BrewTimes™

NOVEMBER 2022

Balaji Enzyme and Chemical Pvt Ltd

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Introducing BrewTimes :

We M/s Balaji Enzyme & Chemical Pvt Ltd, are pleased to bring to you our November 2022 month edition of BrewTimes.

We would like to use this platform to introduce our association with BetaTec, UK for their natural solutions for ethanol recovery in grain and molasses distilleries. The product is revolutionary and unlike any in the market is 100% natural and antibiotics free. Vitahop series of products helps in ensuring optimum yield and keeps the yeast healthy all naturally.

We are extremely proud of announcing our association with IIT Bombay Research Park. We have begun a journey together to work on sustainable, reliable and innovative solutions for the Food and Beverage Industry.

About Our Company :

We M/s Balaji Enzyme & Chemical Pvt Ltd are a leading supplier of Enzymes, Filter aid, Yeast, Hops, Processing aids, Clarifiers and food fortification products to breweries, distilleries, malt extract industry, starch industry, juice and beverage industry, and other food industry.

Vitahop®

Increase profits in BIOETHANOL...naturally

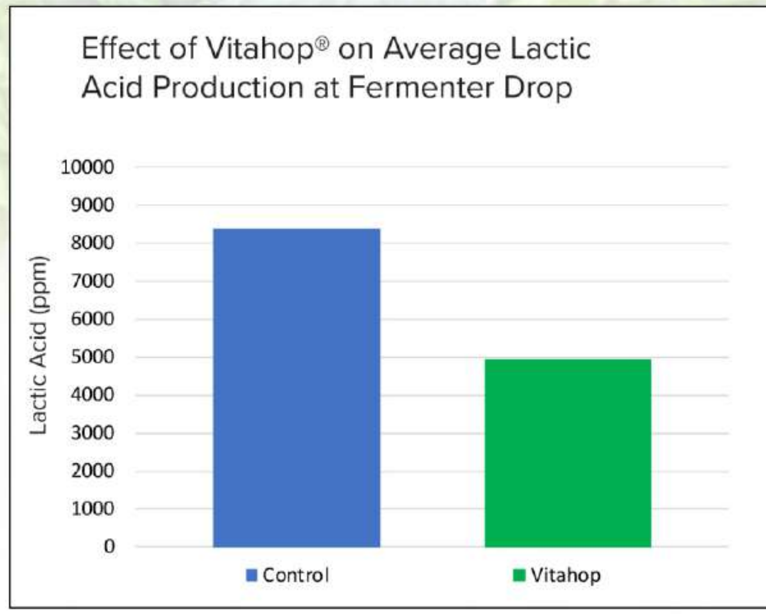
Vitahop® is a range of natural hop extracts, ideal for production of bioethanol from a range of raw material feedstocks, as they protect yeast from bacterial growth, and their acid by-products, during fermentation processes. When used as part of a planned process regime with regular additions, bacterial infections do not develop and spoil yeast fermentations.

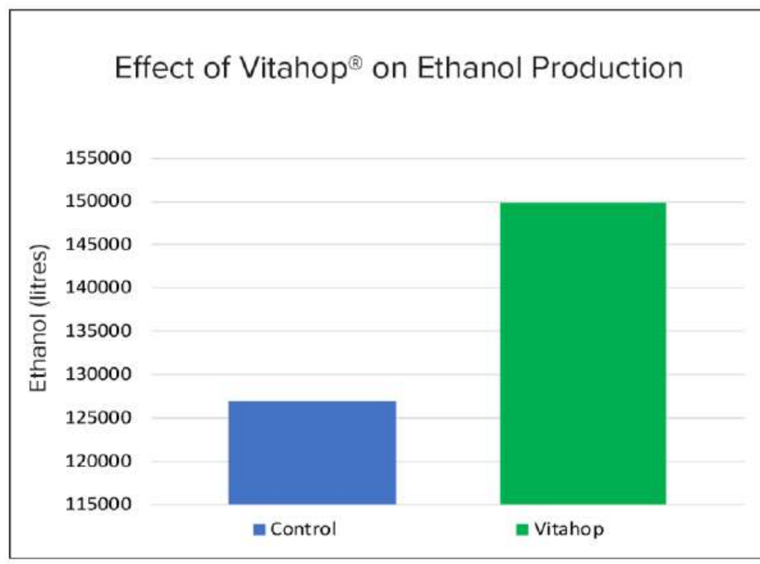
When infections do develop, they can quickly get out of control and disrupt production, potentially causing substantial losses and lost revenue. By controlling bacteria and preventing bacterial growth, catastrophic infections can be a thing of the past.

Vitahop® is used in both continuous and batch fermentations. It helps ensure healthy, vitalised yeast growth and during fermentation suppress gram positive bacteria. If bacteria are allowed to prosper, they will compete with and eventually inhibit the yeast, slowing fermentation sometimes to a complete stop, resulting in a "stuck" fermentation. Bacteria will also use up valuable feedstock producing organic acids such as lactic acid, further reducing ethanol yields. Prevent this happening with **Vitahop®.**

Key Benefits of Vitahop®

- **Maintains optimum ethanol yields**
- **Ensures reliable fermentations**
- **Keeps yeast healthy**
- **Controls bacteria**
- **Demonstrated benefits in ethanol production plants worldwide**
- **Safe and natural, easy to use**
- **Safe DDGS for animal feed**
- **A natural alternative to antibiotics**





Unpublished data BetaTec 2015

Vitahop®

BetaTec is the first company worldwide specialising in the application of hops and hop-derived compounds for use in “beyond brewing” industries. Our product portfolio includes natural fermentation aids, antibacterials, flavours and functional ingredients. Our key business areas are alcohol, yeast and sugar production.
All BetaTec products are accompanied by on-site support, process optimisation and consulting.

Please contact our technical experts to learn how Vitahop® can help you sustain improved ethanol yields.

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Great Malvern, Worcestershire WR14 3SZ
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BetaTec® hop products

“Transforming your world with our natural hop solutions”

BetaStab® XL

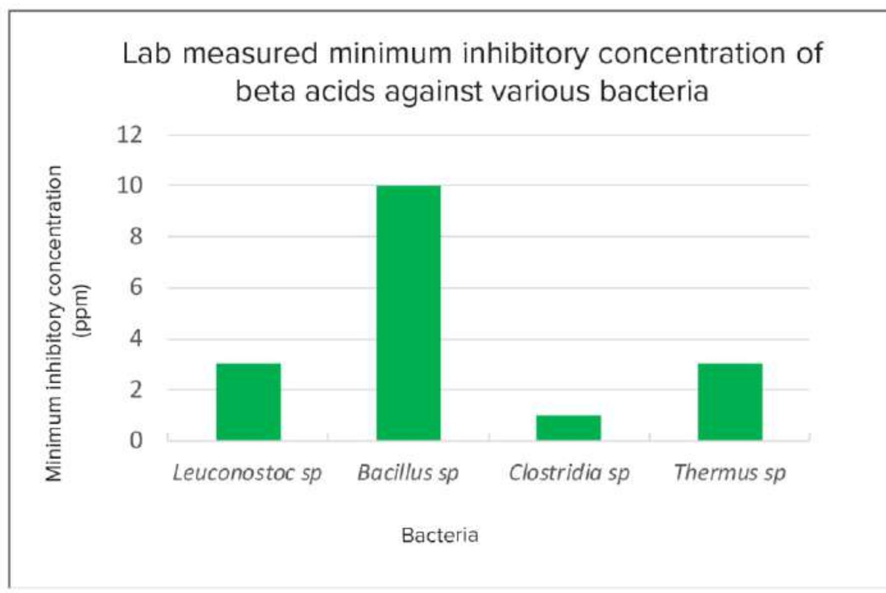
Reduce your sugar losses ...naturally

BetaStab® XL controls problematic Gram postive bacteria found in sugar extraction

Microbial sugar losses are a major problem in sugar production resulting in lower yields, increased processing problems and higher impurities such as lactic acid and dextran.

