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Influence of Iron-Filings on Marshall and Volumetric Properties of Asphalt Concrete

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Abstract

The growth and expansion of road infrastructure had resulted in the continuous use of materials, increased construction costs of flexible pavements and increased environmental impact during the service life of the road. Consequently, many researchers have sought to use methods to maintain these roadways sustain environmental impact and traffic loads. One of these approaches is the use of additives to improve asphalt's volumetric character. In this research, iron filings were used as partial replacement of fine aggregates, and the Marshall and volumetric properties were assessed before and after the implementation of iron filings. Specimens were prepared with iron filings addition of (2, 4, 6 and 8%) by weight of fine aggregates. The Marshall mix design procedure was used to calculate the optimum asphalt content and the volumetric properties, including bulk density, Total voids, voids in mineral aggregates V.M.A., and voids filled with asphalt V.F.A. The Marshall Flow and Stability were calculated. Test results were assessed before and after the inclusion of the iron filings. It was concluded that the addition of iron filings can enhance the Marshall and volumetric properties of asphalt. The stability increased by 15% when replacing fine aggregates by 2%, of iron filings by total weight. Also, the air voids and the VMA decreased by increasing the percentage of iron filings, while VFA was not significantly affected as compared to the conventional specimen. The ideal ratio of iron filings which fulfill the optimal requirements was 5%.

Keywords: Iron Filings; Volumetric Properties; Marshall; Stability; Flow; Mix Design.

1. Introduction

The advancement in material technology to support the sustainability in infrastructure design and construction has brought research work into focus. The major issue is to reserve the materials resources, reuse of reclaimed materials, reduce the need for energy, and improve the quality of the materials. One of the sustainable technologies is the use of iron scrap left in city-scattered iron-workshops. Disposal of iron filings is hazardous to the environment and proper disposal is difficult. Furthermore, iron filings can establish the self-repairing property for concrete due to their temperature conductivity. Many research studies have investigated the impact of incorporating iron waste on the quality of the flexible pavement. Jendia et al. (2016) [1] studied the effect of adding steel wool SW to the asphalt concrete. Steel wool S.W. was added by (3.5 and 7%) by weight of the asphalt to 20 samples. Volumetric, stability, and crawl characteristics of asphalt were calculated, as well as a study of its effect on the conductivity of asphalt and the extent of its effect on the self-healing property of asphalt. It was concluded that the rate of 5% of S.W. had improved the conductivity of the asphalt.

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