EFFECTS OF TANNIC ACID INDUCED COMPLEX FILMS ON TRIBOLOGICAL PROPERTIES BETWEEN RAIL AND WHEEL IN RAILWAYS

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Coatings; Tribofilms and 3rd bodies; Green tribology; Railways

ABSTRACT
In late autumn, wheel idling, which may cause transport obstacles, often occurs in mountainous areas on Japanese railways. The wheel slip can be caused by low adhesion condition between the wheel and rail due to fallen leaves [1, 2]. Our previous research has indicated that black films formed by fallen leaves appear on railheads in mountainous areas in late autumn. Further, the formation of the black films was considered because of the reaction (formation of tannic acid-iron complex films) between tannic acid, which is contained in leaves, and iron components in rail under wet conditions such as rain and dew [1]. However, it is not clear whether tannic acid-iron complex films contribute to friction reduction. Therefore, this study focuses on the tribological properties of tannic acid-iron complex films.

In this paper, rolling-sliding friction tests were conducted with twin disc under the condition of dripping distilled water onto the contact zone. The discs were cut from the actual wheel and rail. Before the tests, the rail discs were immersed in a tannic acid solution for several hours. The tannic acid-iron complex films existed on the friction surfaces of the discs after immersion. Figure. 1 show variations in the traction coefficient as a function of time for 50 seconds. Note that about 2 seconds from the start of the test is the acceleration time of the motor, and no tangential force is generated. Both specimens with immersion show lower adhesion than those without immersion.

Plate specimens were cut from the actual rails and immersed in the solution. After immersion, the specimens were subjected to surface roughness *Ra* measurement and wettability evaluation using a contact angle meter. The contact angle is smaller than that of a specimen of similar roughness without immersion, indicating that the immersed surface is hydrophilic (Fig. 2).

Tannic acid has numerous hydroxy groups, some of which are known to form complexes with iron ions [3]. Therefore, the friction surface after immersion in tannic acid solution has a hydrophilic surface with hydroxy groups, which is thought to have resulted in low adhesion under water lubrication.

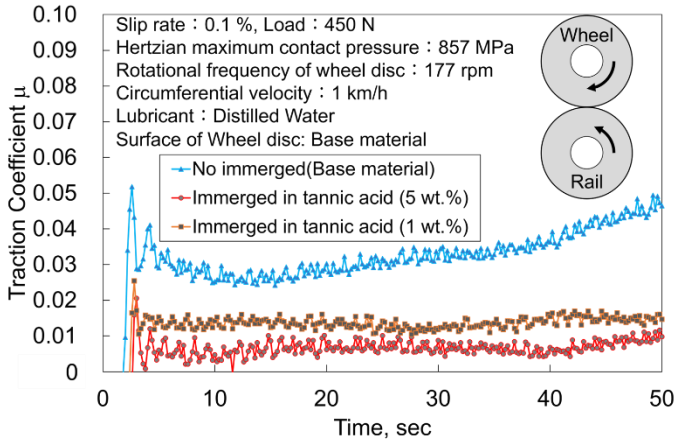

Fig. 1 Variations in the traction coefficient as a function of time for 50 seconds.

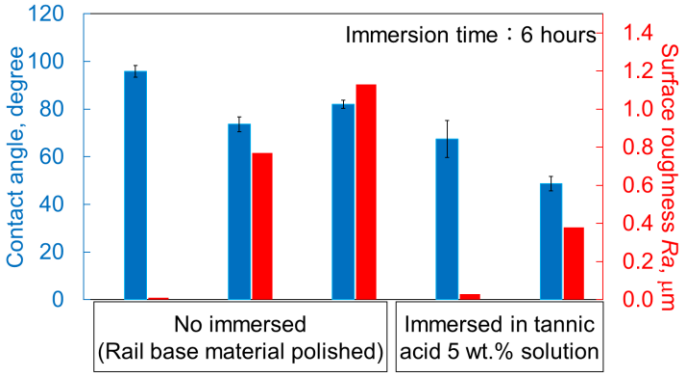

Fig. 2 Contact angle measurement results of rail specimen after immersion tests.

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