# CHAPTER 4

# MOISTURE CONTENT AND BATCH WEIGHT ADJUSTMENTS

It is the duty of the producer to compute the moisture content and batch weight adjustments. Moisture contents are determined as follows:

A representative sample of each aggregate is taken from the storage bin, weigh hopper, or from the stockpile. The moisture content should be typical of the material being used. The sample should weigh a minimum of 500 grams. The sample is weighed, and the weight is recorded. The sample is dried either on a hot plate or in an oven. The weight of the dry sample is then determined. Subtract the dry weight from the wet weight and divide the difference by the dry weight. Multiply the answer by 100 to obtain the percent of total moisture in the sample. From this figure you must subtract the absorbed moisture to obtain the free moisture, which is used to adjust the batch weights. Absorbed moisture is that which is actually absorbed by the aggregate. The free moisture content is that moisture which is on the surface of the aggregate. The value to be used for absorbed moisture is found on the aggregate data sheets. (See pages 3-31 and 3-32.) The moisture test for each size aggregate should be run separately. An example of the calculations needed to determine free moisture is found below:

Weight of Wet Sample = 1040 grams
Weight of Dry Sample = 1000 grams
Total Moisture $= \frac{1040 - 1000}{1000} \times 100 = 4.0\%$

Absorption as found on the Aggregate Data Sheet = 0.5%
Free Moisture = Total Moisture - Absorbed Moisture

4.0% - 0.5% = 3.5%

In the event scales are not the tare type, and a pan weight has to be used, the following procedure is applied:

Weight of Wet Sample + Weight of Pan = 1050 grams
Weight of Dry Sample + Weight of Pan = 1010 grams
Weight of Pan = 10 grams

Total Moisture $= \frac{(1050 - 10) - (1010 - 10)}{(1010 - 10)} \times 100 =$

$$\frac{1040 - 1000}{1000} \times 100 = 4.0\%$$

Absorption as found on Aggregate Data Sheet - 0.4%

Free Moisture = Total Moisture - Absorbed Moisture

4.0% - 0.4% = 3.6%

# BATCH WEIGHT ADJUSTMENTS

Since the free moisture on the aggregate will eventually become a part of the mixing water, it is necessary to deduct the water which is free moisture from the mix design. This can be shown best by example:

Free Moisture in Sand = 3.6%
Free Moisture in No. 57 = 1.0%

Design quantities for a one cubic yard batch:

| | |
|---|---|
| Cement | 588 lbs. |
| Sand | 1206 lbs. |
| No. 57 | 1864 lbs. |
| Water | 288 lbs. |

Since there is obviously no water in cement, start with the sand:

Sand = 1206 X 0.036 = 43 lbs. of water added to the mix by wet sand.

No. 57 = 1864 X 0.01 = 19 lbs. of water added to the mix by wet No. 57

Next adjust the aggregate pull weights:

Sand = 1206 + 43 = 1249 lbs.

No. 57 = 1864 + 19 = 1883 lbs.

The above are the quantities of fine and coarse aggregate to be used in the mix.

Next adjust the amount of water to be added to the mix.

The total free water in the aggregates = 43 + 19 = 62 lbs.

This free water must be subtracted from the design water.

288 - 62 = 226 lbs.

This is the amount of water to be added to the mix. To convert this to gallons, you must divide by 8.33 (weight of one gallon of water) as follows:

$$\frac{226}{8.33} = 27.1 \text{ gallons}$$

## Moisture Problem Example

A. Given the following information, determine the percent of free moisture in the Sand and No. 57.

SAND

Weight of wet sample = 585 grams
Weight of dry sample = 540 grams

NO. 57

Weight of wet sample = 1205 grams
Weight of dry sample = 1190 grams

ABSORPTION

Sand = 0.5%
No. 57 = 0.9%

Free Moisture: Sand 7.8% No. 57 0.4%

CALCULATIONS:

Sand: $\frac{585 - 540}{540} \times 100 = 8.3$ 8.3 - 0.5 = 7.8

No. 57: $\frac{1205 - 1190}{1190} \times 100 = 1.3$ 1.3 - 0.9 = 0.4

B. Based on the preceding moisture determination, correct the following mix design weights to batch weights or "pull weights" for four cubic yards.

