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Successfully measuring massecuite solids content and mother liquor concentration in vacuum batch pans

Massecuite solids content and mother liquor concentration are commonly monitored parameters in the vacuum pan as they are used to control the crystallization process and therefore have an effect on the end product quality, the sugar crystals. Massecuite solids content is the mixture of crystals and mother liquor resulting from the crystallization process and mother liquor concentration is the liquid phase in the massecuite during crystallization. Massecuite solids content, or total sugar content, is typically determined using microwave meter or nuclear density probe whereas mother liquor concentration (dissolved sugar) is measured using a refractometer. The measurement scale is usually Brix.

Varying process conditions presents a challenge to measuring massecuite solids content accurately. When process medium changes from liquid to massecuite consisting of both liquid and crystals during the different production phases, calibrating measurement devices such as microwave or nuclear density instruments can generally be calibrated quite well either for liquid phase or for massecuite phase, but not for both. This means that these measurement devices cannot not produce reliable results as they do not cover the whole processing range. For accurate results, the calibration needs to cover the full range from pure liquid to the point where Vol 55 % of the massecuite is crystals. However, if the vacuum pan is equipped with a refractometer, the calibration difficulties can mostly be avoided.

Crystallization process

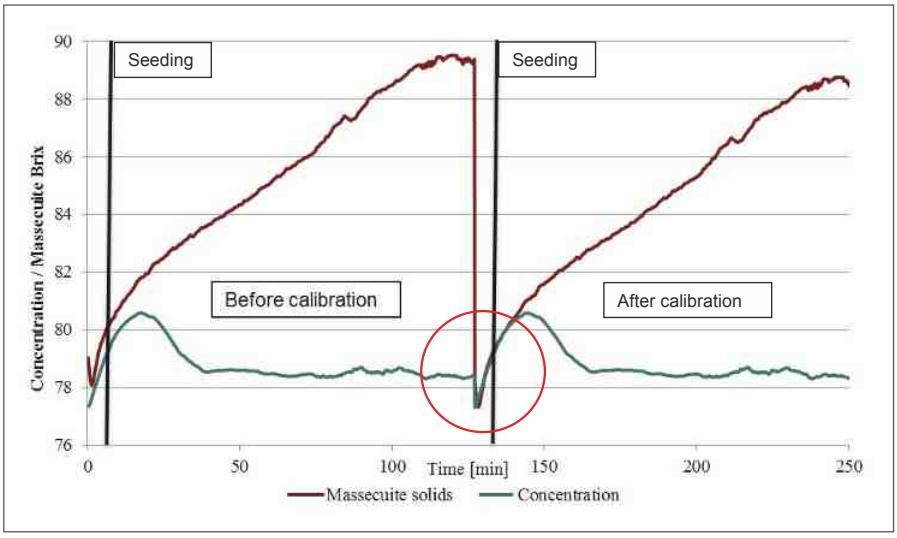
In the beginning of the strike the process medium is pure liquid. At this point the refractometer and the massecuite solids content meter should give the same measurement value. The crystals are introduced only after the pan has been seeded. After seeding the massecuite solids content increases as the crystal content increases whereas refractometric concentration stays rather constant (±3 Bx). Improved accuracy in massecuite solids measurement can be achieved when refractometer is combined with microware meter/nuclear density meter. Moreover, refractometer can offer calibration reference value for the massecuite solid content meter at the seeding point.

Calibration procedures

K-Patents Process Refractometers are factory calibrated according to International Commission for Uniform Methods of Sugar Analysis (ICUMSA) Brix table. The factory calibration should be verified against the production laboratory when commissioning the instrument. The laboratory reference values should be taken in the beginning of the strike

when there is only liquid present in the vacuum pan. Small BIAS adjustment should be enough for matching the refractometer and the production laboratory.

Typically, the massecuite solids content meter needs regular calibrations and calibration checks. The best calibration result is typically achieved when the instrument is calibrated on narrow range for either liquid sugar or massecuite. In vacuum pans the recommended calibration practice is to calibrate instrument from seeding point to the end of the strike, which means that the reference samples should be taken at the seeding point, end of the strike and one sample in between (minimum three samples).



Picture shows how should the refractometer and massecuite solids content measurement trend look like after calibration. The liquid concentration and massecuite solids content should be the same before the seeding, which after they will separate as the crystals start to grow.

An example of a calibration table is presented below:

Sample	LAB (Mass. Sol. Cont.)	K-Patents refractometer (Concentration)	Microwave/ Nuclear (Mass. Sol. Cont.)	Difference Refractometer – LAB	Difference Microwave/ Nuclear – LAB
1	77,6	77,5	78,5	-0,1	+0,9
2	79,5 (Seeding)	79,4	80,9	-0,1	+1,4
3	85,6	78,5	86,3	–	+0,7
4	90,5	77,9	91,3	–	+0,8

An example of a calibration table after calibration procedure is presented below:

Sample	LAB (Mass. Sol. Cont.)	K-Patents refractometer (Concentration)	Microwave/ Nuclear (Mass. Sol. Cont.)	Difference Refractometer – LAB	Difference Microwave/ Nuclear – LAB
1	77,6	77,6	77,6	0,0	0,0
2	79,5 (Seeding)	79,4	80	0,0	+0,5
3	85,6	78,5	85,4	–	-0,2
4	90,5	77,9	90,4	–	-0,1

Refractometer offset adjustment +0.1
Massecuite solids meter offset adjustment -0.9

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