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MESSAGE FROM THE MANAGING DIRECTOR

Hello Friends,

Past is History, Future is Mystery and if we can take care of our Present, then we will be on track to achieve our goals!

I would like to implore each one of you to work on your strengths and eliminate your weaknesses on a regular basis. Looking inwards enables one to develop his/her skills and thereby have a greater chance of success.

There are always going to be hurdles and barriers in our path. We should not waste time on brooding over what could have been. Focus on what can be and should be done, and Do IT. This is the positivity which Catalysts represents and has ingrained in our working culture.

I am sure that with the dedication and sustained efforts we shall not only succeed but also enjoy our journey towards our Vision.

Keep smiling!!

Munish Madaan

Vision 2020

Catalysts vision is to be a rapidly growing organization and a happy workplace. An integrated biotechnology company; we will evolve as a globally recognized and valued brand. Catalysts will develop a business defined scalable infrastructure pan India and with Global footprints. World class manufacturing infrastructure and accredited research & development facilities will be created to meet the business requirement, for innovative products in existing and new customer base.

We will have a work culture of integrity, respect, team work, ownership, trust, learning and happiness for all stakeholders. Catalysts will be a process driven, professionally managed and people centric organization. We will create Catalysts as a high value business venture with an inclusive growth opportunity for all stakeholders.

Inhibition of Biogenic Hydrogen Sulfide Production in Waste Waters

- B. Chandrashekhar, R&D

INTRODUCTION

Stabilization ponds, also known as Lagoons, are earthen facilities for the biological treatment of wastewater and generally used in sugar, Alcohal manufacturing industries to treat wastewaters. Lagoons are designed to remove Biochemical Oxygen Demand (BOD) and to reduce the concentration of disease causing organisms. Large lagoons have been known to generate hydrogen sulfide odors even with extensive aeration, mainly because of inadequate dissolved oxygen dispersion in the water. Another major issue with lagoons is inadequate mixing in the water to allow adequate dissolved oxygen dispersion. Problems associated with lagoons are:

- Odor, mainly ammonia and/or hydrogen sulfide;
- Sludge build-up, requiring periodic dredging and solids removal; and
- Inadequate water discharge quality, in terms of total nitrogen, ammonia, fecal coliforms count, and phosphorus concentration.

Conventional methods that have been tried with limited success includes the use of biocides (Hodges and Hanlon, 1991), which are added to the water to reduce bacterial growth. The main reason for limited success is the dissipation of biocide in reducing growth of all bacteria – aerobic, anaerobic, sulfate reducing, etc., some of which are needed for biological treatment of the water. The sulfate reducing bacteria (SRBs) responsible for generation of biogenic sulfide and hydrogen sulfide mainly reside within biofilms in the sediment, and most biocides are unable to penetrate and kill these robust biofilms (Hamilton, 1985).

Another approach is aeration of the water or use oxidants to oxygenate the water, which reduces the effectiveness of SRBs. However, aeration of water is expensive and results in increased emissions of hydrogen sulfide initially as it strips the dissolved gas from the water. Enzymes are biological catalysts that can be used to direct a chemical transformation.

Enzyme technology has recently received extensive interest, especially in environmental treatment using biological systems, such as bacteria, fungi, or other microorganisms (Whiteley and Lee, 2006).