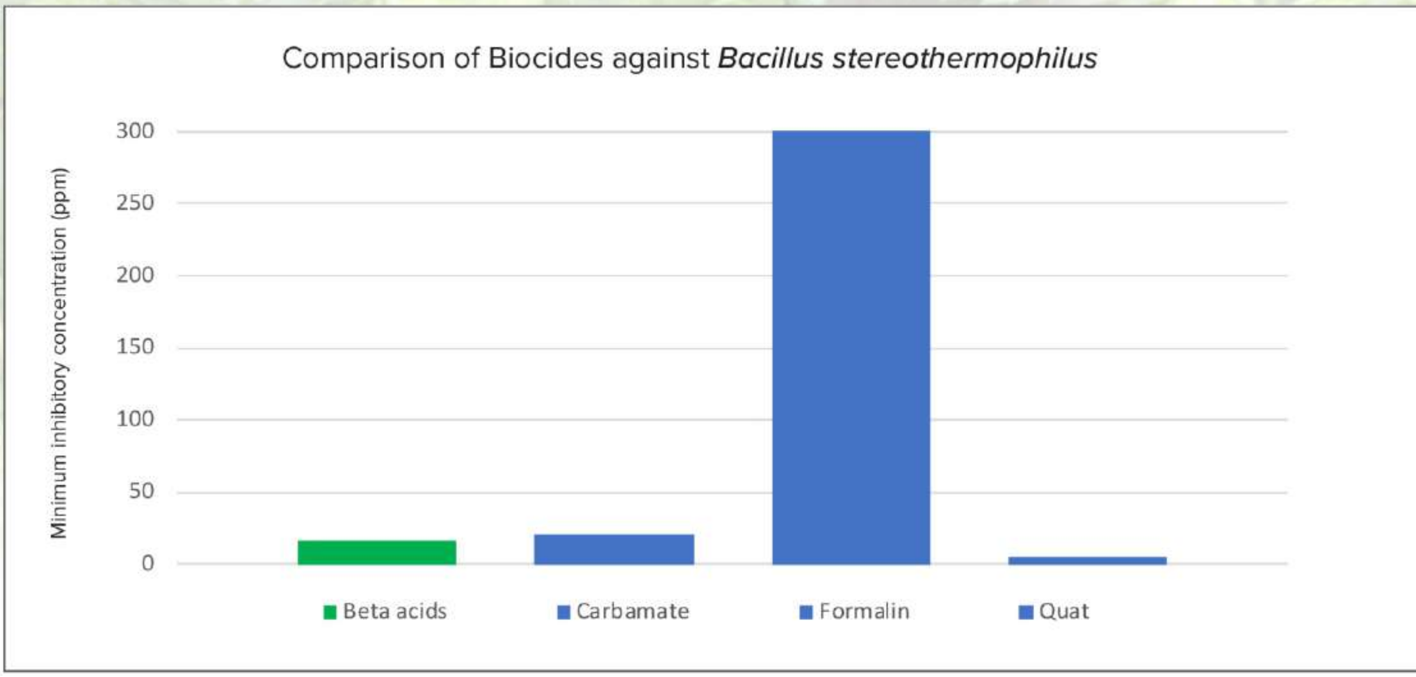
The hop product BetaStab® XL is a natural food processing aid. For more than 10 years it has proven effective at controlling bacteria in factories worldwide and is a cost effective alternative to synthetic biocides.

Our product can be applied during the production of sugar from either beet or cane. it is an aqueous solution of natural hop acids and is active over a wide range of temperatures and pH values.



Key advantages of BetaStab® XL

- **Active against bacterial contamination at ppm levels. Immediately stops bacterial growth**
- **Control of lactic acid, dextran and nitrite production**
- **Effective over a range of pH values and temperatures**
- **Demonstrated activity in sugar cane mills and sugar beet factories worldwide**
- **Cost effective alternative to synthetic biocides**
- **Can be used in thick juice storage, prolonging storage times**
- **Products are water based for ease of dosing**
- **Safe to handle and non-corrosive to equipment**
- **Coproducts suitable for animal feed**
- **Residues are beneficial for yeast and ethanol fermentation processes**



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BetaTec® hop products

"Transforming your world with our natural hop solutions"

WATER FOR BEER BREWING

BIJAY BAHADUR

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Introduction

Breweries use large amounts of water, (generally called `liquor' in the UK). As beers usually have water contents of 91-98% and the amounts lost by evaporation and with by-products are relatively small it follows that large volumes of waste water are produced. Sometimes large volumes are produced because of operational inefficiencies but breweries operating in efficient but different ways, and with different product ranges, have substantially different water requirements. Apart from brewing, sparging and dilution liquors, water is used for a range of other purposes. These include cleaning the plant using manual or cleaning-in-place (CIP) systems, cooling, heating (either as hot water or after conversion into steam in a boiler), water to occupy the lines before and after running beer through them, for loading filter aids such as Kieselguhr, for washing yeast and for slurrying and conveying away wastes as well as for washing beer containers such as returnable bottles and kegs. The acquisition and treatment of liquor and the disposal of the brewery effluents are expensive processes.

Historically, different regions became famous for particular types of beer and in part these beer types were defined by the waters available for brewing. Thus Pilsen, famous for very pale and delicate lagers has very soft water. Burton-on-Trent, with its extremely hard water, rich in calcium sulphate, is famous for its pale ales while Munich is well-known for its dark lagers, and Dublin (which has similar soft water) for its stouts. Breweries may receive water from different sources, which may be changed without warning. Water supplies may vary in their salt contents between day and night, from year to year and between seasons. It is now usual for breweries to adjust the composition of the water they use. In some few regions of the world saline water must be used, even sea water. In principle, several desalination methods might be used, but in practice it seems that purified water is obtained from sea water either by a highly thermally efficient distillation, which is very costly, or by reverse osmosis. Usually, breweries obtain their water either from their own wells, springs or boreholes (surface waters are avoided where possible).

Most brewers find it necessary to treat the water coming into the brewery. The variety of substances that may occur in water is large, and different treatments are needed to deal with them. Different waters require different treatments and brewers require grades of water treated in different ways depending on the uses to which it will be put. In some instances, it may only be necessary to pre-treat the liquor, while in other cases extensive further treatment will be needed.

Because each water treatment technology removes a specific type of contaminant, none can be relied upon to remove all contaminants to the levels required for critical applications. A well-designed water treatment system uses a combination of treatment technologies to achieve final water quality.

Each of the treatment technologies must be used in an appropriate sequence to optimize their particular removal capabilities. The schematic below shows a central laboratory water treatment system designed to produce water for critical applications.

The first step is pre-treatment equipment specifically designed to remove contaminants in the feed water. Pre-treatment removes contaminants that may affect treatment equipment located downstream especially ion exchange, reverse osmosis (RO) systems. Examples of pre-treatment are:

- Particulate filters for sediment/silt/particulate removal
- Carbon filters (or tanks) for chlorine removal,
- Softening agents to remove minerals that cause "hard" water.

The next treatment step is either Ion Exchange or Reverse Osmosis (RO). RO removes 90 to 99% of all the contaminants found in water. It is the heart of any well-designed water treatment system because it effectively removes a broad range of contaminants.

However, the tight porosity of the RO membrane limits its flow rate. Therefore, a storage container is used to collect water from the system and distribute it to other points-of-use such as polishing systems. Polishing systems purify pre-treated water, such as RO water, by removing trace levels of any residual contaminants. Polishing elevates the quality of pre-treated water to “ultrapure" water.

A polishing system is designed to remove residual traces of impurities from water already pretreated by some other means (such as reverse osmosis or ion deionization). Treating raw tap water using such a system would quickly exhaust its capacity and affect final quality.

A typical polishing system may consist of activated carbon, mixed-bed deionization, organic scavenging mixtures and 0.22 μm final filtration. Systems can also be enhanced with ultra-filtration, ultraviolet oxidation or other features for use in specific applications.

This combination of treatment technologies, combined with proper pre-treatment, will produce water that is virtually free of ionic, organic and microbial contamination.

