Technology in Practice

What, Why & How?

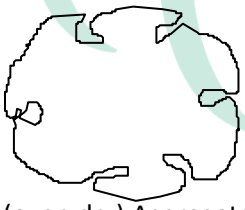
TIP 6 - Aggregate Moisture and Making Adjustments to Concrete Mixtures

This TIP outlines concepts on aggregate moisture for mixture proportioning and production of concrete

WHAT is Aggregate Moisture?

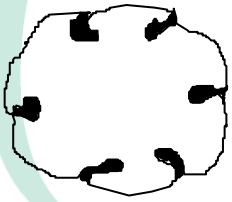
The moisture content of an aggregate when batched in concrete mixtures is an important consideration. Aggregate particles have internal pores that absorb water. Aggregate stored in a stockpile or bin is typically in a wet condition, meaning it contains absorbed water and moisture coating the surface, called free or surface moisture. The total moisture content of an aggregate sample is the sum of the absorbed moisture and the free surface moisture.

The moisture content of the aggregate is defined at four states. When the aggregate has no moisture on the surface or the interior pores then the aggregate is in a **dry** (sometimes called oven-dry) state. When some of the interior pores of the aggregate are filled with water and there is no moisture on the surface then the aggregate is in an **air-dry** state. When all the interior pores of the aggregate are filled with water but there is no moisture on the surface then the aggregate is in a **saturated-surface-dry (SSD)** state. When all the interior pores of the aggregate are filled with water and there is moisture on the surface then the aggregate is in a **wet** state. The dry (oven-dry) and SSD conditions are not typically found for aggregate in storage, but are used as the basis for moisture content measurements and associated calculations.

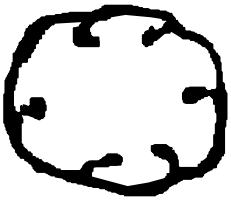


Dry (oven dry) Aggregate (contains no water)

Air-dry Aggregate (partially absorbed water)



Saturated-Surface-Dry Aggregate (SSD) (absorbed water)



Wet Aggregate (Absorbed + free surface moisture)

WHY is Aggregate Moisture Measured?

The properties of fresh and hardened concrete are affected by the quantity of mixing water in the concrete mixture. The mixing water includes all sources of water including batch water, free moisture on aggregates, ice, water incorporated as a component of large dosages of admixtures and water added after concrete is batched, such as at the jobsite. The mixing water content used determines the water to cementitious materials ratio (w/cm) of a concrete mixture. For a set of materials, there is a unique relationship between the w/cm and the strength and durability characteristics of concrete. As indicated earlier, the total moisture content of the aggregate is the sum of the absorbed and free surface moisture. The absorbed water remains within aggregate pores and does not affect the slump of concrete and is not included when calculating the w/cm. The surface moisture makes up a portion of the mixing water, affects slump and is included when calculating the w/cm of the mixture. If the moisture content of wet aggregate is not compensated for, the slump may be too high and w/cm will not conform to the mixture requirement. The batched water should be less than the mixing water required by the amount of free moisture on the aggregate. The aggregate in storage prior to batching in concrete can also be in an air-dry state. In this case, the aggregate when batched in concrete will absorb water from the batch water resulting in a lower slump. This water that will be absorbed by dry aggregates needs to be accounted for by adding additional water to the mixture. Therefore the aggregate moisture has to be measured and the amount of batch water adjusted accordingly.