In recent years, interest has increased in the use of specific enzymes for treatment of aqueous systems in place of live cultures. Use of living microorganisms for treatment presents several problems, which include: (1) the inability of microorganisms to survive under stringent conditions, such as high temperature, low or high pH, etc. (2) the need for nutrients and other substrates, such as oxygen, nitrogen, phosphorus, etc. for microbial growth, thereby requiring biostimulation (3) competition from other indigenous organisms that are better adapted to the field conditions, thereby requiring bioaugmentation (4) generation of biomass, which has to be handled as a by-product, and (6) slow degradation rates, which severely limit of microbe-based treatments. Reduction of sulfate to sulfide requires an organic electron donor molecule, e.g., lactic acid, which is used by the sulfate reducing bacteria such as Desulfovibrio and Desulfuromonas species, to reduce sulfate to hydrogen sulfide and concomitantly form bicarbonate, which results in an increase in pH (Eq. 1). Soluble metal salts react with the sulfide ion in-situ to produce insoluble metal sulfides (Eq. 2), thereby reducing the metal (M) concentrations in the water and forming black sludge precipitates. Bicarbonate ions react with the protons to form carbon dioxide and water, thus removing acidity from the solution as carbon dioxide gas (Eq.

Magnified image of *Desulfovibrio* – a sulphate reducing bacteria

3). $3SO_4^{2-}$ + lactate→ $3H_2S + 6HCO_3$(1)

$H_2S + M_2^{+} \rightarrow MS$ (precipitate) + $2H^{+}$(2)

$HCO_3^{-} + H^{+} \rightarrow CO_2$ (gas) + H_2O (3)

ENZYMES INVOLVED IN BIOGENIC SULFATE REDUCTION

Several enzymatic reactions are known to be involved in sulfate reduction. For example, adenosine 5'-phosphosulfate (APS), which is synthesized from sulfate and adenosine triphosphate (ATP) by the enzyme ATP sulphurylase (Enzyme classification 2.7.7), serves as a nucleoside sulfate donor in sulfate reduction. APS is then broken down into sulfite and adenosine monophosphate (AMP) by APS reductase (Enzyme Classification 1.8.99), followed by reduction to sulfide by sulfite reductase (Enzyme Classification 1.8.99)

INHIBITION OF SULFATE REDUCTION

Inhibition of biogenic sulfide production is typically attempted using one or more of the following approaches: (1) application of biocides; (2) use of nitrate; and use of nitrite. Several biocides have been reportedly used for inhibiting sulfide-producing bacteria, by several mechanisms. However, very high levels of the reported biocides are required to inhibit hydrogen sulfide production (e.g., 50 to 500 parts-per thousand), making these treatments expensive and environmentally undesirable.

ENZYMATIC COMPOSITION FOR INHIBITION OF SULFATE REDUCERS

The enzymatic composition for sulfate reducer inhibition can be comprised of several enzymes which is generally prepared by growing a nitrate-reducing sulfide-oxidizing (NR-SO) bacterial culture in a nutrient medium that preferably

contains a sulfate salt, an oxidized nitrogenous inorganic salt (e.g., a nitrate salt) and one or more organic salts. A bacterial growth inhibitor (e.g., a nitrite salt) is then added to the culture in an amount sufficient to substantially arrest bacterial growth in the mixture, after which enough water is removed from the resulting mixture to form a solid composition. Preferably, most of the water can be removed by reverse osmosis to concentrate the mixture, and then the obtained concentrate is further dried. One such suitable bacterial culture is putative *Campylobacter* sp. strain CVO, which is described in U.S. Patent No. 5,686,293 (Jenneman et al. 1997) and reportedly was deposited under the provisions of the Budapest Treaty on June 20, 1995 at the Agricultural Research Service Culture Collection of the United State Department of Agriculture, National Center for Agricultural Utilization Research.

