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AGGREGATE MOISTURE MEASUREMENT

Aggregate stockpile moisture content can significantly influence drying energy cost, plant production rates, and mix volumetric properties and performance. Moisture is perhaps the most influential production variable – its importance and impact should not be discounted.

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The 1–11–11 Moisture Rule

The exact relationships between moisture, drying energy, and production cost vary based on plant and material conditions; however, general rules apply. A 1 percent increase in moisture will increase the drying energy by approximately 11 percent and will decrease the plant production rate by approximately 11 percent. The "1–11–11 Moisture Rule" is an easy way to remember this.

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Moisture Impact on Plant Asphalt Binder Content Addition

When the aggregate blend moisture content differs from the plant moisture content setting, substantial impacts to the added binder content may result. For example, if the plant's moisture setting is 5 percent and the actual moisture is 7 percent, the plant will add binder based on the weight of the 7 percent moisture aggregate with the result being an over-asphalted mix. Likewise, if the actual moisture is 3 percent, the added binder will be too low and the mix will be under-asphalted. This affects mix economics, volumetrics, and performance.

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Minimizing Aggregate Moisture

The first step in minimizing moisture in aggregate stockpiles is good stockpile practices. If possible, consider covering (preferred) and/or paving underneath aggregate stockpiles. This is especially critical for fine aggregate and recycled products (RAP and RAS). Fine aggregate (e.g., screenings and manufactured sand) will likely be more prone to moisture retention than clean stone. Water retention will be maximized with well-graded fine aggregate with high minus No. 200 contents.

The stockpile area should be sloped to ensure moisture drains away from the stockpile. While paving under stockpiles is a good practice, covering the aggregate is ideal (i.e., keeping the water out instead

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of draining water away). Many covering options exist, with prices ranging from $5 to $15 per square foot, not including freight or installation. When considering a covered or paved stockpile area, evaluate the payback period by calculating the decreased moisture content's impact on plant production rate, drying energy, and overall mix variability.

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Aggregate Moisture Measurement Methods

Most commonly, moisture content is measured with direct or gravimetric methods in which the sample dry mass and water are measured using conventional oven (ASTM D2216) or microwave (ASTM D4643) methods. However, some locations have had success measuring moisture with indirect methods, such as a nuclear moisture content gauge.

APAC Central, A CRH Co. (Tulsa, Okla.), has used a nuclear gauge to provide results that align with conventional oven measurements for a variety of materials (clean stone to fine aggregate) and moisture contents (0.5 to >7%). It should be noted that difficulties were experienced when using the nuclear gauge for recycled materials' moisture contents.

APAC Central's method of using the nuclear gauge for moisture testing is briefly described below. Such a protocol should be strongly considered as a way to obtain accurate moisture contents in a more time-efficient manner.

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Nuclear Gauge Moisture Testing Steps

1. Build a miniature stockpile.

2. Back drag a smooth surface.

3. Place the nuclear gauge on the surface. A 6-inch probe depth and 1-minute count time has been used successfully by APAC Central.

4. Ideally, the moisture content will be checked at three or more locations and the average taken as the stockpile moisture.

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Impacts

Aggregate moisture significantly impacts production and cost. Reduce and control aggregate moisture; monitor moisture content frequently, especially for fine aggregates.

References

Oldcastle Quality Bulletin #PRD-012015. Aggregate Moisture Importance and Measurement. Oldcastle Materials. Asphalt National Performance Committee.

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