General Requirements

Water, in terms of quantity, is the most important raw material of beer. Therefore, the chemical and biological composition of water has a significant relevance in beer production, and there is no step in the brewing process that is not influenced by the constituents of water. Consequently, treatment of water is in many cases necessary. Since the breweries obtain their process water either from public mains, river and/or from their own wells, water treatment needs to be addressed in two aspects:

- Treatment of crude water to fulfill legal criteria.
- Treatment of drinking water due to technological brewing requirements.

Water used in the Brewery

The use of water in the brewery can be divided into three main categories:

1. Brewing Water
2. Process Water-Water for Cleaning & Sterilization
3. Service Water

Brewing Water

Brewing water plays a very important role in the flavor of the beer. Water makes up 95% of beer ingredients by weight, the majority of brewers rarely consider what type of water to use. High consumption of good quality water is characteristic of beer brewing. Most brewers rarely give it much thought, and water is the least appreciated of beer ingredients.

At the other extreme, many brewers spend hard earned money on spring water because they don't fully understand how water affects flavor. More than 95% of beer is water and an efficient brewery will typically use between 4 and 5 liters of water to produce one liter of beer. Some breweries use much more water, especially small breweries. In addition to water used for beer mashing, wort boiling, sparging at Lauter Tun, beer or wort filtration, de-brewing, and bottle washer also use water for heating and cooling as well as COP (cleaning out place) and CIP (cleaning in place) of vessels, tanks and pipe lines.

To know the character of the local available water source as well as how to adjust it to improve your beer is a critical skill, particularly for more advanced brewers.

Table 1:Brewing Water Composition Requirements

Composition	Max. Level (mg/l)	Referred Concentration (mg/l)
Total Solids	500	-
Alkalinity (as $CaCO_3$)	50	0 – 25
Chloride	250 – 300	50 - 200
Sulfate	500	-
Nitrate	30	0 – 0.2
Fluoride	1.2	Not necessary
Silicates (as SiO_2)	10 - 50	0.1
Arsenic	0.05	-
Chromium	0.05	-
Copper	1.0	-
Lead	0.05	-
Manganese & Iron	0.1	-
Phenolic substances	0.001	-
Selenium	0.01	-
Zinc	5	-
Oxidizable Substances ($KMnO_4$)	< 100	-
Residual Alkalinity	-	2 – 3 ^{0}D hardness
Calcium (kettle & sparge)	-	40 – 70
Calcium (In wort boiling)	-	80 – 100
Calcium (remaining in beer)	-	60 – 80

Water for diluting beer (for high-gravity brewing) must correspond to the following average specifications:

- Dissolved oxygen content as low as possible (<0.05 ppm)
- The CO2 content of the water should be equal to or slightly above the level of the beer to be diluted. Attention should be paid to the O_2 content of the Co_2.
- The water must be free of microorganisms.

Process Water-Water for Cleaning & Sterilization

For cleaning and sterilization operations, it is necessary to pay great attention to the water quality. This water should be of potable standard and free from off flavours for cleaning operations. For sterilization, the water must be free of microorganisms and off flavours. For cleaning and rinse water, it is desirable to use potable water containing 0.1 mg/l of free chlorine at the point of use.

Attention must be paid to the possibility of interaction of Phenolic compounds with chlorine with formation of chlorophenols. The flavours threshold of chlorophenols is very low. Water for dissolving detergents should be low. Water for disinfectants should be soft and sterile.

Service Water

Water for boilers must correspond to the specifications of the boiler IBR Act or the manufacturer of the boiler.

Water for refrigeration plant must also correspond to the specifications of the manufacturer of the compressors or refrigeration plant. Chemical and microbiological treatment of water is necessary.

Water for pasteurizer must be treated to reduce its content of minerals salts, and to prevent the growth of algae or microorganisms. The pH of the water must be constantly controlled. The water treatment must be compatible with the materials of the pasteurizer so as to avoid any corrosion.

Water impacts beer in 3 ways

1. Mashing process – impact on enzyme efficiency and flavor of wort.
2. Hop utilization – water pH effect on hop utilization.
3. Beer flavor – water adds flavor directly to the beer itself.

The effect of brewing water on beer can be characterized by six main water ions: Carbonate, Sodium, Chloride, Sulfate, Calcium and Magnesium.

We can get a water report from your local municipality/Govt. approved laboratory for the mineral content of the water sample to be used for brewing process. On a water report we will often see these listed as parts per million (ppm) which is equivalent to one milligram per liter (mg/l). Each of the critical ions for lager beer type is described below:

- Soft water with low mineral content, low carbonates
- Calcium ions are important at levels > 30 mg/l

Brewing water can be adjusted by the addition of some brewing salts.

Brewery Water Consumption

On the basis of water usage ratio of 6 hl/hl of beer, the following typical consumption proportions can be made:

- Brewing Water : 45%
- Process Water : 52%
  (Water for Cleaning & Sterilization)
- Service Water : 3%

Of the 6 hl of water consumed per hl of beer, following are the estimated break-up of the usages, losses of water at various stages in the brewery along with generation of effluent.

- In finished beer : 15%
- Loss by evaporation : 3%
- Loss with spent grain and spent yeast : 2.5%
- Effluent : 60.5%
  (Brewhouse, Fermentation, Lagering, Filtration, Bottle Washer, Filler, Pasteurizer, Cleaning and CIP etc.)
- Effluent-Domestic : 2%
- Effluent-Water treatment : 17%

Water Treatment

There are a number of chemical and physical alternatives available for water treatment. In the scope of this chapter, only the most common methods will be discussed. In recent years the following compounds have had to be disposed of as the most common problematic materials: iron, manganese, nitrates, halogenated hydrocarbons as well as pesticides.

Table 2: Quality criteria of brewing water

Characteristic	Value	Reason
pH	7 - 8	Too acidic: danger of corrosion; Too basic: inhibition of enzymes
p	0 - 0.3 mval/l	Water does not aggression CO_2, but only low fraction of CO_3^{2-} and OH^- ions
m	0.7 - 1.2 mval/l	Only low residual of acid destroying HCO_3^-; low fraction but positive for palateful taste
Non-carbonate hardness	At least twice, better three times the carbonate hardness	Balanced alkalinity
Residual alkalinity	-2 to 2 ^{0}dH < 5 ^{0}dH < 10 ^{0}dH	For Pilsner beers For light beers For dark beers
Sulfate	100 - 150 mg/l	Dry bitterness, tendency to a hop aroma
Chloride	< 150 mg/l 300 mg/l	Salty taste, corrosion Toxic to yeast
Nitrate	< 25 mg/l	Fermentation disturbances are avoided; low value is better as nitrate is also introduced into the beer by hop and malt
Sodium	30 – 60 mg/l	Sour and salty taste
Potassium	300 – 500 mg/l	Saline effect
Iron	< 0.1 mg/l	Flaws in taste, danger of gushing, danger of turbidity, beer taste in stability, brown colour to the foam
Zinc	0.08 – 0.20 mg/l 0.6 mg/l	Activates fermentation & limits formation of H_2S Inhibits yeast growth & fermentation
Copper	> 10 mg/l	Toxic to yeast
Manganese	< 0.2 mg/l	Affect colloidal stability
Free aggressive CO_2	-	Danger of corrosion

This process is necessary-even from a brew technological point of view – if the iron concentration is above 0.12 mg/l and the manganese concentration is above 0.05 mg/l. Through oxidation with adequate aeration devices, water - insoluble compounds are formed and removed from the water by filtration.

Through aeration, the soluble iron (2+) compounds are transferred to insoluble iron (3+) compounds. Organically bound iron is precipitated by the addition of oxidants (e.g., cupper permanganate and flocculant Fe (2+) salts). The reaction is pH dependent, where the oxidation rate increases with higher pH.

Demanganization is a considerably more sensitive process. Manganese (2+) is oxidized to manganese (4+). A precipitation of manganese oxide is achieved at a pH above 9 by the addition of oxidants (e.g., potassium permanganate). A bio-chemical oxidation by manganese bacteria can occur simultaneously on the filter bed. Consequently, a longer adjustment period during demanganization is to be expected as compared to the deferrization filter.

