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**1-Introduction:**

**Background Information:**

 Aggregate particles have certain physical and chemical properties which make the aggregate acceptable or unacceptable for specific uses and conditions, specific gravity is one of the physical properties of aggregates which refer to the physical structure of the particles that make up the aggregate. Specific gravity is the Ratio of the mass of a substance relative to the mass of an equal volume of water at a specific temperature.Specific gravity is a mean to decide the suitability of the aggregate, Low specific gravity generally indicates porous, weak and absorptive materials, whereas high specific gravity indicates materials of good quality.

 Several types of specific gravity are commonly used depending upon how the volume of water permeable voids (pores) within the aggregate are addressed:

1. Bulk specific gravity(Gsb) (bulk dry specific gravity): is the ratio of the mass in air of a unit volume of aggregate at a stated temperature to the mass in air equal volume of gas-free water at a stated temperature. Bulk dry specific gravity includes the volume of both permeable and impermeable pores, but does not include the voids between the aggregate particles.

The formula for it:

Gsb = A/ (B-C)

Where:

A=Oven dry mass

B=SSD mass in air

C=SSD mass in water

1. Bulk SSD specific gravity (saturated surface dry ):is the ratio of the mass of a unit volume of aggregate, including the weight of water within the voids filled to the extent achieved by submerging in water for approximately 15 hours, to the mass of an equal volume of gas-free distilled water at the stated temperature.( Particles appear moist but not shiny (surface dry))

The formula is:

Gsb SSD =B/ (B-C)

Where

A=oven dry mass

B=SSD mass in air

C=SSD mass in water

1. Apparent specific gravity (Gsa):  the ratio of the mass of a unit volume of the impermeable portion of aggregate (does not include the permeable pores in aggregate) to the mass of an equal volume of gas-free distilled water at the stated temperature.” only the volume of impermeable pores”.

 The formula is:

Gsa =A/ (A-C)

Where

A=oven dry mass

B=SSD mass in air

C=SSD mass in water

1. Absorption (% Abs):  is the increase in mass due to water in the pores of the material. Aggregate absorption is a useful quality because:
* High values can indicate non-durable aggregate.
* Absorption can indicate the amount of asphalt binder the aggregate will absorb.

The formula is:

%Abs=] (B-A)/A 100 × [

Where:

A= oven dry mass

B= SSD mass in air

 **Purpose:**

* To measure the specific gravity for coarse and fine aggregate **.**
* To determine the water absorption of aggregates**.**

**2- instrument:**

|  |  |
| --- | --- |
| 1. Sample of coarse aggregate

   | 1. Sample of fine aggregate

  |
| 1. Oven

 | 1. Pycnometer

 |
| 1. Fried electric

 | 1. flask of water

 |
| 1. Manual Balance

 | 1. Wire basket

 |
| 1. Griddle

 | 1. Towels

   |
|  1. Electrical balance

 |  |

**3-Procedures :**

**Part 1 : course aggregate .**

1. The sample was divided into four parts and two quarters were taken .
2. The samples were left from water and dried by using a towels , until the most of samples became dry surface then it weighed
3. The sample was placed in a submerged container and drowned in water bucket then weight in saturated condition.
4. Finally , the sample was placed in oven at temperature of 110 C for 36 hours until became completely dry and then weighed again.

Same procedures done on coarse aggregate sample2

**Part 2 : fine aggregate .**

1- The sample was divided into for parts and two quarters were taken .

2- The sample came to saturated surface dry by using a heater to evaporate the water . The sample was stirred constantly to assure uniform drying and that was checked by pen .

3- The Pycnometer was nearly filled with water to make sure it is not leaking and to remove all air bubbles , then it weighed by using a sensitive balance .

4- Some water was removed from the Pycnometer and replaced by the sample

5- Then the Pycnometer filled completely with water and its weighed by using a sensitive balance to obtain the saturated condition weight .

6- Finally , the sample was placed in the oven at a temperature of 110 C for 36 hours until it was completely dried and then weighed again.

Same procedures done on fine aggregate sample2.

