250 ºC, 450 ºC, and 600 ºC. The higher the tempering temperature, the harder the sessions will decrease. Cooling using a salt solution increases the hardness number the most drastically compared to. air and oil SAE 40 cooling media. The tempering temperature and cooling medium affect the hardness number of the

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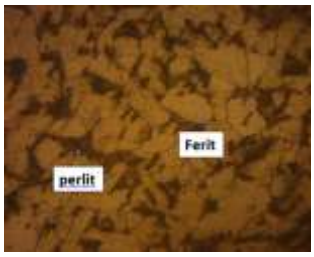
specimen.In accordance with the results of research on the effect of cooling media on mechanical properties and changes in microstructure [6, 7].

THE GEAR CHAIN MICROSTRUCTURE OBSERVATIONS

Observation of the gear chainmicrostructure after tempering treatment usingScanning Electron Microscope (SEM) merk ZEISS EVO, using a magnification of 400 x, The microstructure of specimens without heat treatment, dominated by ferrite and pearlite randomly with larger ferrite size and smaller pearlite. After preheating at a temperature of 930°C, cooling with air cooling medium, the microstructure of ferrite and pearlite are obtained which are both smaller in structure. Cooling with SAE 40 oil cooling medium obtained pearlite and ferrite microstructures with small shapes, with salt solution cooling media obtained more ferrite and pearlite microstructures. The ferrite structure is decreasing. Tempering at a temperature of 250°C obtained a microstructure dominated by ferrite and pearlite in a smaller form. Cooling with air cooling medium ferrite microstructure more, cooling with salt solution began to appear cementite structure.Tempering at a temperature of 400c, cooling with air cooling media obtained microstructures dominated by ferrite and pearlite in a smaller form, with SAE 40 oil cooling media obtained microstructures dominated by pearlite and ferrite in the same small form, with solution cooling media salt obtained a microstructure dominated by ferrite, pearlite and cementite structure appears.SAE 40 oil cooling medium obtained a microstructure dominated by pearlite and ferrite in the same small form. Cooling with continued salt solution cooling media obtained ferrite and pearlite.

	Cooling Media		
	Air	Olie SAE 40	Salt Solution
Heating 930 ºC			
Tempering 250 ºC			

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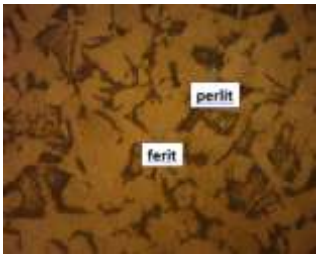
Tempering 400 ºC			
Tempering 600 ºC			

RESULTS OF THE COMPOSITIONTEST

SPECIMENT	ELEMENT	ATOM NO.	NETTO	MASS (%)	MASS NORM. (%)	ATOM (%)	ABS. ERROR (%) (1 SIGMA)	REL. ERROR (%) (1 SIGMA)
Untreatment	Fe	26	83799	102,45	96,42	85,26	3,04	2,97
	C	6	1189	3,81	3,58	14,74	0,85	22,26
Tempering 600 ºC	Fe	26	83239	98,33	95,67	82,63	2,92	2,97
	C	6	1446	4,45	4,33	17,37	0,94	21,08

The results of the chemical composition test of the specimen showed an increase, where the specimen that had undergone 600^0C Tempering had a mass of 9833%, normal mass 95.67%, atomic 82.63%, Abs error 2.92% in 1 sigma and rail error 2.97 % in one sigma of Fe content. While the carbon content (C) has a mass of 4.45%, normal mass 4.33%, atomic 17.37%, Abs error 0.94% in 1 sigma and rail error 21.08% in 1 sigma.The increase in carbon content causes an increase in the hardness number and decreases the ductility of the specimen, this is in accordance with the research results [2, 7].

IV. CONCLUSION

Preheating with a temperature of 930 ºC, cooling in air, the lowest hardness number is 175.85 Kg/mm². While quenching with salt solution the highest hardness number is 188.84 Kg/mm² compared to tempering. As the tempering temperature increases, the hardness number decreases. Tempering at temperature .temperature of 600°C, cooled using air cooling media, the hardness number becomes 112.22 Kg/mm². cooling with oil cooling media SAE 40 hardness number is 123.73 Kg/mm². andn using a salt solution cooling medium, the hardness number is. 126.93 Kg/mm².

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