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Edited by: **Mohd Fadzli Bin Abdollah**

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Preface by Editor-in-Chief

This open access e-proceedings contains a compilation of 234 selected papers from the 6th Asia International Conference on Tribology (ASIATRIB2018) that was held in Kuching, Sarawak, Malaysia, from 17 to 20 September 2018.

ASIATRIB is the mega event in the series of International Tribology Conferences under the auspices of the Asian Tribology Council (ATC), the apex body of national tribology society of Asia-Pacific countries such as China, South Korea, Japan, Australia, India, Malaysia, Taiwan and others. This conference is organized every four years with the great involvements from the various universities and major industry players. This year, ASIATRIB celebrates its 20th anniversary since its inception in 1998. Malaysia for the first time has been given the opportunity to host the ASIATRIB and become the first South-east Asian country to host this event. ASIATRIB2018 is organized by Malaysian Tribology Society (MYTRIBOS).

The call for papers attracted more than 300 submissions from different countries and continents. All submitted papers are then peer-reviewed, revised according to the reviewers' comments and ultimately 234 papers were accepted for publication in this proceedings. This open access e-proceedings can be viewed or downloaded via www.mytribos.org/proceedings/asiatrib2018. I hope that this proceedings will serve as a valuable reference for tribologists.

With the large number of submissions, the conference has achieved its main objective which is to bring together academicians, researchers, students, authorities, and practitioners from universities, industries, institutions, and related agencies to share their findings through oral and poster presentations. Thus, promoting new opportunities for research activities and enhancement. In addition, there is an opportunity for participants especially young researchers and students to enhance research network with established and renowned tribologists from local and abroad in the respective field in the quests to get new experiences, exchange research ideas, and build rapport through informal discussions.

As the editor-in-chief, I would like to express my gratitude to the fellow review members for their tireless effort in reviewing the submitted papers for this proceeding. I also would like to say special thanks to all the authors for promptly revising their papers according to the proceeding requirements. Finally, I would like to express my deepest gratitude to all sponsors for the support given in ensuring the success of this conference.

Thank you

Mohd Fadzli Bin Abdollah

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Measurement of film thickness of lubricant using ultraviolet induced fluorescence method

K. Koshiba*, T. Iwai, J. Rahman, Y. Shoukaku

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Keywords: Fluorescence; ultraviolet light; water film thickness; tire

ABSTRACT – Fluorescence method is used to measure the lubricant film thickness between two surfaces of glass pieces. The fluorescence intensity was obtained though the irradiated UV ray on pyranine solution. As a result, the relationship between fluorescence intensity and film thickness was obtained. Newton's rings interference fringes created by plano-convex lens contacted flat glass plate. It was used to calibrate the gap.

1. INTRODUCTION

Recently, the tire labeling system in Japan is evaluated to apply tire's low fuel consumption and brake performance on the wet road surface. These performance on wet road surface is largely influenced by the thickness of water film between tread rubber tire and road surface. However, there are not many reports about the measurement method for this purpose. Therefore, Ultraviolet induced fluorescence method expected to be able to provide accurate measurement method between two surfaces.

2. METHODOLOGY

Figure 1 is the schematic of optical system used in this experiment. In this apparatus, plano-convex lens was attached on balanced arm and the top of lens was in contact with flat glass plate. In addition, the arm can be applied a constant load. Pyranine aqueous solution is fluoresced by irradiating ultraviolet ray. In this experiment, it was used as any water film. it was measured the fluorescence intensity of pyranine aqueous solution filled in the gap between two pieces. As a result, it was determined the relationship with each element.