EFFECT OF ENZYMATIC COMPOSITION ON SULFATE REDUCING BIOFILMS

Biofilms are complex mixtures of mixed cultures primarily dominated by sulfate reducers at the solid-biofilm interface, facultative bacteria covering the sulfate reducers and aerobic bacteria at the biofilm-water interface (Wolfaardt et al., 2000). This stratification protects the sulfate reducers (sulfide generators) from dissolved oxygen as well as biocides, and explains the robustness of these biofilms for sulfide generation even after aggressive treatment with biocides or extensive aeration. The enzymatic composition only inhibits the sulfate reducers and does not impact the facultative and the aerobic layers of the biofilm. This specificity of the enzymes renders it very effective in inhibiting sulfide generation at low concentrations in the aqueous phase. Since the inhibited SRBs are unable to derive adequate metabolic energy through sulfate reduction, they decay naturally, thereby allowing the biofilms to detach from the immersed solid surfaces. This is a major benefit of using the enzyme composition. since most of the sulfide generation occurs within these biofilms. As noted earlier, biocides and/or aeration (dissolved oxygen) does not sufficiently penetrate the biofilms to effectively reach the SRB layer, and sulfide generation generally continues or is inhibited temporarily. The enzymatic composition can specifically inhibit the metabolic rates of SRBs sufficiently to enable their natural decay rate to exceed their growth rate, resulting in a natural decay of the SRBs followed by the physical sloughing-off of the biofilm from the solid surface.

ENZYMATIC SULFIDE INHIBITION IN SUGAR WASTEWATERS

Such enzymatic composition can be added to the wastewater resulting in an enzymatic concentration in the range of 10 - 25 ppm in the wastewater. After a period of about 20 days, the smell of hydrogen sulfide becomes less and after 60 days, there is no detectable hydrogen sulfide smell near the lagoon. The lagoon water also becomes very clear and there is no black precipitate settling at the bottom. Such enzymatic compositions have been found to selectively inhibit growth of sulfate reducing bacteria which are primarily responsible for sulfide generation in wastewater, resulting in air emission of hydrogen sulfide, growth of fungi in the water and increased sulfide corrosion. Laboratory and field studies have shown that the enzyme mixture, dissolved in water, can be easily and economically added to significantly reduce sulfide generation in sugar production wastewaters.

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The Function of Wort Boiling

Rohit Chauhan – Business Development

The purpose of wort boiling is to stabilise the wort by:

- Killing spoilage micro-organisms.
- Reducing the amount of coagulable nitrogen thus promoting colloidal stability.
- Extracting the desirable principles of hops to give beer its characteristic aroma and flavour.
- Reducing undesirable volatile compounds through evaporation.

Clarified wort is usually collected directly in the wort kettle or run to a wort receiving vessel (often called a pre-run or underback) before being transferred to the wort kettle.

The wort kettle is fitted with heating, either using direct fuel combustion or indirectly, using steam. The wort in the kettle is first heated from wort separation run off temperature, which is between 65°C and 78°C, to boiling (usually just above 100°C, at atmospheric pressure because of the dissolved solids).

The kettle contents are then boiled for between 30 and 120 minutes. Wort boiling has a high energy demand and accounts for as much as 40% of the energy consumption of a brewery.

Most of the energy required to heat worts to boiling point is recovered during wort cooling through the use of heat exchangers, heating up the incoming brewing water (liquor) in preparation for the next brew. This gives a heat recovery efficiency of up to 99%.

The additional energy required to evaporate the water vapour during the boil is generally lost up the chimney. It is by reducing this energy loss that real savings can be achieved. A variety of schemes are available to recover part of the energy from evaporation.

The most effective ways to reduce energy consumption are by reducing % evaporation rates. The average % evaporation rates have fallen over the last 30 years from around 12 – 20% to between 4 – 8%.

In order to appreciate the consequence of reducing evaporation rates it is necessary to understand the principle changes which occurring in the wort during boiling.

Sterilisation of the Wort

Brewing raw materials such as malt, hops and occasionally brewing water itself are infected by micro-organisms, and these have to be killed during the brewing process to prevent wort and beer spoilage.

After boiling the wort is largely free from microbial contamination. Some micro-organisms, primarily Bacillus sp. and other thermophilic bacteria are able to form spores which can withstand heat treatment, including boiling, and if present in the raw materials or the brewing water may persist into the finished beer. However beer does not support the subsequent growth of these organisms.

