

Effects of Temperature and Compaction Effort on Field and Lab Densification of HMA

Robert L. Schmitt¹, Carl M. Johnson², Hussain U. Bahia³, and Andrew Hanz²

Abstract

The objectives of this study are to evaluate the effect of compaction effort and temperature on densification of HMA in the field and in the lab. The field study investigated the minimum limiting temperatures at which 92% G_{mm} field density can be achieved with commonly used compaction effort. The lab study was conducted to determine if a relationship similar to the field can be found for lab compaction using varying temperatures and compaction pressures. To accomplish these objectives, field testing and loose-mix sampling occurred on 22 unique construction projects, totaling 30 unique layers of HMA during the 2007 paving season. Field data recorded included nuclear density, core density, temperature, roller passes, roller type, and vibratory setting. Loose-mix samples from the construction projects were compacted in the Superpave Gyrotory compactor at two pressure settings, 300 kPa and 600 kPa; and at three temperatures, 120, 90, and 60°C. Analysis of field data found that factors affecting density gain in importance rank order were temperature of mat surface, number of roller passes, roller type, vibratory setting, and PG binder grade. The results from field data indicate that a density of 92% G_{mm} can always be achieved, however at lower temperatures, more roller passes are necessary. For lab compaction, pressure and temperature showed significant main effects and significant interactive effects. Using 300 kPa pressure yields a density (@ N_{des}) about 1.8 % less than 600 kPa at a baseline temperature of 248°F. The density is reduced by about 0.4% when compacting at 194°F, and 2.4% at 140°F. The results, in general, point out the possibility of optimizing the compaction process by understanding the role of temperature and pressure, which are mixture-type specific.

Key Words: Densification, Compaction, Temperature, Pressure

¹ P.E., Ph.D., Professor, Dept. of Civil and Envir. Engr., 132 Ottensman Hall, Univ. of Wisc., Platteville, WI, 53818. 608-342-1239, schmitro@uwplatt.edu.

² Hwy. Res. Engr., Dept. of Civil and Envir. Engr, 3335 Engineering Hall, Univ. of Wisc., Madison, WI, 53706, 608-890-1766, cmjohnson3@wisc.edu.

³ Ph.D., Professor, Dept. of Civil and Envir. Engr, 3350 Engineering Hall, Univ. of Wisc., Madison, WI, 53706, 608-265-4481, bahia@engr.wisc.edu.