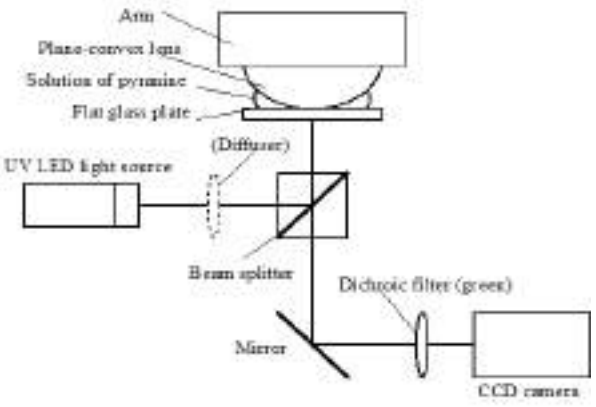

Figure 1 Schematic of optical system.

About experimental conditions, the curvature radius of plane-convex lens attached to the arm is 20.76 mm. The bore diameter of this lens is 20 mm. Flat glass plate is 25 mm square and 3 mm thick. Both specimens are made of BK7 (borosilicate glass) and shape accuracy is better than λ. In each experiment, the arm was applied a constant load. Temperature on this experiment was 23℃, in the dark.

3. RESULTS AND DISCUSSION

It was possible to change the gap between two surfaces to change the load to plano-convex lens attached the arm. Therefore, it was decided the relationship between water film thickness and fluorescence intensity of pyranine aqueous solution in this experiment.

It was determined the gap between plano-convex lens and flat glass plate applied elastic contact theory of Hertz. The contact circle radius a was obtained by the equation (1) (defined load to the arm w, radius of curvature R, Poisson's ratio v, and Young's modulus E).

$$a = \left\{\frac{3}{4} wR\left(\frac{1-{\nu_1}^2}{E_1} + \frac{1-{\nu_2}^2}{E_2}\right)\right\}^{1/3} \quad (1)$$

In addition to this radius a, it was decided the gap between two pieces applied distance x from the center of contact circle in this experiment. Next, it was studied the relationship between the gap and fluorescence intensity. The gap h between plane-convex lens and flat glass plate was obtained by the Equation (2) (Figure 2).

$$h = \sqrt{R^2 - a^2} - \sqrt{R^2 - x^2} \quad (2)$$

Results are shown in Figure 3. It was understood that even when the load was changed, almost the same fluorescence intensity was exhibited at the same film thickness. Therefore, it was possible to measure water film thickness between two pieces by the relationship between the gap and the fluorescence intensity of lubricant film using the ultraviolet light induced fluorescence method with pyranine aqueous solution.

Table1 Numerical of theoretical contact circle radius.

Load, N	Theoretical contact circle radius, mm
9.9	0.153
20.0	0.194
29.9	0.222

In the above description, contact circle radius was decided from Hertz theory Equation (1) and determined the gap between plano-convex lens and flat glass plate by Equation (2). However, elastic deformation of lens and plate was occurred by applying the load. It affected the

outside of contact circle surface, so it might affect the equation that the gap between two surfaces was decided. Therefore, it decided to use the method of Newton rings because it was possible to measure the gap between two pieces by reading interference fringes of Newton rings observed by sodium lamp. From observation, it was analyzed the relationship between fluorescence intensity and its gap as water film thickness. As a result, it was possible to get the relationship between fluorescence intensity and water film thickness.

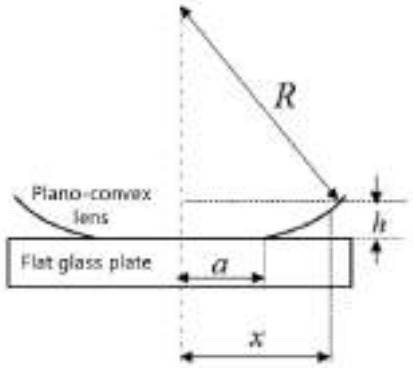

Figure 2 Clearance gap between plano-convex lens and flat glass plate.