Two separated filter units are normally advantageous for the removal of iron and manganese. Deferrization occurs in the first filter (saving cleaning water, iron compounds are easily rinsed off). In the second filter demanganization is carried out (increased holding time, gradual coarsening of the filter material through black manganese dioxide).

Nitrate Reduction

Because of the intensive use of nitrogen fertilizers in agriculture, the nitrate level of ground waters has significantly increased.

Chemical as well as biological methods are used for the removal of nitrated from crude water. The following methods of treatment are available:

Chemical Treatment:
- Ion Exchanger
- Reverse Osmosis
- Semi-permeable Membranes
- Electrolysis

Biological Treatment:
- Heterotrophic Denitrification
- Autotrophic Methods

Deaeration

The high-gravity brewing procedure involves Deaeration techniques for dilution water. Several techniques are available such as:

- Thermal Degassing
- Vapour Stripping
- Vacuum Degassing
- Combined Systems
- CO2 Stripping

Volatile substances (e.g., halogenated hydrocarbons) can be expelled to a large extent by “stripping” the water with air (e.g., intensive aeration).

Dechlorination (Carbon Adsorption)

Water used in the brewing process should be from of chlorine. Chlorine can be adsorbed by active carbon.

Carbon absorption is a widely used because of its ability to improve water by removing disagreeable tastes and odors, including objectionable chlorine. Activated carbon effectively removes many chemicals and gases, and in some cases, it can be effective against microorganisms. However, generally it will not affect total dissolved solids, hardness, or heavy metals. Only a few carbon filter systems have been certified for the removal of lead, asbestos, cysts, and coliform. There are two types of carbon filter systems, each with advantages and disadvantages: granular activated carbon, and solid block carbon. These two methods can also work along with a reverse osmosis system.

The ability of an activated carbon filter to remove certain microorganisms and certain organic chemicals, especially pesticides, THMs (the chlorine by-product), trichloroethylene (TCE), and PCBs, depends upon several factors, such as the type of carbon and the amount used, the design of the filter and the rate of water flow, how long the filter has been in use, and the types of impurities the filter has previously removed.

The carbon adsorption process is controlled by the diameter of the pores in the carbon filter and by the diffusion rate of organic molecules through the pores. The rate of adsorption is a function of the molecular weight and the molecular size of the organics. Certain granular carbons effectively remove chloramines. Carbon also removes free chlorine and protects other treatment media in the system that may be sensitive to an oxidant such as chlorine.

Carbon is usually used in combination with other treatment processes. The placement of carbon in relation to other components is an important consideration in the design of a water treatment system.

Advantages:

- Removes dissolved organics and chlorine effectively.
- Long life (high capacity).

Disadvantages:

- Can generate carbon fines.

Activated - Carbon Filtration (ACF)

Activated-carbon filtration is useful for polishing and removal of problematic substances in the water. There, contaminants adsorb onto the surface of the activated carbon and are thus fixed. In this repeatedly recommended and used process, the problem is shifted as this alternative provides no elimination and mineralization of these problematic substances. The activated-carbon filter serves, among other things, for the removal of:

- Odorous substances and flavorings.
- Discoloration.
- Organic water constituents (e.g., pesticides).
- Halogenated hydrocarbons.
- Chlorine and chlorine derivatives.
- Microorganisms.

In order to enable sterilization of the filters and thus avoid microbiological contamination, the activated-carbon filter should be made out of stainless steel. Active carbon is widely used due to its large specific surface area (700 – 1500 m2/g).

Combination Processes Using Oxidation/UV Irradiation

Both sterilization and mineralization of organic contaminants in the water are possible through the combination of chemical and physical reaction mechanisms. The chemical oxidation occurs with hydrogen peroxide or ozone. Thin-walled radiators with high application rates are used in the subsequent UV irradiation.

Common Processes for Brewing Water Treatment

The composition of the brewing water is of great importance for the quality as well as the character of the beers. Apart from the change in hardness former (softening), the reduction of nitrate concentration in the brew water plays an ever-increasing role.

Treatment with Lime

Lime treatment precipitates alkaline-earth bicarbonates by the following reactions:

$$Ca(HCO_3)_2 + Ca(OH)_2 \rightarrow CaCO_3 + 2H_2O$$
$$Mg(HCO_3)_2 + Ca(OH)_2 \rightarrow CaCO_3 + MgCO_3 + 2H_2O$$
$$2NaHCO_3 + Ca(OH)_2 \rightarrow Na_2CO_3 + CaCO_3 + 2H_2O$$

Carbon dioxide is removed by the following reactions:

$$Co_2 + Ca(OH)_2 \rightarrow CaCO_3 + H_2O$$

The efficiency of this softening process is influenced by the following factors:

- High temperatures: above 12 °C.
- Strong convection: stirring, pumping, fluidized-bed reactor.
- Crystallization seeds: contact sludge, sand.
- Pressure or rapid decarbonization.

The pH of the brew water after softening is relatively high at about 8.5. This has no influence on the mash pH as the buffering capacity of the water is low. To control the quality of the brew water, the p and m values are determined. The m value serves to determine the softening effect; the p value gives an indication of the correct dosage of lime.

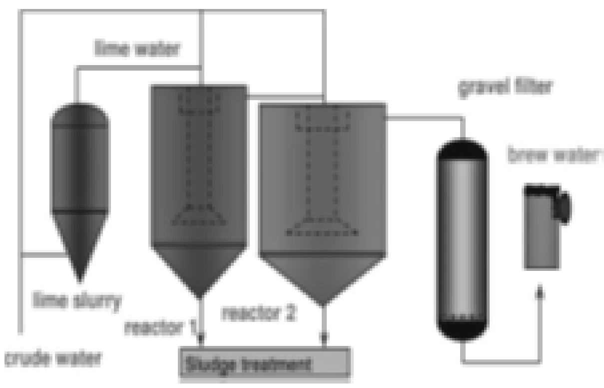


Figure 1: Lime precipitation unit

Kolbach (1953) indicated that different treatments were necessary for the following groups of water:

1. When the calcium hardness > total alkalinity (water rich in $CaSO_4$ or permanent hardness), the water is very easy to decarbonate.
2. When the calcium hardness = total alkalinity (water that contains pure calcium carbonate), the water is very easy to decarbonate.
3. When the calcium hardness < total alkalinity (water that contains, in addition to calcium bicarbonate, magnesium and sodium bicarbonate), the water is difficult to decarbonate.

Treatment with lime may be difficult if water contains organic matter and magnesium salts.

Split Treatment

Magnesium bicarbonate can be removed by an excess of lime according to the following reaction:
$Mg(HCO_3)_2 + 2Ca(OH)_2 \rightarrow 2CaCO_3 + Mg(OH)_2 + 2H_2O$

A large excess of lime is necessary (pH 10.5 – 11.0) for precipitation. After treatment the water must be neutralized with acid.

Lime treatment and split treatment methods of water decarbonization are large producers of effluent because of the volume of carbonate deposits.

Ion Exchange

The use of ion exchangers is widespread in the beverage industry for demineralization of crude waters, since this process allows selective removal of cations as well as anions. The hardness former of the water (calcium, magnesium, sodium) can be removed by using weak and/or strong acidic ion - exchange resins. In the subsequent use of weak basic resins, the water can be completely demineralized. Nitrate-selective (strong basic) resins, on the other hand, only reduce the nitrate concentration.

Table 3: Differentiation of Ion Exchangers

Type	Removal of	Anchoring Groups	Counter Ion	Regenerant: Aqueous Solution of
Cation Exchanger				
Strong acidic	Ca, Mg, Na	Cl, SO_4, NO_3 HCO_3	H^+ Na^+	HCl, H_2SO_4 NaCl
Weak acidic	Ca, Mg	HCO_3, CO_3	H^+ H^+ Na^+	HCl, H_2SO_4 CO_2 NaOH
Anion Exchanger				
Strong basic	All anions Cl, SO_4, NO_3, HCO_3	All cations Na, K, Ca, Mg	Cl^- SO_4^{2-}	NaCl, HCl Na_2SO_4, H_2SO_4
Weak basic	Anions of strong acids Cl, SO_4, NO_3	All cations Na, K, Ca, Mg	Cl^- OH^- (free basic form) HCO_3	NaCl NaOH CO_2

Ions exchangers are solid materials that are able to adsorb cations and anions from an electrolytic solution, and replace these with an equivalent of amount ions of the same charge. In a cation exchanger, sulfonic acid residues are fixed in the matrix of the resin. The corresponding sodium ions can move freely within the structure. Cations, such as calcium ions, enter without problem; anions, such as chloride ions, are repulsed by the negatively attached ions.

A differentiation of ion-exchangers is presented in Table 3. Only legally licensed regenerating materials are allowed to be used to regenerate the ion-exchanger. Furthermore, the resins need to be safe for all foods-no flavorful, olfactorial or health-damaging materials is allowed to be given off.

The following points should be considered for the planning of an ion-exchanger plant:

- Free from floating materials.
- Polishing filter in the case of organically polluted waters.
- Deferrization and demanganization.
- Free of chlorine and chlorine derivates.
- Activated - carbon filter prior to softening to protect the ion - exchange material.

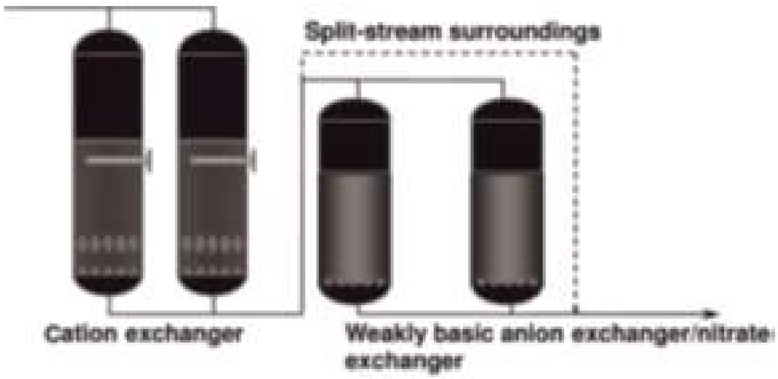
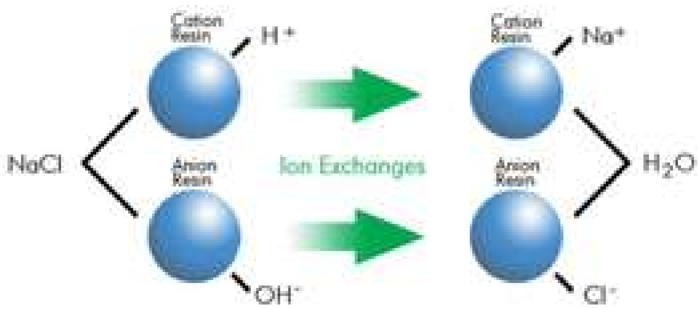


Figure 2: Schematic presentation of an ion exchanger

A common process combination of a cation and anion exchanger is presented in Figure 2. The removal of the hardness former is carried out through cation exchange. The optimal following anion exchanger can be designed either to serve as a weak basic resin for complete demineralization or as a strong basic resin to selectively remove nitrate. Depending on the choice of the combination processes, a special regeneration scheme is applied.



Advantages:

- Removes dissolved inorganic effectively.
- Regenerable (service deionization).
- Relatively inexpensive initial capital investment

Disadvantages:

- Does not effectively remove particles, pyrogens or bacteria.
- DI beds can generate resin particles and culture bacteria.
- High operating costs over long-term.

Membrane Processes

Reversed osmosis is normally used for brewing water treatment. In this process a high pressure is administrated onto the crude water. This must be greater than the osmotic pressure, so that the water molecules are forced to migrate through a semi-permeable membrane, whereas the salts are mostly retained. Thereby, the water is completely demineralized. Adjustment of the desired brewing water quality (see Table 2) can be achieved by, for example, a blend with crude water, an increase of hardness with lime slurry and so on Generally, filtration processes can be classified into their separation spectra.

- Semi-permeable membrane: A semi-permeable membrane is partly permeable (i.e., only a certain part of a substance or mixture is able to pass). However, it is permeable towards the solvent.
- Permeate: The permeate is the cleaned solution of the membrane process (i.e., the part of the feeding water that migrates through the membrane).
- Concentrate (retentate): In reversed osmosis the concentrate is the concentrated water that, corresponding to the volume of obtained permeate, contains the dissolved substances of the feed in concentrated form.
- Yield: The yield is the rate of permeate volume to the feed volume:

$$\text{Yield (\%)} = \frac{\text{Permeate}}{\text{Crude water}} \times 100$$

It is important to note that with increasing yield the salt concentration in permeate also increases. An optimum between quality of permeate and the yield of the permeate needs to be established for every use. The yield of permeate (i.e., the ratio of treated water to introduced crude water) can be arbitrarily adjusted through variations of pressure and flow rate. A brewing water treatment plant commonly works with a yield of about 80%.

For an economical operation mode of membranes, there are a number of limiting factors, which either damage the membranes or lead to a blockage. For example, the barium concentration of the crude water should be below 0.1 mg/l to avoid irreversible precipitation of barium sulfate onto the membrane.

Advantages:

- Effectively removes all types of contaminants to some extent (particles, pyrogens, microorganisms, colloids and dissolved inorganic)
- Requires minimal maintenance.

Disadvantages:

- Flow rates are usually limited to a certain m3/day rating.

Microbiological Control (Sterilization of Water)

All types of waters (liquors) contacting the product stream at any stage of the brewing process should be sterile; this is especially import with regard to water-borne organisms.

Bacterial contaminations of water can occur at any stage during storage, even at high temperature. For example, contaminations with thermophilic bacteria (such as bacillus stearothermophilus) may survive in hot brewing water tank at 80 0C. A small leak of water across the paraflow heat exchange plates into the water stream can provide the bacteria with sufficient nutrient to grow to considerable numbers within hot water and can actually cause wort and beer clarity problems when the contaminated water is used for wort production.

Microbiological purity in the brewery is important from wort cooling to the finished product. To inactivate microorganisms the following techniques are used:

a) Chlorination:

Chlorination is carried out by the application of chlorine gas, hypochlorous acid, hypochlorite solution, or chloramines. Before application, a water analysis should be available to guide the correct choice of treatment. It is important to determine the free chlorine concentration at the point of water utilization.

b) Ozonization:

This treatment is very powerful and inactivates microorganisms 1000 times more rapidly than chlorine. Ozone, as well as disinfecting, degrades organic substances, which are flocculated. The amount of ozone to be injected depends on the water composition and varies between 0.5 – 3.0 ppm. Precautions concerning corrosion must be taken, as ozone is a powerful oxidant.

c) Ultraviolet Radiation:

Ultraviolet radiation for water disinfection using mercury vapour lamps at wavelengths between 200 and 300 nm are efficient for destroying microorganisms. It is important to check water composition for concentrations of organic substances and microorganisms.

Ultraviolet radiation has widely been used as a germicidal treatment for water. Mercury low pressure lamps generating 254 nm UV light are an effective means of sanitizing water. The adsorption of UV light by the DNA and proteins in the microbial cell results in the inactivation of the microorganism.

Recent advances in UV lamp technology have resulted in the production of special lamps which generate both 185 nm and 254 nm UV light. This combination of wavelengths is necessary for the photo oxidation of organic compounds. With these special lamps, Total Organic Carbon (TOC) levels in high purity water can be reduced to 5 ppb.

Advantages:
- Effective sanitizing treatment
- Oxidation of organic compounds (185 nm and 254 nm) to < 5 ppb TOC

Disadvantages:
- Decreases resistivity.
- Will not remove particles, colloids, or ions

d) Treatment with Silver:

This electrolytic process uses a silver anode and a carbon or stainless-steel cathode. The amount of free silver needed depends on water composition and varies between 0.05 and 0.2 mg/l for protection against infection; for disinfection, the silver concentration is increased to 0.5 – 1.0 mg/l.

Conclusions

It is believes that both Ion Exchange and Reverse Osmosis technologies will continue to grow strongly in the near future. The RO membrane process clearly has a bright future. In addition, with water treatment processes demanding greater efficiency and selectively, ion exchange also have a bright future. The modern technology of water treatment requires the combination of several technologies. For example, the integration of different membrane processes, such as ultra-filtration and RO membrane separation, or the combination of several techniques like RO and Ion Exchange.

The two state-of-the-art process solutions (RO and Ion Exchange) to allow the process designer to optimize the water treatment process with the goal of a lower cost and higher reliability of water treatment for the process.

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STOICHIOMETRY AND ITS IMPORTANT IN BEVERAGE PROCESS INDUSTRY

SAURABH N. PERKAR

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Head brewer
Alchemy microbrewery, bangalore

Stoichiometry or process calculation help us to understand and determine relationship between the quantities of reactants and products before , during and following chemical reactions.

considering with or without chemical reaction if the amounts of separate reactants are known then the amount of product can be calculated.

Now, why its important for us ?

because with help of stoichiometry we can calculate theoretical production of any product at any stage. lets have a look at an example to understand it perfectly.

Ethyl alcohol is produced by fermentation using 1000 kg of molasses. this molasses sample contains 45% by weight sucrose. the reaction taking place in the fermenter are

$$\underset{\text{Sucrose}}{C_{12}H_{22}O_{11}} + H_2O \xrightarrow{\text{Invertase}} \underset{\text{(d-Glucose)}}{C_6H_{12}O_6} + \underset{\text{(d-Fructose)}}{C_6H_{12}O_6}$$

$$\underset{\text{(Monosaccharide)}}{C_6H_{12}O_6} \xrightarrow{\text{Zymase}} \underset{\text{Alcohol}}{2C_2H_5OH} + 2CO_2 \uparrow$$

And now we need to calculate production of rectified spirit of density 0.785 kg/l in liters per tonne of molasses.

Now from data above ,

sucrose in molasses = 0.45 * 1000 = 450 kg

from the reaction , we have

1 kmol sucrose is equivalent to 4 kmol of alcohol

so from molecular weigth of each

342 kg sucrose is equivalent of 184 kg of alcohol

theoretical production of rectified spirit from 450 kg sucrose will be

(184/342)*450 =242.1 kg

Density of rectified spirit = 0.785 kg/l

so theoretical production of rectified spirit in terms volume

242.1/0.785 = 308.41 liter

so just now we have look at a small example how useful a stoichiometry can be for our beverage process calculation. this is useful right from mashing conversion , lautering efficiency calculation, water chemistry , hops isomerisation, oxygenation of wort during wort chilling, ion concentration distribution after salt or acid addition in wort or brewing water.

we will have look at it in detail about this with another example next time.

The Health Benefits Of Hops & How To Get Them Without Boozing

AKSHAT JAIN

Business Development Manager-Craft Brewing

Health benefits of hops.

The hops flower been used medicinally for more than 2,000 years to help manage a variety of ailments. Modern research, though in early stages, affirms that hops can help improve mood, relaxation, and more.

This is likely because the flower is loaded with antioxidants, polyphenols, and beneficial essential oils such as linalool, which helps with oxidative stress. With all of these compounds at play, emerging research shows hops might be able to help out with the following:

1. It can help you sleep.

First and foremost, hops is known for its calming properties. If you have trouble sleeping or you have a wonky schedule that wreaks havoc on your circadian rhythm, also known as your sleep-wake cycle, hops might be able to help.

2. It can promote a better mood.

Hops can help brighten your mood, too. "A recent study showed that mild depression, anxiety, and stress in otherwise healthy young adults was improved with daily supplementation of a hops dry extract

3. It can help with hot flashes.

Hops may also help with hot flashes4 and other symptoms of menopause, according to another 5study. A flavonoid in hops, known as 8-prenylnaringenin, is a phytoestrogen, a plant-based compound that may behave like estrogen in the body.

4. It can support immune health.

A review of existing medical data states that the compounds in hops show promise in warding off some disease processes, including those related to metabolic syndrome.

How to get your hops fix without boozing.

You don't have to head to your neighborhood pub or brewery to reap the benefits of hops. You can buy the flower in many forms and use it as a supplement that suits your needs and lifestyle.

Straight-up hops supplements are available both in tincture and capsule form, or hops can be paired with other supplements for a multi-vitamin. Hops pair especially well with full-spectrum hemp oil to promote a sense of chill, since hops and hemp belong to the same plant family, Cannabaceae. They are thought to work synergistically together to support a more positive, relaxed mood.

If you crave a bitter beverage without the buzz, you can also find hops in certain herbal teas and hopped-up kombuchas, or you can buy hops in dried flower form or as a powder and make your own concoctions.

Are there any side effects I should look out for?

Hops are generally considered safe. However, some people do have a hops allergy6 so be mindful of a runny or stuffy nose, hives, or itching following the flower. If you've avoided beer in the past for this reason, hops might be the culprit.

The bottom line

Hops are widely known for giving different beer styles their flavor and aroma profiles, but they can be consumed without having to toast the town. Ongoing research backs up the benefits of hops in supplements meant to promote better sleep, mood, and overall health.

Source: midbodygreen.com

BECPL TEAM AT SEA BREW 2022, BANGKOK

IMMOBILIZATION USING BIOPOLYMERS

SACHIN MOGAL

Senior Manager (Alcohol and Malt spirit)

Definition of immobilization

An immobilized molecule is one whose movement in space has been restricted either completely or to a small limited region by attachment to a solid structure. In general the term immobilization refers to the act of the limiting movement or making incapable of movement i.e., retard the movement.

What can we immobilize?

Many molecules have been immobilized and the majority of them are biomolecules due to their biological and biomedical applications. The following are examples of some of these molecules:

•roteins, Peptides, Substances composed of amino acids, Drugs, Anticancer agents, Saccharides, Sugars, oligosaccharides and polysaccharides, Lipids, Ligands,

• Nucleic acids and nucleotides:

Methods of immobilization

The main advantage of enzyme immobilization is the easy separation of the enzyme from the reaction mixture (substrates and products) and its reusability for tens of time, which reduces the enzyme and the enzymatic product's cost tremendously. Besides this splendid advantage, the immobilization process imparts many other advantages to the enzyme such as:

- The ability to stop the reaction rapidly by removing the enzyme from the reaction solution (or vice versa)
- The product is not contaminated with the enzyme
- Easy separation of enzyme from the product (especially useful in food and pharmaceutical industries)
- Enhancement of enzyme stability against pH, temperature, solvents, contaminants, and impurities.

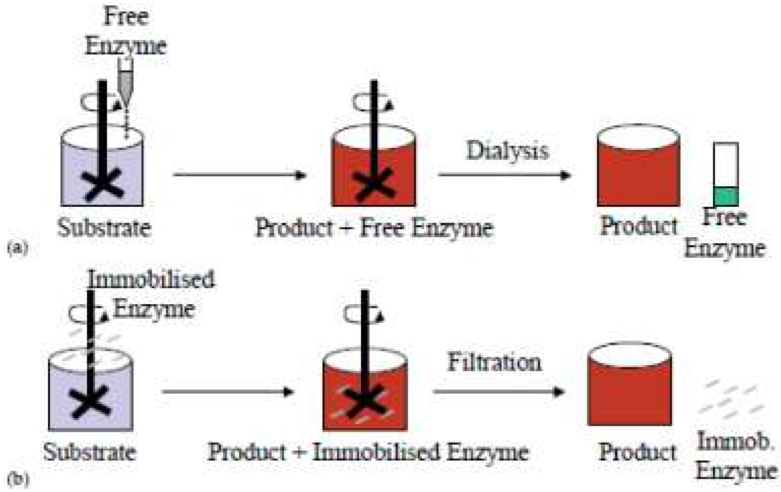


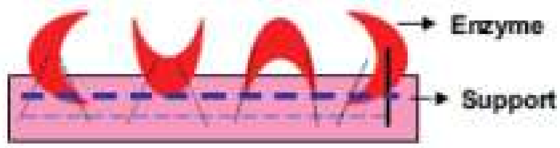
Fig. 1. Schematic diagram of free and immobilized enzyme reactions. (a), Reaction of free enzyme with substrate and formation of product, which has to be separated via dialysis; (b), Reaction of immobilized enzyme with substrate and formation of product, which can be separated via filtration or using a fluidized magnetized bed reactor system.

