



Effect of chemical compounds in tidal water on asphalt pavement mixture

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Abstract

Roads along North coastal area of Java Island (Indonesia) often receive special attention due to their bad performance as a result of the presence of tidal inundation. Past researches indicated that the tidal water was a compound of chloride and sulfate with different concentrations from one location to another, and together they had an adverse effect on the road pavement. Unfortunately, the detailed information of the effect of each chemical compound on the pavement performance was still unexplainable. To examine the effect of each compound on the mixture, a simulation was conducted in this study by soaking samples of asphalt mixture continuously and intermittently (in wet-and-dry cycle) in solutions of chloride with different concentrations. For comparison, the results were evaluated against those of the mixtures immersed in fresh water and real tidal inundation collected from three different places along North coastal area of Java Island. The results showed that chloride may be the main contributor to damage the mixtures, however, a combination of chemical compounds and interaction of them had a more significant contribution to cause damage.

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Keywords: Asphalt mixture; Tidal water; Chemical compound; Soaking

1. Introduction

Road pavement condition generally declines over the period due to the effect of traffic loads and moisture. Many studies have been conducted on the influence of moisture against the rate and level of pavement damage [1–3] and they agreed that the moisture has a significant contribution to the functional damage, such as stripping and advanced moisture damage in road pavements can lead to rutting, shoving, corrugations, fatigue cracking, raveling, flushing, and potholes. In most cases, the moisture-related pavement damage is generally caused by lack of pavement drainage facilities in managing rainfall, including inappropriate

design of roadway superelevation and insufficiency of drainage system capacity. In coastal regions, another threat to road pavement also comes from tidal inundation, i.e. a phenomenon of overflow of mainland caused by poor drainage system and the occurrence of land subsidence. The presence of tidal water has a higher impact on the mixture because it contains a high level of sulfate (SO_4^-), sodium (Na^+) and chloride (Cl^-) with the following typical composition: chloride (55%), sodium (31%), and sulfate (8%) [4]. The level of damage of salts will cause to a road depends upon the type and concentration of salt [5] and it is believed that the moisture-induced damage potential of asphalt mixture due to tidal water is higher than that of rainwater [6]. The salt, after evaporation, accumulated on the surface of asphalt pavement can damage to asphalt materials due to erosion and crystal formation after dehydration [7].

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Tidal inundation is also very common to be found in several cities on the North Coast of Java Island, Indonesia, such as Jakarta and Semarang (Central Java Province) (see Fig. 1), and it could soak the roads in hours or days. In Semarang (located at coordinate 6°58'S 110°25'E), roads that suffered by tidal inundation generally are asphalt pavements that use asphaltic concrete (AC) as asphalt mixture. It is suspected that the use of this kind of mixture, which has less asphalt in the mixture, tends to be less durable [8], contributing to the damage due to tidal wave.

Setiadji et al. [9] stated that under soaking condition, water pressure could be one of the main causes of strength loss of the mixtures; however, the damage of the mixture could be also contributed by certain chemical compounds (at sufficient amounts) in tidal water. The compounds in the water can be found differently between one area and another, depending on the kind of wastes (produced by

activities at surroundings such as industrial and residential) that mix with sea water that overflows into mainland. The aim of this study was to evaluate the effect of certain chemical compounds at different amounts against durability of asphalt mixture. To do so, several amounts of certain chemical compound (chloride in this case) were proposed as immersion media for samples of asphalt mixture. Tidal waters from three different areas in Semarang city were collected as comparison media. They are tidal waters from Tanjung Emas, Ronggowarsito and Terboyo areas (see Fig. 1), each area representing different land uses. It is expected from this study that the information of chemical content in tidal water could be discovered in a better way, so further studies on the development of materials for the asphalt pavement with high resistance to the effects of these chemicals can be done more comprehensively.