Halting Enzyme Action

Enzymes rely on their three dimensional structure for their activity. Above certain temperatures, (usually in the range of 50-75°C) the tertiary structure of the enzyme becomes denatured, and they lose their activity. By the time the wort has reached boiling point there is usually no residual enzyme activity.

The continued action of enzymes after the normal mashing programme will alter the fermentability of the wort, and hence in a programmed mash there is a final mash temperature rise to between 76° and 79°C, which is sufficient to halt the malt enzyme activity.

Concentration of Wort

During wort boiling water is driven off as steam, thus concentrating the wort. The amount of water removed during the boil is directly proportional to the rate of evaporation (and hence the amount of energy supplied) once boiling has been achieved. The efficiency will be affected by the design of the kettle, particularly the surface area.

Traditionally, high gravity beers, such as strong lagers and barley wines had a long boil time, the major purpose being the evaporation of water to concentrate the wort. There are however other ways of achieving high gravity worts without excessive wort boiling:

- *Parti-gyles*- collecting different coppergravities.
- *Sugar adjuncts* –direct addition of extract to the copper.
- *Weak wort recycling* –recovering the weak worts from the lautertun to be re-used for mashing.
- *Dewatering grains* –where the extract left in the grains is recovered and reprocessed for mashing, sparging or to be added to the kettle.
- *High extract wort separation techniques* –such as the Mash Filter achieve high gravity worts and high extract efficiencies.

These techniques enable the production of high gravity worts, while still maintaining brew house yield without the use of unnecessary heat for wort concentration.

Isomerisation of Bitter Substances

During boiling the insoluble alpha acid extracted from hops are converted to a more soluble iso-alpha acid. This reaction is accelerated by temperature.

Isomerisation is a relatively rapid reaction with production of over 90% of the wort bitterness occurring within the first 30 minutes of boil. Maximum isomerisation usually occurs within 60 to 70 minutes ofboiling and accounts for around 60% of the total alpha acid present. Iso alpha acid continues to be lost during the fermentation and maturation process and is lost in any foam produced so that the final conversion value of alpha acid into iso- alpha acid in the beer is around 40% (see Figure 1).

Removal of Volatiles

During the evaporation stage of wort boiling undesirable volatile compounds are driven off with the steam (see Figure 2).

The principal malt derived volatile lost during wort boiling is DMS or dimethyl sulphide which comes from lager malts and gives lagers a taste described as “sweetcorn”. It is produced by thermal decomposition of S-methyl-methionine in a first order reaction, with a half life of around 35 minutes.

The DMS released during boiling is rapidly lost through evaporation. However, the breakdown of S-methyl methionine continues during the period between the end of boiling and wort cooling.

The DMS released is not lost and persists into the finished beer. It is, therefore, possible to control the level of DMS by varying the duration of boil and whirlpool stage.

Methods of control

DMS levels in beer:

- use malt with low S- methyl methionine levels.
- long wort boiling time to decompose precursor and vaporise DMS.
- short whirlpool stand time to reduce decomposition of the precursor.
- rapid wort cooling – reducing the time the wort is held hot.
- use wort stripping after the whirlpool stand to remove DMS.

(Note: not all DMS comes from the malt and small amounts are produced during fermentation and by beer spoilage organisms).

It was found that by reducing the boiling time from 60 minutes to 45 minutes, with the same level of absolute evaporation, the survival of DMS precursor increased by 16% for a standard wort corrected to 1039° original gravity.
Hop volatiles (hop oils) are also lost during wort boiling, and if present in too high a concentration will contribute a bitter, vegetable grassy flavour to the beer. Most of the hop oil volatiles are lost during a standard 60 to 90 minute boil. Where late hop characteris required in beer, a small amount (up to 20% of the total hop charge) of selected aroma hops can be added to the kettle 5 to 15 minutes before the end of the boil.