Mix Design - 1 $yd^3$

Based on SSD condition

| | | Batch Quantities | |
|---|---|---|---|
| Cement | 635 lbs. | Cement | 2540 lbs. |
| Sand | 1070 lbs. | Sand | 4612 lbs. |
| No. 57 | 1840 lbs. | No. 57 | 7388 lbs. |
| Water | 286 lbs. | Water | 784 lbs. |
| | | | 94.1 gals. |
| Air | 6 % | Air | 6 % |

CALCULATIONS:

Sand - 7.8 %
No. 57 - 0.4 %

Sand : 1070 (1070 + 83) x 4 = 4612
x .078
83

No. 57 : 1840 (1840 + 7) x 4 = 7388
x .004
7

Water : 83 + 7 = 90

286 - 90 = 196 196 x 4 = 784 lbs. or $\frac{784}{8.33}$ = 94.1 gallons

Cement : 635 x 4 = 2540

# Chapter 4
# Study Problems

## Moisture Problem No. 1

A. Given the following information, determine the percent of free moisture in the sand and No. 57.

SAND

Weight of wet sample = 635 grams
Weight of dry sample = 598 grams

NO. 57

Weight of wet sample = 1240 grams
Weight of dry sample = 1220 grams

ABSORPTION

Sand = 0.6%
No. 57 = 0.2%

Free Moisture: Sand _____ No. 57_____

CALCULATIONS:

B. Based on the preceding moisture determination, correct the following mix design weights to batch weights or "pull weights" for one cubic yard.

Mix Design - One Cubic Yard
Based on SSD Condition

| | | Batch Quantities |
|---|---|---|
| Cement | 635 lbs. | Cement _____ lbs. |
| Sand | 1067 lbs. | Sand _____ lbs. |
| No. 57 | 1835 lbs. | No. 57 _____ lbs. |
| Water | 288 lbs. | Water _____ lbs.<br>_____ gals. |
| Air | 6.5 % | Air _____ % |

CALCULATIONS:

## Moisture Problem No. 2

A. Given the following information, determine the percent of free moisture in the sand and No. 57.

SAND

Weight of wet sample = 628 grams
Weight of dry sample = 582 grams

NO. 57

Weight of wet sample = 1245 grams
Weight of dry sample = 1215 grams

ABSORPTION

Sand = 0.9%
No. 57 = 0.4%

Free Moisture: Sand _____ No. 57_____

CALCULATIONS:

B. Based on the preceding moisture determination, correct the following mix design weights to batch weights or "pull weights" for one cubic yard.

Mix Design - One Cubic Yard
Based on SSD Condition

| | | Batch Quantities |
|---|---|---|
| Cement | 635 lbs. | Cement _____ lbs. |
| Sand | 1070 lbs. | Sand _____ lbs. |
| No. 57 | 1840 lbs. | No. 57 _____ lbs. |
| Water | 286 lbs. | Water _____ lbs.<br>_____ gals. |
| Air | 6.0 % | Air _____ % |

CALCULATIONS:

## Moisture Problem No. 3

A. Given the following information, determine the percent of free moisture in the sand and No. 57.

SAND

Weight of wet sample = 621 grams
Weight of dry sample = 580 grams

NO. 57

Weight of wet sample = 1362 grams
Weight of dry sample = 1343 grams

ABSORPTION

Sand = 0.7%
No. 57 = 0.4%

Free Moisture: Sand _____ No. 57 _____

CALCULATIONS:

B. Based on the preceding moisture determination, correct the following mix design weights to batch weights or "pull weights" for four cubic yards.

Mix Design - One Cubic Yard

Based on SSD Condition

| | | Batch Quantities |
|---|---|---|
| Cement | 635 lbs. | Cement _____ lbs. |
| Sand | 1070 lbs. | Sand _____ lbs. |
| No. 57 | 1840 lbs. | No. 57 _____ lbs. |
| Water | 286 lbs. | Water _____ lbs.<br>_____ gals. |
| Air | 7.0 % | Air _____ % |

CALCULATIONS: