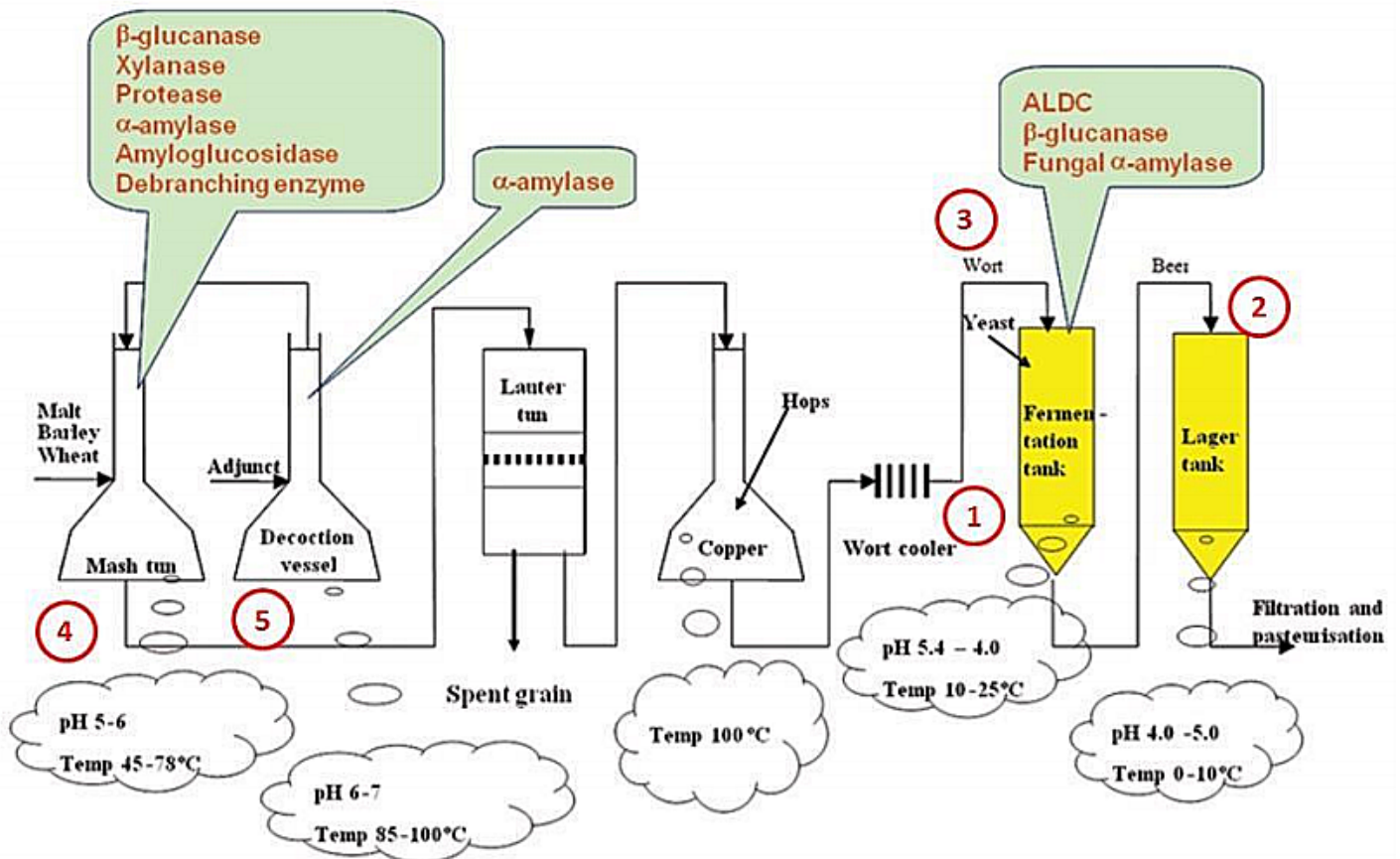


## Introduction

Brewery is facility to produce beer. Breweries process is the manufacturing process of beer, which is a fermented beverage with low alcohol content made from various types of grain. Wheat, maize and other grains can be used for this. Brewing process starts from malted barley that is to form a mash by milling and mixing with hot water. The malt starches are converted to sugars during this process. This sugar rich water is then strained through the bottom of the mash and will be called as "wort". Then the wort will be brought to boil by bringing to the brew kettle. For bitterness or aroma hops are to be added at different times during the boil. Then the wort is cooled and aerated. And brewers yeast is added for fermentation. From the sweet wort the yeast produces carbon dioxide, alcohol and other byproducts. The GREEN BEER undergoes maturation after fermentation. Filtration and carbonation are the last steps. Finally the beer will be stay in holding tank until it is bottled or kegged.