The principal factors which effect the evaporation of volatiles include:
- Temperature of wort
- Vigour of boil
- Surface tension
- Condensation of volatiles in the vapour stack
- Thickness of diffusion path
- Duration of boil

The kettle design will have a major influence on the factors listed above and it is found that more late hopcharacter persists in gently agitated systems such as isometric kettle, than in more vigorous boiling systems with turbulent flow such as kettles fitted with an external wort boilers.

Increase in Colour
The colour of wort increases during the boil. The reactions responsible for colour development fall into three broad categories:

- Maillard reaction between carbonyl and amino compounds (see Figure 4).
- Caramelisation of sugars, which is limited in steam heated coppers.
- Oxidation of polyphenols.

Oxidation during wort boiling increases the colour particularly with oxidation of the polyphenols, which also has the effect of decreasing the reducing power of the wort and beer. Mash and wort produced with low oxidation produces lower wort and beer with lower colours and improved flavour stability.

Reducing Wort pH
Control of pH throughout the brewing process, from brewing water to final package, is fundamental for product consistency. Wort pH starts to decrease during mashing continues to fall during wort boiling. The principal fall in pH is due to the reaction of Ca_2^+ compounds with phosphates and polypeptides to form an insoluble compounds releasing H^+ (hydrogen ions) See Table 1.

At least half the calcium present in wort is precipitated by the end of wort boiling. Hence sweet wort with a starting concentration of 100 ppm will produce beer with around 40 ppm calcium.

To assist in the fall in pH extra calcium ions in the form of calcium sulphate or calcium chloride are added to the kettle. An alternative method to decrease pH is through the direct addition of acids such as phosphoric or sulphuric acid which drop the wort pH.

In Germany, where the addition of mineral acid is prohibited under the Reinheitsgebot the product of an acidified mash fermentation using lactic acid bacteria is sometimes added to the kettle to assist in dropping the pH and improving beer flavour.

It is important to achieve the required decrease in pH (generally around pH 5.0) as it effects wort and beer character, in particular the fall:
- Improves protein coagulation

- Improves beer flavour in particular VDK (diacetyl) reduction
- Encourages yeast growth
- Inhibits the growth of many other contaminating organisms.
- Lower pH results in poorer hop utilisation.
- Lower pH results in less colour formation.

Reducing Wort Nitrogen Levels

During the brewing process it is necessary to decrease the level of high molecular weight nitrogen, which comes from the malt, and if allowed to persist can effect the pH, colloidal stability (chill haze and permanent haze), fining and clarifying properties, fermentation and taste of the beer. Wort boiling is only one, if an important stage, in the reduction of nitrogen, and the effect in reducing the amount of wort nitrogen (measured by the Kjeldahlmethod) for a standard boil at 100°C are shown below.

% Nitrogen removal after different boiling times for a standard boil

Time of boil (hrs)	% nitrogen removal
0	0
0.5	5.4%
1	6.2%
1.5	7.7%
2	9.9%
3	10.4%

Ref: Hough, Briggs and Stephen "Malting and Brewing Science"

Because of the relatively small overall reduction in total nitrogen during wort boiling it is difficult to obtain consistent results even from the same kettle with the same quality of wort. (for example, over 9 samples from individual brews, a result of 1.9 ± 2.3 mg/100 ml. was obtained at 95% confidence level). However, using a more specific test (gel electrophoresis) it is possible to separate the nitrogen compounds by their molecular weight, to show that wort boiling is more effective at removing the higher molecular weight fraction, which is also the fraction responsible for colloidal instability in packaged beer (see Table 2)

The process of protein/polypeptide coagulation involves the replacement of intra by inter molecular bonds, thereby increasing the effective molecular weight of each molecule.

Aggregates of different molecular weight molecules are built up during wort boiling as a result of inter-molecular bonding, provided that they are not disrupted by mechanical shear. During the whirlpool phase, with sufficient time and momentum, these aggregates continue to coalesce and sediment out as hot break.

