INTISARI

Sistem *nonballasted track* kereta cepat terdiri dari *prefabricated concrete slab* yang diikat kuat pada *concrete base* menggunakan *interlayer cement asphalt mortar* (CAM), juga berperan sebagai *damping layer*. Ada dua tipe CAM yang dapat digunakan yaitu CAM modulus elastisitas tinggi (E-tinggi) atau CAM modulus elastis rendah (E-rendah). Beberapa penelitian mengungkapkan adanya masalah kegagalan lekatan *interface* CAM dan penurunan redaman pada CAM. Polimer *styrene butadiene rubber* (SBR) diusulkan untuk meningkatkan lekatan *interface* CAM, serbuk karet diusulkan untuk meningkatkan sifat redaman CAM. Selain itu serbuk aluminium diusulkan sebagai *expansive agent*. Penelitian ini bertujuan mengkaji pengaruh polimer *styrene butadiene rubber* (SBR), serbuk karet dan serbuk aluminium pada karakteristik kompatibilitas, *workability*, mekanik, redaman dan lekatan *interface* pada kedua tipe CAM.

CAM tersusun dari material semen, aspal emulsi, agregat halus dan bahan tambah. Polimer SBR digunakan sebagai bahan tambah pada CAM, serbuk karet digunakan sebagai substitusi agregat halus dan serbuk aluminium sebagai *expansive agent*. Penelitian diawali dengan mengkaji pengaruh nila pH polimer SBR terhadap kompatibilitas aspal emulsi dengan semen pada CAM, kemudian dilakukan kajian pengaruh dosis polimer SBR, dosis serbuk karet dan serbuk aluminium pada karakteristik *workability*, mekanik, redaman dan lekatan *interface* CAM E-tinggi maupun CAM E-rendah. Kompatibilitas aspal emulsi dengan semen dikaji berdasarkan *separation rate*. *Workability* dikaji berdasarkan *funnel fluidity time* dan *slump flow time CAM*. Sifat mekanik dikaji berdasarkan kuat tekan dan kuat lentur CAM. Karekteristik redaman CAM dikaji berdasarkan rasio redaman. Karakteristik lekatan *interface* CAM dikaji berdasarkan waktu kegagalan *debonding interface* CAM akibat beban lentur, kuat lentur komposit beton dengan CAM dan *shear bonding strength* akibat beban geser pada komposit beton dengan CAM.

Berdasarkan hasil kajian disampaikan bahwa polimer SBR pada nilai pH 10,0 menghasilkan kompatibilitas aspal emulsi dengan semen pada CAM. Peningkatan dosis polimer SBR 4%, 5%, dan 6% menghasilkan peningkatan *workablity* dan karakteristik mekanik CAM E-tinggi, sedangkan pada CAM E-rendah *workability* meningkat namun karakteristik mekanik menurun. Serbuk karet menghasilkan penurunan *workability* dan karakteristik mekanik CAM E-tinggi maupun CAM E-rendah, namun pada dosis serbuk karet 10% penurunannya relatif tidak signifikan. Peningkatan dosis polimer SBR 4%, 5%, 6% dan serbuk karet 10% menghasilkan peningkatan rasio redaman CAM E-tinggi maupun CAM E-rendah. Serbuk karet 10% menghasilkan penurunan karakteristik lekatan *interface* CAM E-tinggi maupun CAM E-rendah. Peningkatan dosis polimer SBR sampai 6% tidak signifikan menghasilkan peningkatan karakteristik lekatan *interface* CAM E-tinggi maupun CAM E-rendah. Pada dosis serbuk aluminium 0,017% signifikan menghasilkan peningkatan karakteristik lekatan *interface* CAM E-tinggi maupun CAM E-rendah. Berdasarkan hasil penelitian disampaikan bahwa dalam pembuatan CAM E-tinggi menggunakan rasio aspal emulsi terhadap semen (AE/C) 0,2 dan CAM E-rendah menggunakan AE/C 0,6 masing-masing dengan bahan tambah polimer SBR pH 10,0 dosis 5%, serbuk karet dosis 10% dan serbuk aluminium dosis 0,017% menghasilkan karakteristik optimum kompatibilitas, *workability*, mekanik, redaman dan lekatan *interface* CAM.

