**Q1** The Sand Equivalent (SE) value for two materials A and B is as follows:

SEA = 70% and SEB = 35%.

2-1 which of the two materials contains more fines? And why do we care for fines in asphalt concrete mix?[5 marks]

***Answers:***

[http://pavementinteractive.org/images/1/11/Se_sm_eqn.gif](http://pavementinteractive.org/index.php?title=Image:Se_sm_eqn.gif)

If SE is high, then the sand reading is high. Thus material with high SE contains fewer fines. Accordingly, material “B” contains more fines.

Because fines or dust in aggregates can have the following negative impacts in an asphalt concrete mixture.

(a) Fines (dust) can stay in the interface between bitumen (binder) and the stone surface. Thus reduces the adhesion between the stones and the binder, leading to a reduced strength of asphalt concrete. It can also cause durability problems since it allow stones to strip-off.

(b) Fines can also increase the demand for bitumen. Bitumen is required to coat the surfaces of all the stones and fines. More fines increases the surface area, thus, increasing the bitumen demand. More bitumen in the asphalt concrete mixture can negatively affect the economy.

**Q2** Briefly state the difference between the bulk specific gravity and the apparent specific gravity [5 marks].

Specific gravity is the ratio of the mass of a unit volume of a material at a stated temperature to the mass of the same volume of gas-free distilled water at a stated temperature.

Apparent Specific Gravity ( Gsa): The volume measurement only includes the volume of the aggregate particle; it does not include the volume of any water permeable voids. The mass measurement only includes the aggregate particle. Apparent specific gravity is intended to only measure the specific gravity of the solid volume; therefore it will be the highest of the aggregate specific gravities.

Bulk Specific Gravity (Gsb): The volume measurement includes the overall volume of the aggregate particle as well as the volume of the water permeable voids. The mass measurement only includes the aggregate particle. Since it includes the water permeable void volume, bulk specific gravity will be less than apparent specific gravity.

|  |  |
| --- | --- |
| [Figure 1. Dry aggregate.](http://pavementinteractive.org/index.php?title=Image:Aggregate_dry.jpg)  Figure 1. Dry aggregate. | [Figure 2. Wet aggregate.](http://pavementinteractive.org/index.php?title=Image:Aggregate_wet.jpg)  Figure 2. Wet aggregate. |

**More for you to know on SE**

How SE fits in the Design aspects of Pavements?

The table below is an example of specifications with relevance to SE

|  |  |  |  |
| --- | --- | --- | --- |
| **Table 1: Superpave Mix Design Sand Equivalent Specification** | | | |
| **Material of Concern** | **Value** | **Specification** | **HMA Distress** |
| Fine aggregate | Sand equivalent | See Table 2 | Stripping |

|  |  |
| --- | --- |
| **Table 2: Superpave Mix Design Sand Equivalent Specification by Design ESALs** | |
| **20-yr ESALs1 (millions)** | **Minimum Sand Equivalent (%)** |
| < 0.3 | 40 |
| 0.3 to < 3 | 40 |
| 3 to < 10 | 45 |
| 10 to < 30 | 45 |
| ≥ 30 | 50 |

**More for you to know on Specific gravity**

There is no specification for bulk specific gravity, but it is used to calculate other specified parameters when designing Hot-mix Asphalt. We will revisit this section latter.

Bulk Saturated Surface Dry (SSD) Specific Gravity: Volume measurement includes the overall volume of the aggregate particle as well as the volume of the water permeable voids. The mass measurement includes the aggregate particle as well as the water within the water permeable voids.

Effective Specific Gravity (Gse): Volume measurement includes the volume of the aggregate particle plus the void volume that becomes filled with water during the test soak period minus the volume of the voids that absorb asphalt. Effective specific gravity lies between apparent and bulk specific gravity.

Gsa ≥ Gse ≥ Gsb

Bulk (SSD) specific gravity ≥ Gsb

**C:\Program Files\Microsoft Office\MEDIA\CAGCAT10\j0252349.wmfUseful Links on aggregates**

Check the following useful WebPages.

<http://training.ce.washington.edu/wsdot/Modules/03_materials/03-2_body.htm>

http://www.dot.ca.gov/hq/esc/Translab/pubs/Ontario\_Gradation.pdf

http://pavementinteractive.org/index.php?title=Sand\_Equivalent

http://pavementinteractive.org/index.php?title=Bulk\_Specific\_Gravity