

Cereal Crops Research Unit Malting Systems

The USDA ARS Cereal Crops Research Unit's Malting/Quality Analysis group analyzes early generation barley samples, submitted by public sector researchers, for malt quality. Very limited amounts of grain from each line are available for this purpose. Consequently, our standard scale of malting is 170g (dry basis) per sample. These samples undergo the 3 malting phases (i.e. steeping, germination, kilning) in separate, dedicated machines, collectively known as our "Traditional Malting System", or in Joe White Micro-malting systems, which perform all 3 processes in one chamber.

Barley kernels retained on a 5/64" slotted screen are malted. All samples receive the same, systematic conditions for each process. Internal malting standards are included for quality control.

Traditional Malting System:

This experimental malting equipment was custom fabricated by Standard Industries (Fargo, ND), patterned on apparatuses described in the following papers*: Anderson, J.A., Laboratory Malting Equipment I, Canadian Journal of Research, C, 15:204-216 (1937) and Anderson, J.A. and Meredith, W.O.S., Laboratory Malting III: Steeping Equipment and Method, Cereal Chemistry, 17:66-72 (1940).

Steeping Cans: Stainless steel, cuboidal design with screen mesh bottom (dimensions: 6" tall x 3.5" long x 3.5" wide).

Germination Cans: Stainless Steel, cylindrical design, with tight-fitting lid and double rows of ten 1/8" diam. holes around the circumference (dimensions: 53/4" diam. x 4" tall).

Kiln Cans: Steel cylinders with mesh bottoms (41/4" diam. x 6.5" tall).

Process Schedule:

Steeping: Samples are steeped for 24-48 hours (h), dependent on Thousand Corn Weight. The regimen includes 4h immersion (16C), 4h air rest (18C), 4h immersion (16C), etc., for the total steep time. Steep-out target is 45% moisture.

Germinating: Samples are germinated for 120h at 17°C and >98% humidity, with turning 3 minutes of every half hour. Moisture percent is checked/adjusted to 45% once during germination.

Kilning: Hot air is blown through the samples in a slow, controlled manner. The program lowers finished malt moisture to ~4.0%, over 24h, and consists of the following stages: 49°C for 10h, 54°C for 4h, 60°C for 3h, 68°C for 2h, and 85°C for 3h. 30 minute temperature ramps are used between all but the first plateau.

Joe White Malting System:

These two machines were designed by Joe White Maltings, and manufactured in 1998 and 2000, respectively.

Steeping, Germination, Kilning are performed in one main cabinet. 170g (dry basis) sample malting is typical, but boxes are available for a range of sizes: 50-1000g.

Steeping: Samples are steeped at 19°C for 8 hours wet stage x 8 hours air rest x 5 hours wet stage x 5 hours air rest x 2 hours wet stage x 2 hours air rest x 2 hours wet stage. (During air rests 30% flow is used with 0% recirculation). Water rises in the chamber and immerses the barley during wet stages; the water drains for air rests.

Germination: The samples are germinated at 18°C for 48 hours, then 17°C for 24 hours, and 16°C for 24 hours. 30% air flow with 0% recirculation is maintained throughout and 4 full turns are completed every 2 hours. The cabinet humidity is >90%. Humidified air is blown up through the samples throughout this stage.

Kiln Cycle: 40% air flow is used with 0% recirculation in stages 1-3, 50% recirculation during the fourth stage, and 75% recirculation during the final stage. The stages are: 10 hours (49°C), 4 hours (54°C), 3 hours (60°C), 2 hours (68°C), and 3 hours (85°C); 30 minute time ramps are used between stages.

The dried culms are removed and the samples rest/"equilibrate" for one week prior to quality analyses.

Though the malting schedules use very different time and temperature profiles, both systems yield similar finished malt. These schedules were designed to produce adjunct lager type malts with malting barley varieties.

*"Experimental Malting Equipment" brochure. Standard Industries, 9 South 9th St. Fargo, North Dakota