Accurate Calibration With AK30/AK40/AK50 Moisture Meters Using a Climate Chamber

Performing Multipoint Calibration when Working with a Climatic Chamber and a Balance

In this more accurate way the calibration is done as follows. Follow this procedure step by step and you will get the most accurate calibration to your meter. For best results, extra care is required.

0. By using some general-purpose calibration table of similar basis weight, study the sample on each side with the moisture meter to observe any differences. Coated side vs. uncoated side may give different readings. You should decide which is the important one.

1. Cut the sample paper/board to a size suitable for the chamber and the balance's sample holder. Make sure there is no contact to nearby walls while measuring the weight. Punch a few holes to the sample if your chamber has hooks for holding the samples. Note that this must be done at an early stage, you cannot do it later when you have started measurements. Use some reasonable code marking in each sample for easy recognition.

2. Prepare an Excel sheet for collecting data and for automatically calculating moisture readings from the weights when the dry weight is known. Prepare some graphics too to show the resulting curve after getting in some data. Then you can copy this sheet as a model for all later calibrations. Visilab can also send you a sample sheet.

3. Place the sample into an oven for two hours at about + 102 C

4. While drying, place the balance and the moisture meter into the climatic chamber. If your balance can not withstand the humid conditions, do the weighing outside the chamber with for example a plastic bag. Start the chamber control system and adjust the relative humidity to the lowest possible value. Arrange the moisture meter, if possible, so that you can simultaneously read both the balance and the meter. Using your PC for reading the meter is the best way to do it. The sample should be later placed so that the surrounding air can circulate around it and the wetting will be even at every point on the sample. The moisture meter *should be in SCALE calibration mode.* You can use the table #68 SCALE for this purpose. Then you will use scaling up of the raw moisture signal with a factor of 100 to make its reading easier and more accurate since you have more significant numbers at disposal. The meter should now be acquiring data to your PC. Tare the balance to zero with the sample holders in place.

5. Quickly move the sample from the oven to your balance for weighing, preferably using an aluminum or plastic bag. If the balance is in the chamber, place the bag unopened there and weigh it and open it only after closing the door by using gloves in the walls. If the balance is on top of the chamber with a suitable measuring cabinet, you might do the weighing there and after that move the sample to the chamber and open the bag. Weighing the sample in free lab air will destroy the accuracy in one second. Note that plastic bags may cause static electricity which may distort weighing results at the dry end. The result will be the dry weight of the sample plus the bag. Tare the bag away from the weight. Try to read also the moisture meter signal by placing quickly the sample under the meter. That is usually a difficult task as both the weight and the signal increase so rapidly within the first 0..2 % range. The dry weight is used later in calculating the actual moisture percentages. Note that this step usually causes the greatest errors to the final absolute calibration accuracy. Errors of the order of +/-0.5 % are common if exceptionally careful precautions are not taken. Static can be eliminated by an ion gun. The meter's readings at the very dry end are usually very useful for depicting how the curve will go.

6. Continue reading the moisture signal-weight pairs as the moisture level slowly increases. Make notes of these readings. At first, you can take readings every minute but as the wetting of the sample will become slower it may be enough to take samples at longer intervals (5 min, 20 min, 1 hour). If long intervals are used, it is advisable to place the meter into low power mode and to tare the balance occasionally. Try to keep the chamber at very low humidities in the beginning (10 %RH) to slow down the wettening. Thereafter, you can increase the %RH to higher levels

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either manually (recommended) or programmatically. Levels, like 30, 40, 50, 60, 70, 80 and 85 %RH are usually quite sufficient. Going higher than that is possible but in many chambers water condensation may occur on the walls causing uncontrolled wetting of the sample accidentally. In many papers, 85 %RH will generate a moisture around 16 % or higher. Some chambers may be able to go cleanly over 90 %RH and one might be able to increase the sample moisture over 40 % with some grades. Special wetting methods are called if really high moisture levels in the sample are needed. If you lower the %RH you will not return to the same moisture points as before. That is due to the paper hysteresis phenomenon.

7. Feed the collected data into your spreadsheet program and draw a picture of it thus forming the actual calibration curve. You should have pairs of numbers (signal --- weight). The signal reading is around 1.0. If it is around 100 you will need to divide it by 100. At bone dry end it is usually around 0.95 and at 30% it could be around 1.25.