Immobilization provides a physical support for enzymes, cells and other molecules. Immobilization of enzymes is one of the main methods used to stabilize free enzymes. The support material and the main methods of immobilization are key parameters in enzyme immobilization. There are five principal methods for immobilization of enzymes and cells (adsorption, covalent, entrapment, encapsulation and crosslinking) and no one method is perfect for all molecules or purposes.

1.Adsorption

Immobilization by adsorption is the simplest method and involves reversible surface interactions between enzyme and support material as shown in Fig. 2. The procedure of adsorption consists of mixing together the biological component(s) and a support with adsorption properties, under suitable conditions of pH and ionic strength for a period of incubation, followed by collection of the immobilized material and extensive washing to remove the unbound biological components

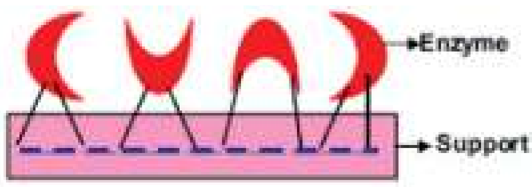
Fig. 2. Immobilization of enzymes using the adsorption technique.



2. Covalent binding

This method of immobilization involves formation of a covalent bond between the enzyme and support material as shown in Fig. 3. Covalent bonds usually provide the strongest linkages between enzyme and carrier, compared with other types of enzyme immobilization methods. Thus, leakage of enzyme from the matrix used is often minimized with covalently bound immobilized enzymes (Cao, 2005). The bond is normally formed between functional groups present on the surface of the support and functional groups belonging to amino acid residues on the surface of the enzyme.

Fig. 3. Immobilization of enzymes using the covalent technique.



3. Entrapment

Immobilization by entrapment differs from adsorption and covalent binding as shown in Fig. 4 in that enzyme molecules are free in solution, but restricted in movement by the lattice structure of a gel . The porosity of the gel lattice is controlled to ensure that the structure is tight enough to prevent leakage of enzyme or cells, yet at the same time allows free movement of substrate and product. The support also acts as a barrier and can be advantageous as it protects the immobilized enzyme from microbial contamination by harmful cells, proteins, and enzymes in the microenvironment

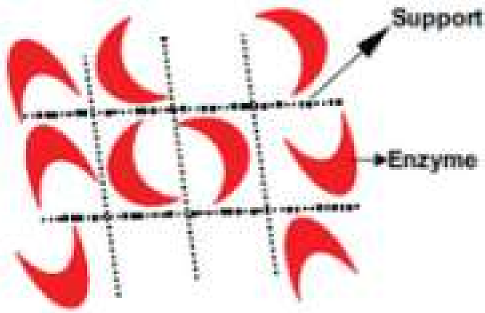


Fig. 4. Immobilization of enzyme using the entrapment technique.

Entrapment can be achieved by mixing an enzyme with a polyionic polymer material, such as carrageenan, and by crosslinking the polymer with multivalent cations.

4. Encapsulation

Encapsulation of enzymes as shown in Fig. 5 can be achieved by enveloping the biological components within various forms of semipermeable membranes (Groboillot et al., 1994). It is similar to entrapment in that the enzyme is free in solution, but restricted in space. Large proteins or enzymes can not pass out of, or into the capsule, but small substrates and products can pass freely across the semipermeable membrane.

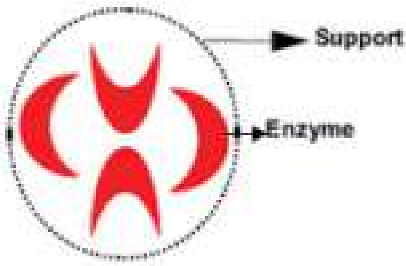


Fig. 5. Immobilization of enzymes using the encapsulation technique.

5. Crosslinking

This type of immobilization is support-free as shown in Fig. 6 and involves joining enzyme molecules to each other to form a large, three-dimensional complex structure, and can be achieved by chemical or physical methods (Xie et al., 2009). Chemical methods of crosslinking normally involve covalent bond formation between the enzymes by means of a bi- or multifunctional reagent, such as glutaraldehyde, dicarboxylic acid or toluene diisocyanate. Flocculating agents, such as polyamines, polyethyleneimine, polystyrene sulfonates, and various phosphates, have been used extensively to cross-link cells using physical bonds. Crosslinking is rarely used as the only means of immobilization, because poor mechanical properties of the aggregates are severe limitations.

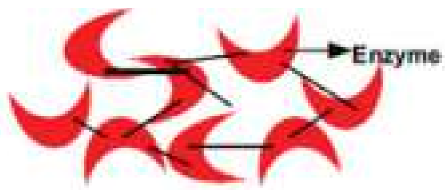


Fig. 6. Crosslinking technique.

Applications of Immobilized Enzymes

Enzyme utilization in Industry Food and Drink Industry

- **Use of yeasts(e.g. Saccharomyces carlsbergensis) in the baking and brewing industries -** because they contain the enzymes for alcoholic fermentation; metabolize hexose sugars to produce pyruvate, but, whereas animals convert this to lactate under anaerobic conditions, the anaerobic endproduct in yeasts is ethanol, with carbon dioxide being evolved

- **The clarification of cider, wines and fruit juices** (e.g. apple) is usually achieved by treatment with fungal pectinases Pectinases are a group of enzymes including polygalacturonases, which break the main chains of pectins, and pectinesterases, which hydrolyse methyl esters. Their action releases the trapped particles and allows them to flocculate (pectins of fruit and vegetables play an important role in jam-making and other processes by bringing about gel formation)

- **Cheese production** involves the conversion of the milk protein, K-casein, to para-casein by a defined, limited hydrolysis catalysed by chymosin (rennin)

- **Papain is sometimes used as a meat tenderizer**; some South American natives have traditionally wrapped their meat in leaves of papaya, the fruit from which papain is extracted Papain (and other proteases) may also be used in the brewing industry to prevent chill hazes, caused by precipitation of complexes of protein and tannin at low temperatures

Other Industrial Applications:

Washing powders incorporating bacterial proteases Commercial importance waned because of fears about the effect of enzyme dust on the respiratory system, but this problem was overcome by containment in granules which rupture only on contact with water The enzymes in question, subtilisins from Bacillus subtilis mutants, are stable to alkali, high temperature (e.g. 65°C), detergents and bleaches. They will attack blood and other protein stains

CHALLENGES FACED BY FERMENTATION INDUSTRY IN ETHNOL PRODUCTION DUE TO BACTERIAL CONTAMINATION

RAGHAVENDRA SHARAN SINGH

Sales & Technical Manager
(Alcohol Industry)

Ethanol production holds a potential global market in Fermentation Industry. Due to its scale and unit processes, several enzymes have been used for the hydrolysis of starch substrates to maintain the fermentation process under aseptic conditions. Sterilization of this treated starch substrate is not feasible at the large-scale production. Most of the ethanol production are carried out in the presence of measurable amount of bacterial contamination.

This leads to the reduction in the production of ethanol yield and generally inhibit yeast growth and its activity. Several studies reported that the presence of 106-107 bacterial count leads to the loss of 1-3% of ethanol production while 107-108 bacterial count can lead to the loss of 3-5%. Other study reported the loss of 17% in ethanol yield in presence of 4.5 X 108 bacterial contaminants per ml in the batch fermentation for 30 hrs.

