# Physical Stability of Beer

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Key Words: *Alcohol cooling test, Chill haze, Rapid cooling test.*

## CONCLUSIONS

1. Neither the rapid methanol cooling test at 0°C nor the rapid ethanol cooling test at −5.5°C could be significantly correlated with the ASBC BEER-27 (1) three-month beer stability test. Only one collaborator was able to obtain a statistically significant correlation with the rapid ethanol cooling test at −5.5°C.
2. Three collaborators were able to significantly correlate their forcing tests to the ASBC BEER-27 Test.

## RECOMMENDATIONS

This subcommittee should be discharged until such time as another rapid method(s) is available for test.

## PROCEDURES

For an initial round of tests, the collaborators were asked to establish how much ACS reagent grade methanol was necessary to add to 200 ml of their degassed beer at 0°C with stirring for 30 min in order to generate a haze comparable to either their forcing tests or, preferably, the ASBC test. They were then to perform this rapid methanol test on 10 separate release tanks of the same beer and report the nephelometric haze value of these beers in triplicate. They were also asked to test these same beers with their normal forcing test and the ASBC three-month test.

For the second round, the collaborators with Helm radiometers were asked to rigorously follow the Chapon (3) type conditions used by collaborator 8 in the first round. Again they were asked to obtain their own force test data. Thus, they were instructed to add 7% (14 ml) absolute ethanol to 200 ml of degassed beer. The samples were to be attemperated for 20 min at 20°C before cooling in a bath at −5 to −8°C for 50 min. After this cooling, the bottles were to be quickly placed into a small ice-alcohol water bath containing a wetting agent before the haze readings of the bottled beers were quickly obtained in the Helm radiometer.

## RESULTS AND DISCUSSION

The ability to rapidly predict the chillhaze stability of a beer would be an aid to determine the type and amount of a chillproof treatment to apply. Brewing quality control departments would also benefit from the availability of a rapid and reproducible procedure. To predict chillhaze, last year's subcommittee (2) evaluated three rapid methods: a methanol chill test with excess methanol, a tannin protein precipitation test, and a saturated ammonium sulfate precipitation test. None of these methods fulfilled the objective. It was decided to pursue a modification of the Chapon (3) method for this year's work, since one of the collaborators routinely checks for stabilization effectiveness by the addition of 6% denatured ethanol to beer held at 0°C for 30 min.

The first round of tests was according to the procedure described above; results are shown in Table I. No statistically significant correlation was achieved for this rapid test and any collaborator

**TABLE I**
**Correlation Coefficients[a] for Rapid, Forcing, and Three-Month Haze Tests**

| Collaborator No. and Instrument | Package | Alcohol | Correlations | | | Forcing Test Conditions |
|---|---|---|---|---|---|---|
| | | | Alc./Force | Alc./ASBC | Force/ASBC | |
| 1 Coleman | Cans | 6% MeOH | 0.00 | 0.08 | −0.31 | 5 day tumble/temp. program |
| 2 Helm | Bottles | 6% MeOH | −0.17[b] | −0.09 | 0.13 | 49°C/7 days<br>0°C/1 day |
| 3 Helm | Bottles | 7.5% MeOH | 0.44[b] | −0.20 | −0.22 | 60°C/5 days<br>0°C/1 day |
| 4 Helm | Bottles | 6% MeOH | −0.55 | 0.54 | −0.59 | 60°C/5 days<br>0°C/1 day |
| 5 Light box | Bottles | 7.5% MeOH | 0.35[c] | ... | ... | 29.4°C/14 days<br>0°C/1 day |
| 6 Coleman | Bottles | 5.0% MeOH | 0.55 | 0.81 | 0.84 | 60°C/3 days<br>0°C/1 day |
| 7 Coleman | Bottles | 8% MeOH | −0.30 | −0.41 | 0.75 | 60°C/3 days<br>0°C/1 day |
| 8 Helm | Bottles | 7% EtOH | ... | 0.79[d] | 0.90 | 50°C/7 days<br>0°C/1 day |
| 2 Helm | Bottles | 7% EtOH | 0.16 | 0.28 | 0.86 | 50°C/7 days<br>0°C/1 day |
| 3 Helm | Bottles | 7% EtOH | −0.42 | −0.42 | 0.82 | 50°C/7 days<br>0°C/1 day |
| 4 Helm | Bottles | 7% EtOH | 0.26 | −0.63 | 0.36 | 50°C/7 days<br>0°C/1 day |

[a] Ten different release tanks were used for this correlation. Significance for n at n = 10 is +0.63 at $P = 0.05$ and ±0.76 at $P = 0.01$ (4).
[b] The MeOH Rapid Test with 60 and 120 min time intervals at 0°C also showed no correlations for collaborators 2 and 3.
[c] Based on visual turbidity determinations.
[d] Attained with Chapon conditions, 7% EtOH, −5.5°C for 50 min.

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force test. Only collaborator 6 obtained a statistically significant correlation of the rapid test with the ASBC three-month test, and collaborators 7 and 8 also had a statistically significant correlation between their force tests and the ASBC three-month test. Collaborator 8 was able to apply 7% ethanol addition at −5.5° C for 50 min to obtain a statistically significant rapid test correlation with the ASBC three-month test. This prompted a second round of testing with these specified conditions.

Only subcommittee members who had a Helm radiometer were able to participate in this round because of the experimental limitations of the Coleman nephelometer at temperatures below 0° C. Collaborators 2,3, and 4 were unable to verify the correlation reported by collaborator 8 with their beers, nor did the rapid ethanol test correlate with their force tests. However, both collaborators this time observed a statistically significant correlation of their force tests with the ASBC three-month test. Thus, the data in Table I suggest that a rapid alcohol test either at or below 0°C is not worth further pursuing on the typical beer products of the USA and Canada. Several collaborators have expressed renewed interest in their force test as a result of their participation in this work.

Some comments should be made about experimental design. Originally, collaborators were asked to obtain their data with different brands of their company's beer, making it more probable to thereby select beers with a greater difference of chillhaze potential (as opposed to different tanks of the same brand) and thus be able to expand the FTU range for each correlation. A potential problem with this approach was that the various brands would inherently respond in a different manner to the various tests and thus negate any possibility of correlation. An attempt to combine these approaches was made and no significant correlation was found. The combined data of collaborators 2, 3, 4, 6, and 7 gave a correlation coefficient of −0.003 for n = 50. These combined data represent approximately 33% of the Helm radiometer FTU scale, which should have been a large enough range in which to observe any statistically significant correlation.

### Literature Cited

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