8. Decide whether the results are reasonable by looking at the graph generated from the data. If not, you have to get more data from step 6. You could run the chamber up and down slowly to get more data. Note that thick papers with BW higher than 100 g/m2 require longer stabilization times. With very thick papers the settling time may be hours.

9. Having obtained a reliable calibration curve, decide which points on it actually are adequate for representing it with the accuracy you have specified. You can use only 2 to 10 of them for the calibration table. Straight part of the curve can be handled with a single line segment. Usually thin papers (BW < 60 g/m2) have a straight line as the curve and thick papers have some curvature at the dry end and a straight line above 8 %.

10. Take a printout of the numeric calibration point table and graph and identify and mark the selected points with step numbers.

11. In the meter, select an empty or unused table

12. Go to the MULTI calibration menu

13. Set the step number in "2 = #STP".

14. Press "4" and type in the corresponding signal (now scaled down if you earlier scaled it up) as a decimal number. The value is typically between 0.90 and 1.50. Use always as many decimals as there are available and try to round them correctly.

15. Press "5" and set the corresponding moisture value. *Do not use the Execution ("3") in this method!* Else the signal value is replaced with the current signal reading. This option depends on the model of the meter used. AK30 has CALIBR and EDIT separately. Editing is safe to do.

16. Repeat the steps 13., 14. and 15. until all calibration points are fed in. Make sure the number of points used is the same as in the upper menu is indicated (option "3"). Correct if not.

17. In the upper menu, check the calibration mode to be MULTI.

18. Save the calibration table by pressing the Save key. You can also edit the name of the new table by selecting the option "3" in the main menu. Save again the table there after editing it. Model D meter will save the new table by itself. You can press the ESC key a few times and start measuring with the new table.

19. For most accurate work you might want to check the reading and make a fine tuning to have a perfect result. It is advisable to dry the sample again and determine its dry weight as guided before. Then allow the sample to wet again to some level around the most useful moisture range where to usually measure it, by using your chamber. Use the new calibration table to read the moisture of the sample and the weight of it too. The Excel sheet will now reveal the

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true moisture and you can compare the two readings. You can then keep the sample under the meter and do the adjustment to fine tune to force the meter reading exactly the same. The fine tuning (Adjust) is in AK30/40 in option "9 = More.." and "4 = Adjust". Type in some small decimal number to see what happens. Iterate to get the correct reading. Before leaving the menus, save the table and possibly also the new configuration the main menu, if necessary.

Do not forget to download the library to your PC to save your valuable work to a safe folder. Always modify the library name too.

If you will need to use the dry weight instead of the default total weight moisture, you would need to do the conversion for each moisture reading according to:

$$\text{dry-\%} = \frac{\text{total-\%} * 100}{(100 - \text{total-\%})}$$

Tips and Tricks

With thin papers (BW < 150 g/m2) the paper is usually behaving with one-sided infrared moisture meters so that the total moisture can be measured and sidedness is not so important. For best results, measure both sides of the sample. However, if you have climatized the sample properly, this does not give any extra information. This is sheet calibration and it is performed for highest accuracy over a black aluminum plate, one sheet at a time. Never keep other papers under the sample with thin papers while measuring.

If the sides are different, on the other hand, like one side coated and the other not, then it is advised to keep the side information apart from each other. They really behave slightly differently. One has to decide which side is important for practical measurements and perform the calibration for that side alone.

With thin papers sometimes one would need instead of sheet calibration also the reel calibration. This has an infinite BW and it can be simulated at calibration time easily. While measuring in the chamber, always keep a bunch of similar or identical papers as the background over which the actual sample is placed. Keep the resulting bunch rather tight when doing measurements to avoid any air gaps between them. The signal readings will now be those corresponding to reel measurements. In this way, you might be able to generate two calibrations with the same effort, in simple steps: one for sheet (black background) and another for reel (stack background).

With thick papers it does not matter if you have any other papers under the sample or not. If it does, then you should have both sheet and reel calibrations.

While waiting the samples to climatize for hours, set the meter to LowPower mode to avoid generating extra heat to the chamber. That would unnecessarily load the control system and possibly slow down the whole process.

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