

## APPLICATION NOTE

# WHERE TO MEASURE DISSOLVED OXYGEN IN THE BREWERY

## In Wort

Once in the brew kettle, boiling removes dissolved gases. This de-aerated wort is then normally cooled to around 10° C to 15° C before transfer to the fermenter. Yeast is then added together with oxygen to allow yeast growth.

## Air or Oxygen?

Air contains roughly 4/5th nitrogen and 1/5th oxygen. If air is injected into the wort in an unpressurized fermenter, the wort will at most contain 8-12 ppm oxygen, depending on the temperature.

If pure oxygen is injected and allowed to saturate the wort, then dissolved oxygen levels could rise to greater than 15 ppm.

Modern brewery practice has seen a large changeover to pure oxygen addition. The tables that follow give the basis for this rationale.

## Air injection—Advantages

- Compressed air is inexpensive.
- It will saturate to approximately the level required by the yeast, although dissolved oxygen should still be measured to ensure consistent fermentations.

## Air injection—Disadvantages

- Air must be sterilized.
- The large volume of N<sub>2</sub> introduced with the air is very difficult to fully dissolve and will pass through the fermenter, causing thick top foams.
- Aromatic flavor compounds can be sparged from the wort by these bubbles.

## O<sub>2</sub> injection—Advantages

- Manufactured oxygen is free from microbes.
- Only the quantity of oxygen required for the fermentation needs to be injected, to reduce energy costs.
- Nitrogen foaming will be eliminated in the fermenter.
- Concentration levels are adjusted easily and accurately.
- Since oxygen is very soluble, costs are minimized.

## O<sub>2</sub> injection—Disadvantages

- It is easy to over oxygenate unless oxygen concentrations in the wort are monitored.



## CO<sub>2</sub> Collection

CO<sub>2</sub> being harvested should be checked with an oxygen analyzer to ensure all the air is vented off.

## Inert Purging of Vessels

A major source of air contamination in bright beer occurs when it is transferred between vessels. All pipes and filters should be filled thoroughly with water and all vessels purged with pure N<sub>2</sub> or CO<sub>2</sub> before receiving beer. In small breweries it is possible to water pack the vessels and drain them under N<sub>2</sub> or CO<sub>2</sub>, but this is not feasible in large breweries due to the volume of water needed.

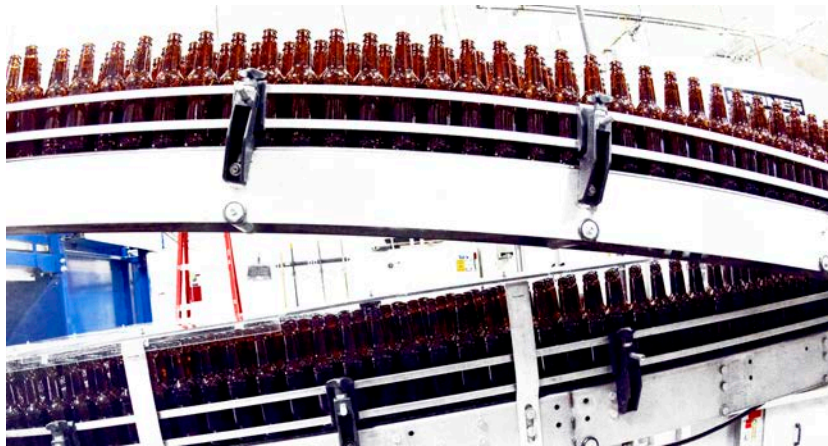
## Finished Beer

After every tank transfer, or operation such as filtration, the beer should be checked to ensure it is not picking up dissolved oxygen.

The major source of air contamination is inadequately purged vessels. Leaking pump glands valves, filter aid dosing pumps, and centrifuges can also allow air ingress.

By measuring throughout the process it is possible to identify the source of any air contamination.

## In Package



The packaging process has the potential to be another major source of air contamination. Care needs to be taken to make sure air is excluded both from the container before filling and from the headspace of the filled package

Kegging can usually be carried out successfully without air ingress, but the keg must be evacuated to remove air before being filled with beer and the keg line counter pressured with oxygen-free CO<sub>2</sub> or N<sub>2</sub>.

Canned beer needs to have as much air as possible removed from the packages before the filling process begins. Once the cans are full, it is important to optimize the seaming process, so that as little oxygen as possible is trapped in the container before the can end is applied.

Bottles provide a similar challenge, but since they are a rigid package they can be pre-evacuated before filling and a fine needle jet of water can be injected into the filled bottle to promote fobbing. As the beer fobs on its way to the crowner, air in the headspace will be driven out.

## Tank Purging

When purging tanks to remove oxygen, it is best to use a low pressure gas supply and to control the gas flow with valves on the inlet and outlet. This allows the purge gas to gently fill the vessel, and minimizes gas wastage. Tank purging should be done as close to filling as is reasonable.

When using CO<sub>2</sub> as the purge, always fill from the bottom and vent at the top of the tank since CO<sub>2</sub> is considerably denser than air.

If the purge gas enters too rapidly, usage will be very high and turbulence in the tank may even extend the purging time.

Typical acceptable oxygen levels after purging are in the range of 0.2%–0.5% or less.

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