

Tech Corner

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By Ken Woodson

What is the difference between apparent attenuation and real attenuation? The term attenuation in brewing means the reduction in the wort's specific gravity caused by the conversion of sugars into alcohol and CO₂. Apparent attenuation (AA) is defined as:

$$AA = \frac{(OE-AE)}{OE} * 100\%,$$

where

OE = original extract of the wort before fermentation, measured in gravity units

AE = apparent extract after fermentation, measured in gravity units.

For example, if the specific gravity of your wort is 1.052 (52 gravity units) just prior to fermentation and the specific gravity decreases to 1.011 (11 gravity units) after fermentation, then the apparent attenuation is:

$$\begin{aligned} AA &= \frac{(52-11)}{52} * 100\% \\ &= 78.85\% \end{aligned}$$

That is, the measured gravity units have fallen 78.85% of the original gravity unit amount, due to fermentation of the wort.

Specific gravity measures the density of the wort or beer relative to the density of water. When we measure the apparent extract after fermentation, alcohol has been introduced, which distorts the true gravity of the extract remaining after fermentation.

A more accurate measure of the extract after fermentation is real extract (RE). If we substitute RE for AE in the apparent attenuation formula we obtain the real attenuation (RA), defined as:

$$RA = \frac{(OE-RE)}{OE} * 100\%,$$

where

OE has the same definition as before, and

RE = real extract after fermentation, measured in gravity units.

Conceptually, to determine the real extract (RE), after fermentation, you would have to remove the alcohol (by boiling) and replace the alcohol by an equal amount of distilled water. Since we are making beer and not whiskey, you probably do not want to remove the alcohol from your beer just to determine the RE. Fortunately, for normal gravity beers there is a formula to estimate the real extract (RE) in terms of original extract (OE) and the apparent extract (AE). Namely,

$$RE = .8114*AE + .1886*OE.$$

Returning to the original example with OE=52 and AE=11, the real extract is:

$$\begin{aligned} RE &= .8114*11+.1886*52 \\ &= 18.73. \end{aligned}$$

And the real attenuation (RA) is:

$$\begin{aligned} RA &= \frac{(52-18.73)}{52} * 100\% \\ &= 63.98\% \end{aligned}$$

Note that real extract (RE) is always greater than apparent extract (AE), because each value is measured after fermentation, and alcohol is less dense than water. As a result, real attenuation (RA) is always less than apparent attenuation (AA). In fact, for most normal gravity beers, apparent attenuation is roughly 1.2 times the real attenuation.

If you would like to read more about attenuation here is a good resource:

Brew By The Numbers – Add Up What’s In Your Beer, Zymurgy Summer 1995, by Michael L. Hall