1 Monitoring Brewhouse Operations

1.1 Monitoring Brewery Grist

1.1.1 Grist Composition

To achieve a favorable extract yield in the brewhouse, the milling process must be optimized. Therefore, the composition of the grist in the brewery should be monitored regularly.

Principle

The sieve analysis is performed on a sample of brewery grist of a known weight with a shaking device containing a set of sieves (according to DIN ISO 3310-1 specifications or a *Pfungstädter Plansichter* sieving device).

Apparatus

Sieve shaking device equipped with five sieves, base tray and cover.
The following sieves are used for sorting the brewery grist into fractions:

Mesh size [mm]	Wire thickness [mm]
1.250	0.800
1.000	0.630
0.500	0.315
0.250	0.160
0.125	0.080

The set of sieves listed below can be found in a classic *Pfungstädter Plansichter* sieving device and yield the same results as those above:

Sieve number	Material	Mesh size [mm]	Wire thickness [mm]
16	coated steel wire mesh	1.270	0.31
20	coated steel wire mesh	1.010	0.26
36	coated steel wire mesh	0.547	0.15
85	bronze gauze	0.253	0.07
140	bronze gauze	0.152	0.04

Permitted tolerance: ±1 %

Rubber balls and rubber cubes, Ø 15–20 mm
Brush
Laboratory scale

Sample Collection

Remove grist from the sample collection apparatus 5 min after the beginning and 5 min before the end of milling; the total weight of the sample should not exceed 200 g maximum.

Procedure

Brewery Grist

- place three rubber balls and three rubber cubes on each of the following sieves: 0.500, 0.250 and 0.125 mm (DIN) or no. 36, 85 and 140 (*Pfungstädter Plansichter* sieves)
- place all five sieves on the base tray in the correct order
- place cover on top of the sieves and attach clips firmly
- weigh 100–200 g brewery grist to 0.1 g and pour entire grist sample (do not divide sample) onto the uppermost sieve through funnel mounted on the cover
- place lid on funnel
- set timer of sieving device for 5 min and immediately switch on device
- transfer each portion of grist retained on the individual sieves and also that in the bottom tray onto separate pieces of smooth, dark paper; remove any grist residue from sieves by brushing it off onto each piece of paper

- weigh the contents of each sieve
- add any loss due to dust to the weight of the fine flour fraction (contents of base tray)

Designation of the individual grist fractions:

Sieve 1:	husk fragments
Sieve 2:	coarse grits
Sieve 3:	fine grits I
Sieve 4:	fine grits II
Sieve 5:	coarse flour
Base tray:	fine flour

Calculation

Calculate the percentage for each grist fraction using the weights of the fraction with reference to the total weight of the sample.

Results

In % to one decimal place

The absolute numerical values for the percentage retained per sieve differ between the two sets of sieves; however, the overall breakdown of the grist composition remains fairly constant.

Based on the findings from collaborative trials in addition to extensive experience with the *Pfungstädter Plansichter,* MEBAK recommends using the new set of sieves dimensioned according to DIN specifications or to completely replace the *Pfungstädter Plansichter* device as it will not be available on the market much longer.

Standard Values

Example of good lauter tun grist (dry milled) (values based on malt produced from two-rowed European summer barley varieties):

	Lauter tun grist [%]	Mash filter grist [%]
Sieve 1:	18–25	Refer to
Sieve 2:	< 10	manufacturer
Sieve 3:	35	specifications
Sieve 4:	21	
Sieve 5:	7	
Base tray:	< 12–15	

References

1. K-B, p. 185
2. Sch-W-N, volume II, p. 99
3. H.-M. Anger, BWelt *138*,146 (1993)

1.1.2 Husk Volume

As a means of orientation, measuring the husk volume is recommended. The material retained on sieve 1 is poured through a funnel into a 500 ml graduated cylinder (DIN 12680), and without shaking, the volume is read on the graduated cylinder.

Results

In ml per 100 g

Standard Values

> 700 ml/100 g for lauter tun grist

1.2 Mashing

1.2.1 Mashing Intensity

Mashing intensity provides information about the degree of proteolysis during the mashing process and is calculated as the quotient of the nitrogen content of brewery wort and the nitrogen content of Congress wort. It can be used to compare different mashing methods. An increase in mashing intensity usually corresponds to an increase in brewhouse yield.

Principle

Determination of the nitrogen content of brewery wort and Congress wort.

Apparatus

Apparatus for nitrogen analysis
Fluted filter (Hahnemühle FineArt GmbH, www.hahnemuehle.de, no. 572 ½ or comparable)

Reagents

Reagents for nitrogen analysis

Procedure

- boil 200 g laboratory wort containing the amount of hops typically used in a standard beer for 2 h on a reflux condensor
- cool, adjust to the original weight and filter through a fluted filter
- determine nitrogen content of the filtrate

Calculation

$$\text{Mashing intensity [\%]} = \frac{mg\ N/100\ ml\ BW \times \%w/v\ CW}{mg\ N/100\ ml\ CW \times \%w/v\ BW} \times 100$$

BW = Brewery cast-out wort

CW = Congress wort

Results

In % to one decimal place

Standard Values

105–115 % (recommended value > 104 %)

References

1. P. Kolbach, Wochenschr. Brauerei *53*, 369 (1936); *57*, 250 (1940)

1.2.2 Visual Iodine Test

Principle

Higher molecular weight starch degradation products react with iodine after precipitation with alcohol. The reaction between iodine and starch results in the formation of an inclusion-type compound, evident by a change in color.

Reagents

Ethanol, 95 %
Iodine solution, 0.02 N

Procedure

- transfer 5 ml wort at approx. 20 °C to an iodine sample container or large test tube bearing 5, 10 and 30 ml markings
- fill to the 30 ml mark with 95% ethanol, invert several times to mix
- place test tube in a slanted position for 3 min
- decant liquid
- dissolve the precipitated dextrins by adding 10 ml H_2O
- add five drops 0.02 N iodine solution, invert several times to mix

- if no bluish red color appears, add iodine drop by drop until color is evident; do not exceed 20 drops
- for purposes of comparison, add the same number of iodine drops to a second test tube containing 10 ml H_2O

Evaluation

Wort samples that are not completely converted, that is, in which the saccharification process is incomplete, still contain starch or higher molecular weight starch degradation products, resulting in a blue, blue-violet or red color upon contact with the iodine solution.

References

1. P-Sch, pp. 135 and 270