The degree of protein and polypeptide removed depends on the probability of individual molecules colliding and forming stable bonds during the boil, and this is directly proportional to the length and vigour of the boil for a given temperature.

Traditional criteria used for evaluating efficient wort boiling are:

- Temperature of boil (usually just above l00°C when boiling under atmospheric pressure).
- Length of boil
- Evaporation % per hour

Traditionally conditions for wort boiling were a 90 minute boil with a minimum of 10% evaporation per hour. However, because of the need to reduce energy costs and to improve brewhouse efficiencies shorter boiling times with lower evaporation rates are now employed; typical modern kettles operate with a 60 minute boil with between 5% and 9% evaporation.

A criterion not usually measured, but which has been shown to be of critical importance, is the degree of agitation or vigour of the boil. In traditional boiling systems the vigour or boiling intensity has been related to evaporation rate. If some other form of agitation through better design of heat exchange, mechanical rousing or use of pumped or the rmosyphoned system is used, then additional agitation independent of the evaporation rate can be achieved.

The result shows a similar decrease in the high molecular weight nitrogen fraction throughout a boil under atmospheric pressure with different evaporation rates, when the same level of agitation is supplied by an external wort boiler.

Table 1: Changes in pH which can occur during wort pH of wort

Before boil		
	After 3 hours	After 6 hours
6.06	5.69	5.46
5.63	5.39	5.22
5.09	4.99	4.96

Ref: Hough, Briggs and Stephen "Malting and Brewing Science"

These results suggest that, given adequate turbulence during the boil, the actual removal of the high molecular weight nitrogen fraction is a function of time and vigour, and can be relatively independent of evaporation rate for atmospheric boiling.

Vigour is only one feature of importance for coagulation, since protein agglomeration is improved by intense vapour bubble formation. The actual wort surface temperature, and the duration of the intimate contact of the wort with the heating surface, may also be of importance.

Although it is often stated that it is desirable to remove as much protein/polypeptides as possible, nitrogen compounds have an important role in the quality and fermentation performance of a beer and in providing foamcompounds and mouthfeel. Excess protein/ polypeptide removal could lead to poorer quality product.

Table 2: Effect of boiling on the molecular weight distribution of wort proteins

Molecular distribution of proteins/polypeptides measured by gel electrophoresis

	< 5,000	5,000 to10,000	10,000 to 50,000	50,000 to 100,000	> 100,000
Before boil	0.0336	0.195	0.101	0.0023	0.0029
After boil	0.0175	0.125	0.004	0.001	0.0
% removal	49%	32%	96%	95%	100%

Ref: Hough, Briggs and Stephen "Malting and Brewing Science"

Extraction and precipitation of tannins/ poly-phenols Simple hop tannins and most malt polyphenols are soluble in boiling wort and moderately soluble in cold water. Tannins/polyphenols are readily oxidised and polymerise to give an increase in molecularweight. Tannin/polyphenols also combine with proteins to form protein/polyphenol complexes:

- Proteins which combine with oxidised polyphenols are insoluble in boiling wort and are therefore precipitated during the boil to form hot break.
- Proteins which combine with unoxidised polyphenols are soluble in boiling wort but precipitate when chilled and can give rise to chill haze and cold break. The polyphenols may subsequently oxidise during beer processing and may produce colloidal instability in packaged beer.

Unprocessed hops contribute around 40% of the total polyphenol content to boiled wort, however most hop polyphenols are removed as hot and cold break. The rest of the polyphenols comes from the dry goods, (particularly the husk), and less polymerized and hence less likely to be removed. Worts devoid of hop tannins give poorer wort clarity and have a lower reducing potential.

Producing Reducing Compounds

Malt and wort contain a number of reducing compounds which if not oxidised during the wort production or processing stages can provide the packaged beer with oxygen scavenging protection which may delay the onset of stale flavours and the rapid production of oxidised chemical hazes.