## Beer Fermentation

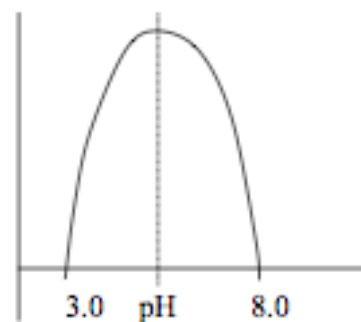


The conversion of fermentable carbohydrates in the wort to alcohol, carbon dioxide and numerous by products by the yeast is called fermentation. The aroma, taste and other characteristics of the beer is depend on the effect of these byproducts. The composition of the wort, yeast and conditions play very important role in fermentation.

## Application Overview

### pH Measurement in Breweries

1. In brewing water: pH determines the acidity or alkalinity of brewing water. A solution at pH 5 is 10 times more acidic than a solution at pH 6, 100 times more acidic than a solution at pH 7, and 1,000 times more acidic than a solution at pH 8 because it is a logarithmic scale.
2. In measurement of titratable total acid in beer/wine/beverages: The sum of all free acids contained in the beverage except carbon dioxide is known as titratable total acid. To an agreed pH value when titrated with a strong base the amount of free acid can be determined. Carbon dioxide is eliminated before titration. When the pH level is within 0.5 pH units of the set point, alarm will be alerted to the user. The beverage is too acidic for consumption if the maximum concentration is exceeded.
3. pH measurement in wort: The flavor of the final product in beer production is controlled by careful observation of pH and DO values.
4. pH measurement during mashing: pH values to be maintained during amylase activity is between 5.2 to 5.6. The mash must be made more acidic since the malts usually have higher pH values. This is called as souring the malt.
5. The enzymes in mashing: pH and temperature play very important role in the activity of enzymes. The activity of the yeast is at maximum when there is an optimum temperature and an optimum pH.
6. Important of PH applications in breweries: # The degree of enzyme activity determines by optimally adjusting the pH value. # When brewing beer, pH should be maintained at pH 5 for endopeptidase which is responsible for decomposing protein in mash.



## Turbidity Measurement in Breweries

There are totally 5 stages in Breweries where turbidity is monitored.

1. Hot water turbidity: Malt and hops in water are cooked and then separation of spent solids from the mixture takes place to extract wort. During the separation process, measuring the extract solids concentration and turbidity will give important data for quality evaluation and separation efficiency control. Final beer flavor and quality are dependent on consistent and uniform wort clarity. Overload of the centrifuge and optimization of the whirlpool hot break is controlled by measuring turbidity.
2. Yeast concentration and pitching: Yeast concentration must be measured precisely and added to the fermentation vessel in exact proportion so that fermentation stage can follow its normal course. This is achieved by using two turbidity meters, one used to measure turbidity before adding yeast to the wort and another after adding.
3. Fermentation: During fermentation, it is necessary to sample the brew for yeast continuously. This will tell us when the fermentation is approaching or has reached the end point. This sampling exposes the process to contamination that may destroy the full batch.
4. Filtering: Filtering is to remove the solid from beer. For quality the amount of turbidity is important. This is measured as beer fed through the filters and this will ensure that they are not overloaded. This helps to control recycling and addition of filter assist in the polishing process.
5. Quality Control: At the final stage beer is monitored for color and turbidity to ensure its quality and consistency of the outcome. Too much turbidity indicates that the beer is cloudy and unappetizing.



## Dissolved oxygen measurement in Breweries

Brewery yeast propagation requires successful dissolution of oxygen in to growth media without excessive fobbing.

## Summary: Common for All the Measurement Points

### Typical problems:

Coating on the sensor

### Remedies:

Frequent cleaning of the sensor

### Solutions:

1. FU20 with "/HCNF" with cleaning reagent. Alternatively, SENCOM Smart Adapter SA11 and sensor can be used.
2. Recommended Installation - in a bypass line

### Tangible benefit:

Save down time in cleaning, repeated calibration, improve end product quality.

#### Trademarks

Co-innovating tomorrow, OpreX and all product names of Yokogawa Electric Corporation in this bulletin are either trademarks or registered trademarks of Yokogawa Electric Corporation. All other company brand or product names in this bulletin are trademarks or registered trademarks of their respective holders.

#### YOKOGAWA ELECTRIC CORPORATION

##### World Headquarters

9-32, Nakacho 2-chome, Musashino-shi, Tokyo 180-8750, JAPAN

<http://www.yokogawa.com/an/>



#### YOKOGAWA CORPORATION OF AMERICA

##### YOKOGAWA EUROPE B.V.

##### YOKOGAWA ENGINEERING ASIA PTE. LTD.

##### YOKOGAWA CHINA CO., LTD.

##### YOKOGAWA MIDDLE EAST & AFRICA B.S.C.(c)

<http://www.yokogawa.com/us/>

<http://www.yokogawa.com/eu/>

<http://www.yokogawa.com/sg/>

<http://www.yokogawa.com/cn/>

<http://www.yokogawa.com/bh/>

Subject to change without notice.

All Rights Reserved, Copyright © 2015, Yokogawa Electric Corporation