

This topic is “practice ready.”  Yes  No

## **Prediction of Virgin Aggregate Temperature in Asphalt Plant Using Thermodynamics and Heat Transfer Principles**

Mohammad I. Hossain<sup>1</sup>, Matthew Mueller<sup>2</sup>, Varun Veginiti<sup>3</sup>, and Justin Krukow<sup>4</sup>

### **Abstract**

Thermodynamic and heat transfer principles are used to predict and verify the temperature necessary to dry and heat virgin aggregates and reclaimed asphalt pavement/recycled asphalt shingles (RAP/RAS) for a given hot-mix asphalt (HMA) mix. Materials from an HMA plant were collected and moisture content was determined for virgin aggregates, RAP, and RAS. The moisture content of virgin aggregates ranged from 2% to 7%; for RAP, it ranged from 5% to 7%; and for RAS, the range was from 7% to 10%. Next, thermodynamic and heat transfer principles were applied to predict virgin aggregate temperatures necessary to dry and heat RAP for various HMA mix proportions (consisting of 90% to 50% virgin aggregates and 10% to 50% RAP) and moisture contents (1% to 5%). Among the many results, it was found that for a mix consisting of 50% virgin aggregates with 3% moisture content and 50% RAP with 5% moisture content, the temperature required to raise virgin aggregate temperature was 608°C (1127°F) to dry and heat virgin aggregates and RAP. As a final step, virgin aggregates temperature is recorded at a drum plant facility, and thermodynamic equations are used to validate the virgin aggregate temperatures. It has been observed that for a given HMA mix (virgin aggregates, RAP, and RAS), the temperature predicted for larger-size virgin aggregates shows good agreement with the recorded value. It

---

<sup>1</sup> Assistant Professor; Department of Civil Engineering and Construction, Bradley University; 1501 W Bradley Ave, Peoria, IL, 61625; phone (309) 677-2945; fax (309) 677-2867; email: mihossain@fsmail.bradley.edu

<sup>2</sup> Chief Materials Engineer; Interra; 600 Territorial Dr. Suite G, Bolingbrook, IL, 60440; email: mmueller@interraservices.com

<sup>3</sup> Former Graduate Student; Department of Civil Engineering and Construction, Bradley University; 1501 W Bradley Ave, Peoria, IL, 61625; email: vveginati@mail.bradley.edu

<sup>4</sup> Former Undergraduate Student; Department of Civil Engineering and Construction, Bradley University; 1501 W Bradley Ave, Peoria, IL, 61625; email: jkrukow@mail.bradley.edu

is theorized that superheated virgin aggregates could burn the virgin binder and aged binder coating of RAP/RAS and produce an inferior-quality HMA mix.

**Keywords: Hot-mix Asphalt—RAP—RAS—Thermodynamics—Temperature**