**4**-**Data and calculation:**

**Fine aggregate Sample1 :**

A=weight of oven dry sample(gr)=77.45

B =weight of saturated surface dry sample(gr)=78.90

Wc=weight of pycnometer Jap filled with water (gr)=600.40

W=weight of pycnometer Jap with water and fine Agg (gr)=722.30

Calculations:

Specific gravity on dry basis = A/Wc+B-W=77.45/600.40+78.90-722.30=1.80

Specific gravity on saturated surface dry basis=B/Wc+B-W=78.90/600.40+78.90-722.30=1.83

Apparent specific gravity=A/Wc+A-W=77.45/600.40+77.45-722.30=1.74

Absorption percent=B-A/A \*100=78.90-77.45/77.45 \*100=1.87

**Fine aggregate Sample2:**

A=weight of oven dry sample(gr)=101.90

B =weight of saturated surface dry sample(gr)=103.20

Wc=weight of pycnometer Jap filled with water (gr)=600.40

W=weight of pycnometer Jap with water and fine Agg (gr)=734.75

Calculations:

Specific gravity on dry basis = A/Wc+B-W=101.90/600.40+103.20-734.75=3.27

Specific gravity on saturated surface dry basis

 =B/Wc+B-W=103.20/600.40+103.20-734.75=3.31

Apparent specific gravity=A/Wc+A-W=101.90/600.40+101.90-734.75=3.14

Absorption percent=B-A/A \*100=103.20-101.90/101.90 \*100=1.27

**Coarse aggregate Sample1** :

A=weight of oven dry sample in air (gr)=311.05

B =weight of saturated surface dry sample in the air (gr)=330

C =weight of saturated surface dry sample in water (gr)=200

Calculations:

Specific gravity on dry basis=A/B-C=311.05/330-200=2.39

Specific gravity on saturated surface dry basis=B/B-C =330/330-200=2.54

Apparent specific gravity=A/ A-C=311.05/311.05-200=2.80

 Absorption percent=B-A/A \*100=330-311.05/311.05 \*100=6.09

**Coarse aggregate Sample2 :**

A=weight of oven dry sample in air (gr)=327.20

B =weight of saturated surface dry sample in the air (gr)=350

C =weight of saturated surface dry sample in water (gr)=200

Calculations:

Specific gravity on dry basis=A/B-C=327.20/350-200=2.18

Specific gravity on saturated surface dry basis=B/B-C =350/350-200=2.33

Apparent specific gravity=A/ A-C=327.20/327.20-200=2.80

Absorption percent=B-A/A \*100=350-327.20/327.20 \*100=6.97

**5- Conclusion**

According to ASTM standards that accept the specific gravity for fine aggregate in the range of (1.44-4.5) and (2.36-3.5) for the coarse aggregate, as shown in the calculations part, all fine aggregate samples are in the range. Also, coarse aggregate samples in the range. For the absorption percentage, it mustn't exceed 3%, but the results of 20 mm, 15mm and 5 mm and sand were higher than 3% which means these samples were weak and the results are not accepted.

Natural absorption of a stone is related to the stone’s ability to resist loading and *Figure 11* below shows the opposite proportionality between the absorption of a stone and its resistance to loadings.

In this experiment we found the specific gravity for aggregates, and we got a good result, in water absorption the percentage should range between (1-3) %, we got a high percentage which indicate the aggregates absorb water from mix it lead to decrease strong mix.



Some errors are expected to be done during the experiment and affecting the results of the experiment:

1) Improper identification of SSD (oven or under-drying)

2) Air entrapped in suspended sample or sample immersion container.

3) Suspension apparatus in contact another object, resulting in false readings.

4) Loss of material during transfer to the drying pans.

5) Weighing errors.

6) Improper pycnometer calibration. 1

**6- Literature citations:**

**Reference used:**

1. **Concrete laboratory manual, pages 24-26.**
2. **A.M NEVILLE, J.J. BROOKS. 2010. CONCRETE TECHNOLOGY. British Library Cataloguing-in-Publication Data. ISBN. 442P .**
3. **Characterisation of bulk solids" by Donald Mcglinchey.**