This problem can be reduced by using continuous processes instead of batch process to increase the productivity but still the bacterial contamination is becoming serious issue day by day. Since ancient times, bacterial contamination is one of the major drawbacks possess by the ethanol fermentation industry in terms of reduction in the ethanol yield and the annual output. Incapability to tackle and control the bacterial contamination, several fermentation plants went under complete closure overseas.

Due to the recently developed microbial and molecular techniques, this has become possible to isolate, biochemically characterize and identify these bacterial microorganisms in the lab scale. Molecular identification provides a high throughput pipeline to identify and characterize the bacterial contamination with complete bacterial gene sequence. With this information, we can develop and suggest specific products to address microbial challenges with precise dosages required to run the fermentation. This workflow will be helpful in maintaining the best possible high yield of commercial ethanol.

Sr. No.	Biochemical Characterization	Micro organisms					
		L. fermentum	*L. casei*	*B. subtilis*	*P. aeruginosa*	*E. coli*	*C. perfringens*
1.	Esculin Hydrolysis	Negative	Positive	Positive	Variable	Variable	Variable
2.	H2S Production	Negative	Negative	Negative	Negative	Negative	Positive
3.	Indole production	Negative	Negative	Negative	Negative	Positive	Negative
4.	Nitrate Reduction	Positive	Negative	Positive	Positive	Positive	Variable
5.	Glucose	Negative	Negative	Positive	Positive	Positive	Positive
7.	Starch Hydrolysis	Negative	Negative	Positive	Positive	Negative	Variable
8.	Gram staining	Positive	Positive	Positive	Negative	Negative	Positive

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MICRO TOURISM... A NOVEL CONCEPT FOR WINE TOURS

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Founder, CEO,
Apex Wine Club India,
Mumbai.

APEX WINE CLUB INDIA Estd. 2018

Sidd Banerji. (Author is vastly travelled wine enthusiast. While he loved travels to corners of India, had considerable exposures to Middle East, Europe, US and of Eastern hemisphere too. Presently he is exploring wine culture of many parts of the world. Started with India, the country with unending scope to explore learn and progress.)

Much before one can undertake a wine tour to watch and experience, learn and participate in stories of wines, Virtual Wine Tourism, in other words, micro tourism has been an idea to foster most of the learning process of a wine tour, within the 4 walls of a class room, hall and Or an. open area, under sky and being with nature.

at Fratelli Akluj

Starting from vineyards, plants (they are creepers) to variety of grapes, leaves and field contours, the study of vineyards to harvesting, manual or mechanical, including de stemming, cleaning, washing before crushing and squeezing to get the juice all could be well depicted almost live, thru selected vdos often created and tailor made ones.

Jai Hind College Mumbai

The winery complex thereafter. It's tanks, pipes, motors and pumps. Labs and bottling units included, all can be shown thru vivid, clear, zoomed and long shots. The concept has born out of need. The fast rising popularity and spreading interest not only to add wines in the beverage list but also to learn the interesting subject, have brought in the concept of presenting the entire wine tour in vdo. It has made a practical alternative to all from far and wide of not only country but even for the ones from overseas. Wine Tourism in fact, is half for knowledge of the subject specific and other half is to know the local food, culture, climate and social atmosphere around.

In total a visual package much for fun and experience as well. Hence , the vdo documenting has come very handy with appropriate compering with explanation notes. Fundamentals of terroir, geographical location of the vineyard is of great importance. Oftain at a remote end of a city or nearby villages sometimes too often on hilly slopes or huge stretch of unending fields, touching horizon. present a picturesque view. In between runs narrow lanes for vehicles and within well arranged lively vineyards lie their small buildings or even the winery.

Micro Tourism At a microscopic cost, compared to the cost involved to have a real tour and at the convenience and comfort of home or a nearby public place, Vertual Wine Tourism, nothing but a micro Tourism, is expected to be popular and shall be much used. Advantageous not only for professionals, students and researchers but also for many, specially of advanced age and those not able to afford the high cost wine tours.

Jai Hind College Mumbai

7 Peaks Winery Nashik

Larger diversities in the management style of vineyards, as well in every other aspects of wine story viz. plants, leaves fruits, machines used, fermentation process, storage patterns etc.
can be much easily and with convenience shown and entertained. The social scenario, food that goes with their winevfestivals are other areas which can also be covered well in vdos.
Regions while in India it is restricted within Maharashtra and Karnstaka for traditional wines but for fruit wines one can venture northern and northeastern states too. Arunachal Pradesh, Meghalaya, Himachal Pradesh are upcoming and prominent tourist destinations for fruit wines.

It is noteworthy to observe rising interest of state governments, to form Wine polucy. Noteworthy states are, Karnataka the starter, Maharashtra, WestvBengal, Meghalaya, ArunachIn overseas countries like France, Italy, Spain Portugal and Germany from the Old World coubtries are welknown. On the New World side New Zealand, Australia, Safrica, Chile Argentina and California are all reknowned to encourage wine tourism. Huge materials are available in internet.

7 Peaks Winery Nashik

Much to be collected from interested participants and few could always be made on specific related subjects. The scope is vast.(The concept of Virtual Wine Tour is novel. While we have fragmented uploads in internet,I've tried to create a storyline with vdos in proper sequence. And with appropriate narrations. The launch was at my speech in presence of senior authorities of Maharashtra Tourism Board at the World Tourism Day'22 event, Jai Hind College Mumbai. Sidd Banerji.)

MAMTA BHARDWAJA

Area Sales Manager, Pune - Oakwood vineyards
Founder and Researcher
Applied B.Sc.in Wine Technology, B.Sc. Microbiology
WSET Level 1

Crystal Vs Glass

There are two types of stemware, crystal, and glass.

All crystal is glass but not all glass is crystal.

Crystal contains minerals, typically lead monoxide. The lead percentage varies from 1 to 30 percent.

In the European community glass with 4 to 10 percent lead monoxide is called glass. Glass with lead content 8 to 10 percent is called lead glass. Glass with 10 to 30 percent lead is called a crystal. Glass with more than 30 percent lead monoxide is called as lead or leaded crystal. While in the United States 1 percent lead monoxide is sufficient to call it crystal. So the meaning of crystal versus glass changes according to country.

Some countries use zinc and magnesium oxide instead of lead which also causes refraction. These are called lead-free crystals. They have a similar refractive index as lead but they are lighter.

Crystal is porous. Mineral strengthens the material and makes it thin but durable. Also, it increases the weight of glass and causes light refraction. In crystal rim is very thin but still strong.

There is one theory that explains that crystal is rougher than glass so roughness creates turbulence in wine which, in turn, causes more aeration of the wine, and therefore more aromatic compounds are released.

The problem with leaded crystal is, lead can leach out of the glass, especially the glasses that are often used. Exposure to lead can increase the risk of heart attack and stroke and can cause memory loss.

Although the highest quality crystal glasses provide a better wine-tasting experience but they are too expensive.

Glass is nonporous and thick. Thicker glass can create distortions. It does not refract light. It is more durable and affordable than crystal. Borosilicate is one type of glass that has high durability and heat and scratch resistance.

It is affordable.

There is a difference between crystal and glass stemware but it is up to you how much you want to spend.

For more detailed information in a visual format, you can always visit www.winesutra.in

Cheers!!!

WINE REPORT

KANCHAN SINGH

Chapter Head - South Delhi, India
Apex Wine Club India
1 October 2022, Saturday

Often referred to as the wine capital of India, with 29 wineries, Nashik is home to Sula Vineyards. Besides, Chandon India has opened its doors to oenophiles for a curated tour and tasting experience.

The winery is set inside a 19 acre property and located on the outskirts of Nashik's Dindori district. It features a vineyard and a factory where the tour takes place, followed by a tasting session.

The educational tour is designed to elaborate the process and science behind wine-making - from harvesting and crushing the grapes to stabilisation, filtration, bottling and fermentation of the wine. For the wine-tasting, two sparkling wines are offered - Chandon's rosé and a brut.


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