



Effects of Ignition Oven Method on Aggregate Degradation in Asphalt Mixtures

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Abstract

The binder content of an asphalt mixture is a critical factor affecting the quality of the mix. The ignition oven is one widely used method for determining the binder content owing to its relatively fast test time and avoidance of the use of hazardous chemicals. However various findings conclude that ignition oven method may cause aggregate degradation and thereby change the physical characteristics of some aggregates. This paper investigates the factors that lead to the aggregate degradation during the ignition oven process.

Keywords: Binder content, asphalt extraction, ignition oven, aggregate degradation

1. Introduction

Asphalt content as binder is often the most expensive fraction in the HMA mixtures, which is critical to their performance, affecting the pavement's tendency for permanent deformation, fatigue life and susceptibility to moisture damage. Therefore, the measurement of asphalt content of HMA mixture is a fundamentally important test for manufactures, contractors, researchers, and regulatory authorities [1,2]. The solvent extraction method was predominantly used in the past to determine the binder content and aggregate gradation using trichloroethylene. However its use resulted in numerous environmental problems and hence alternative means for determining the binder content and aggregate gradation were explored. The Nuclear content gauge rapidly measured the binder content of asphalt mix but provides no information on the aggregate gradation. Biodegradable solvents were not as effective as trichloroethane and were expensive. The ignition furnace with its relatively fast test time and avoidance of the use of hazardous chemicals offered an effective and economical solution [3].

But the ignition furnace method has its own drawbacks. Various findings have indicated that ignition furnace method may cause aggregate degradation and thereby change the physical characteristics of some aggregates [4]. This study

aims to investigate the possible reasons for the aggregate degradation when subjected to Ignition oven method.

It is assumed that the degradation of aggregate is mainly due to:

1. Extremely high temperature condition during the heating process which may not only burn asphalt binder away from the mixture but also cause the aggregate particles to break into smaller pieces.
2. The aggregates might have undergone some disintegration from the process of compaction.

2. Materials

Limestone aggregates, obtained from the local sources are used for this test and the binder used in the study corresponds to Pen 60/70.

3. Research Method

A series of lab testing was conducted on the aggregate mixtures with and without asphalt binder and also using Marshall compaction in order to test the assumed reasons for the aggregate degradation when using the ignition furnace. The test procedure used is ASTM D6307 - 10 Standard Test Method for Asphalt Content of Hot-Mix Asphalt by Ignition Method followed by gradation analysis as per AASHTO T 27.

The experimental set up consists of three tests which are as follows:

- Test1: Fresh aggregates (known gradation) are oven dried to constant mass at $110\pm 5^{\circ}\text{C}$ and tested in the Ignition oven at $540\pm 5^{\circ}\text{C}$ furnace temperature. The ignition test is carried out for a period of 1 hour because it is the test time noted during the process of determining the correction factor for the Ignition oven method. The extracted aggregates are then checked for gradation.