Many of these compounds come from the raw materials, such as tannins described above, but others such as reductones and melanoids are formed during wort boiling through the condensation between sugar and amino compounds. Darker beers with high addition of unprocessed hops tend to produce the greatest reducing power. Brewing systems with low levels of oxidation tend to preserve the natural reducing compounds in the wort, which can persist into package beer and delay the onset of ageing, improving colloidal and flavour stability.

Enzymes in Brewing

Namrata Tyagi, Research & Development

Introduction

Beer and wine are both alcoholic beverages which have been part of our social life for thousands of years. Both beverages are produced by yeast fermentation of sugars. Wine is based on grapes, and beer is traditionally based on barley. The matured grapes already contain the sugars needed for the fermentation, while barley contain starch that has to be broken down to fermentable sugars before the yeast can make alcohol. Therefore, traditional brewing contains and extra step compared with wine-making, namely malting in which enzymes needed for the degradation of starch into fermentable sugars are produced.

Malt is germinated barley or other cereals like wheat and sorghum: First the grains are "steeped" bringing the water content from about 12% to 45%, then they are allowed to germinate for 4-6 days and finally the germination is stopped by heating (kilning) reaching a final moisture content of about 4%. Some enzymes are already present in the barley, e.g. β-amylases, but the majority of enzymes are produced during the germination, e.g. α-amylases and proteases, and in the final malt all the enzymes needed for the conversion of "grains" into a fermentable liquid (wort) is present.

The brewing process

Traditionally, beer is produced by mixing crushed barley malt and hot water in a mash copper to perform the mashing. Besides malt, other starchy cereals such as maize, sorghum, rice and barley, or pure starch itself, can be added to the mash. These are known as adjuncts.

The standard mashing for pilsner type beer consists of several temperature steps, each favouring different malt enzyme activities. The lowest temperature (45 ºC) is the optimal temperature for cell wall degrading enzymes, β-glucanases. The proteases works best at 52 ºC, the β-amylase best at 63 ºC and the α-amylase at 72°C. The last step in the mashing is inactivation of the enzymes at 78 ºC.

If β-glucan and protein are properly broken down during malting, single temperature mashing at 65-71°C has shown to be sufficient, as in the case of traditional ale brewing.

During mashing the starch is degraded to dextrin and fermentable sugars. α-amylase liquefy the gelatinized starch by hydrolysis of the α-1,4 linkages at random. β-amylases are exo-enzymes which attack the liquefied starch chains resulting in successive removal of maltose units from the non-reducing end.

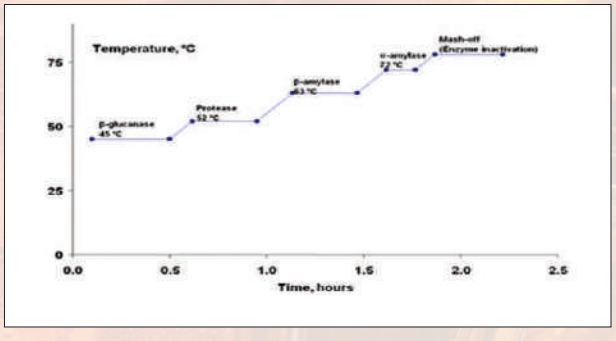


Figure: The traditional mashing temperature profile is determined by the temperature optima for the various malt enzymes.

After mashing, the mash is sieved in a lautertun or on a mash filter. The resulting liquid, known as sweet wort, is then transferred to the copper, where it is boiled with hops. The hopped wort is cooled and transferred to the fermentation vessels, where yeast is added. In normal wort 2/3 of the carbohydrates are fermentable sugars. After fermentation, the so-called 'green beer' is matured before final filtration and bottling. Fig. shows a diagram of the brewing process and where external enzymes are used for process aids.