Kata kunci : *nonballasted track*, *cement asphalt mortar*, *styrene butadiene rubber*, serbuk karet, kompatibilitas, *workability*, redaman CAM, lekatan *interface* CAM

ABSTRACT

The non-ballasted track system of a high-speed train consists of prefabricated concrete slabs firmly bonded to the concrete base using cement asphalt mortar (CAM) interlayer. Apart from that, the primary purpose of CAM is to provide a damping layer. Two types of CAM exist, one with a high elastic modulus of CAM (high-E) and the other with a low elastic modulus of CAM (low-E). Several studies reported problems with the failure of CAM interface bonds and decreased damping in both types of CAM. Styrene butadiene rubber (SBR) polymer is proposed as a material to increase the adhesion of the CAM interface, rubber powder is proposed as a material to increase the damping properties of CAM, and aluminium powder is used as an expanding agent. This research aims to study the effect of styrene butadiene rubber (SBR) polymer, rubber powder, and aluminium powder used as an expansive agent on workability, the mechanical characteristics, damping, and interface bonding of both types of CAM as interlayers on non-ballasted track in a high-speed train.

Cement asphalt mortar comprises cement, asphalt emulsion, fine aggregate, and additives. SBR polymer is used as an admixture in CAM, rubber powder is used as a fine substitute aggregate, and aluminium powder is used as an expansive material. The research began by examining the effect of the pH value of SBR polymer on the compatibility of asphalt emulsion with cement in CAM. Then a study was carried out on the effect of SBR polymer dosage, rubber powder dosage, and aluminium powder dosage on the workability, mechanical, damping, and interfacial adhesion characteristics of high-E CAM and E-CAM. low. The compatibility of emulsified asphalt with cement is determined based on the degree of separation. Workability is assessed based on funnel fluidity time and CAM slump flow time. The mechanical properties were studied based on the CAM's compressive and flexural strengths. CAM damping characteristics are studied based on the damping ratio. The bonding characteristics of the CAM interface were studied based on the failure time of CAM interface debonding due to bending loads, flexural strength of concrete composite with CAM and shear bond strength due to shear loads in concrete composites with CAM.

Based on the study's results, it was stated that SBR polymer at a pH value of 10.0 produces compatibility of asphalt emulsion with cement in CAM. Increasing the SBR polymer dosage of 4%, 5%, and 6% resulted in increased workability and mechanical characteristics of high-E CAM, whereas for low-E CAM, workability increased, but mechanical characteristics decreased. Rubber powder decreased the workability and mechanical characteristics of high-E CAM and low-E CAM; however, the decrease was relatively insignificant at a dose of 10% rubber powder. Increasing the dosage of SBR polymer by 4%, 5%, 6%, and 10% of rubber powder increased the damping ratio of both high-E CAM and low-E CAM. 10% rubber powder decreased the interface bond characteristics of the high-E CAM and low-E CAM. Increasing the SBR polymer dosage to 6% is not significantly increase the interface bond characteristics of the high-E CAM and low-E CAM. A dose of 0.017% aluminium powder resulted in a significant increase in the interface bond characteristics of the high-E CAM and low-E CAM. The research results stated that in making high-E CAM, the ratio of asphalt emulsion to cement (AE/C) was 0.2, and low-E CAM used AE/C 0.6, respectively, with the added material SBR polymer pH 10.0 dose. 5%, 10% rubber powder, and 0.017% aluminium powder produce optimum characteristics of compatibility, workability, mechanics, damping, and interface bond of the CAM interface.

Keywords: non-ballasted track, cement asphalt mortar, SBR polymer, styrene-butadiene rubber, rubber powder, aluminium powder, compatibility, workability, damping, interface bond.