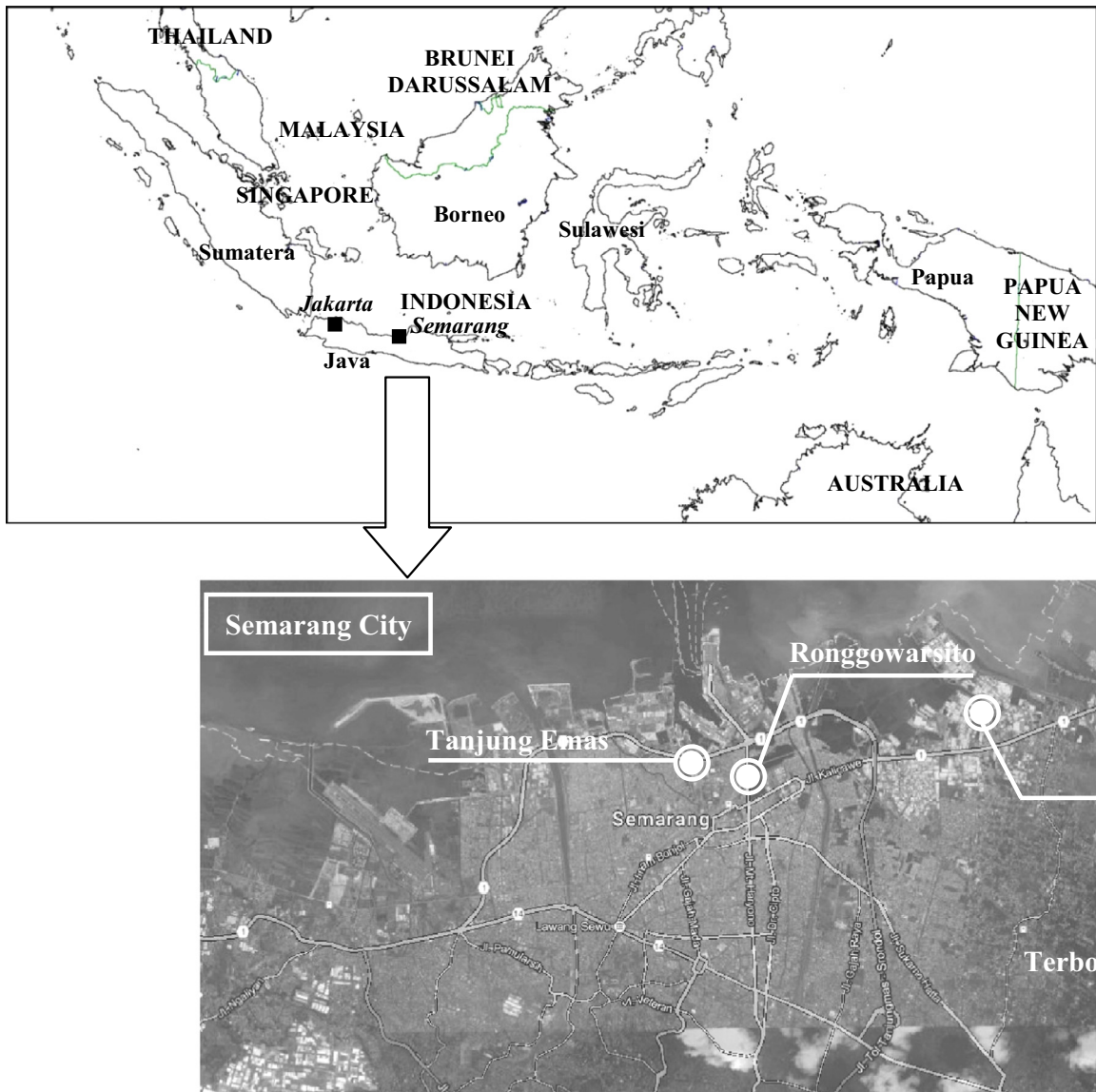


Fig. 1. Location of Semarang city and sampling area.

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