

THE EFFECT OF ASPHALT REPLACEMENT WITH LDPE (LOW DENSITY POLYETHYLENE) PLASTIC WASTE IN AC-BC ASPHALT MIX ON MARSHALL CHARACTERISTICS

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ABSTRACT

The increasing volume of Low Density Polyethylene (LDPE) plastic waste in Indonesia has highlighted the need for environmentally friendly innovations in road pavement materials. This study aims to evaluate the effect of substituting LDPE plastic waste (plastic shopping bags and plastic cups) on the characteristics of Asphalt Concrete-Binder Course (AC-BC) mixtures. The method used was a laboratory experiment with Marshall testing referring to the 2018 General Specifications of the Directorate General of Highways (Bina Marga), using 60/70 penetration asphalt with LDPE content variations of 2.5%, 5%, 7.5%, 10%, 12.5%, and 15% by weight of asphalt through a wet mixing process. Testing of the base materials (coarse aggregate, fine aggregate, filler, and asphalt) met all specification requirements. The Optimum Asphalt Content (OAC) was obtained at 5.5%. The addition of LDPE significantly increased stability (plastic bags up to 2214 kg at 10%; plastic cups up to 2057 kg at 12.5%) due to the increased viscosity of the asphalt, but caused VIM and VMA to increase and VFA to decrease because the asphalt became less able to flow and fill the voids between aggregates. The flow value of plastic bags dropped sharply at high content, failing to meet the specification, while plastic cups remained within the safe range. The Marshall Quotient (MQ) increased but was not a limiting parameter. Based on the overall Marshall parameters, the optimum substitution content of LDPE plastic waste (both plastic bags and plastic cups) in the AC-BC mixture was set at 2.5%, as at this content all parameters still met the specifications with the best balance between strength, flexibility, and ease of mixing. This research provides a sustainable solution for reducing plastic waste in Indonesia.

Keywords: LDPE, AC-BC, Marshall, plastic waste, optimum asphalt content