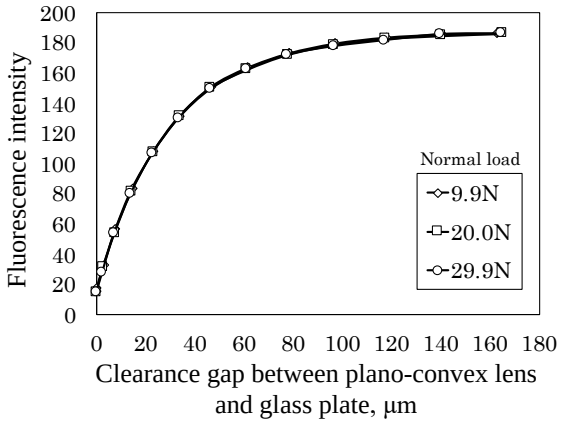

Figure 3 Relationship between fluorescence intensity and clearance gap.

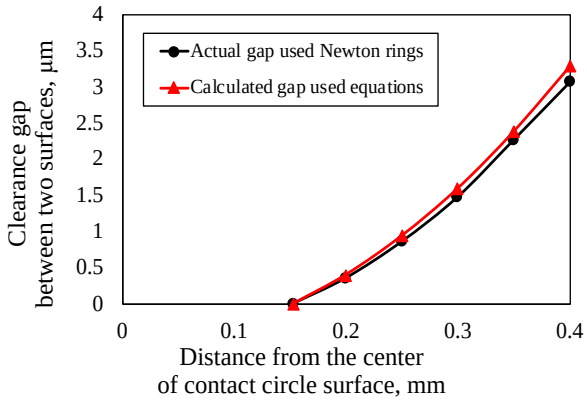

Figure 4 Relationship between distance from the center of elastic contact circle surface and clearance gap.

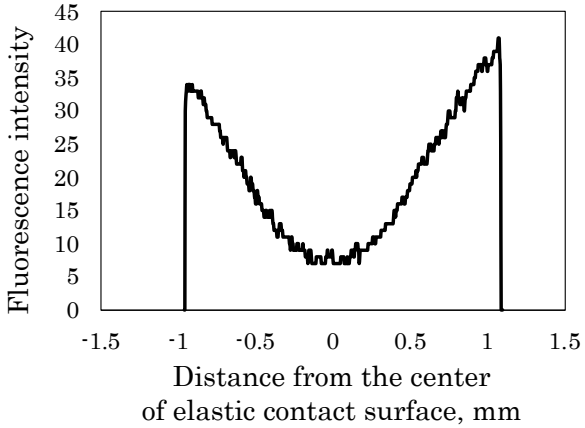

Figure 5 Relationship between fluorescence intensity and distance from the center of elastic contact surface.

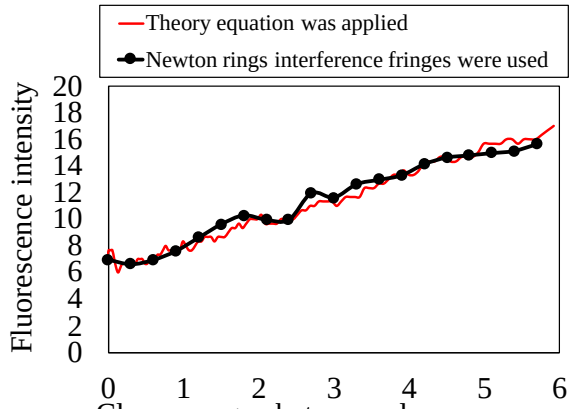

Figure 6 Relationship between fluorescence intensity and clearance gap.

4. CONCLUSIONS

It was possible to measure liquid film thickness between plano-convex lens and flat glass plate by ultraviolet induced fluorescence method with pyranine aqueous solution from the relationship between fluorescence intensity and its gap as water film thickness.

It was determined the relationship between fluorescence intensity of pyranine aqueous solution and water film thickness by Newton rings interference fringes method, created by two surfaces was applied to calibrate the gap.

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