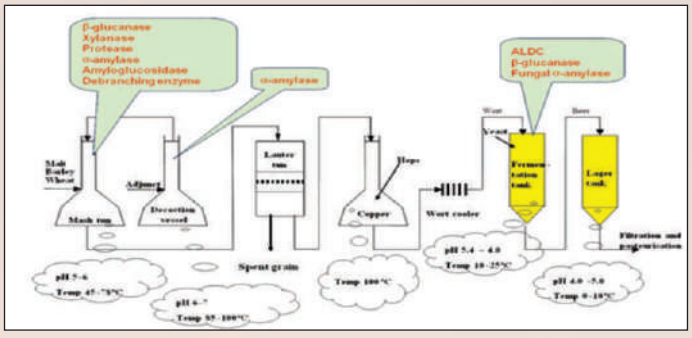


Figure: The processing steps in brewing where exogenous enzymes can be added.

Enzymes at work

Operation	Enzymes	Enzyme action	Function
Decoction vessel (cereal cooker)	α-amylase	Hydrolyse starch	Adjunct* liquefaction. Reduce viscosity
	β-glucanase	Hydrolyse glucans.	Aid the filtration.
Mashing	α-amylase	Hydrolyse starch.	Malt improvement.
	Amyloglucosidase	Increase glucose content.	Increase % fermentable sugar in "light" beer.
	Debranching enzyme	Hydrolyse α-1,6 branch points of starch.	Secures maximum fermentability of the wort.
	Proteases	Increase soluble protein, and free amino- nitrogen (FAN).	Malt improvement Improved yeast growth.
	β-glucanase	Hydrolyse glucans.	Improve wort separation.
	Pentosanase/xylanase	Hydrolyse pentosans of malt, barley, wheat.	Improve extraction and beer filtration.
Fermentation	Fungal α-amylase	Increase maltose and glucose content.	Increase % fermentable sugar in "light" beer.
	β-glucanase	Hydrolyze glucans.	Reduce viscosity and aid filtration.
	α-acetolactate-decarboxylase (ALDC)	Converts α-acetolactate to acetoin directly.	Decrease fermentation time by avoiding formation of diacetyl.
Conditioning tank Protease		Modify protein-polyphenolic compounds.	Reduce the chill haze formed in beer.

* Adjunct is starchy cereals such as maize, rice, wheat, sorghum, barley or pure starch materials added to the mash.

Table: Steps of the brewing operations where microbial enzymes are used.

Brewing with barley

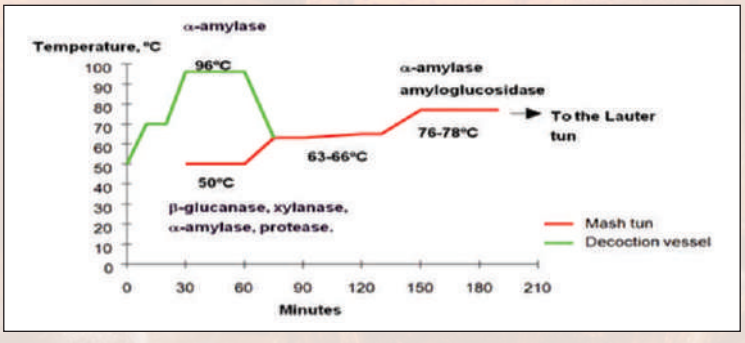


Figure: Mashing diagram for barley brewing (an example)

Enzymes to improve fermentation

Small adjustments in fermentability can be achieved by adding amyloglucosidase alone or in combination with debranching enzymes at mashing-in or a fungal α-amylase at the start of fermentation.To describe to which extent the extracted sugars are fermentable brewers define degree of attenuation, which is synonymously with degree of fermentation or fermentability.

Beer types with very high attenuation ("light beer" or "low calorie beer") are most often produced using amyloglucosidase alone. Extended mashing at 63°C and high dosages of enzymes is necessary to produce extremely high attenuated beer (see figure 6). Fungal α-amylases are used to produce mainly maltose and dextrins whereas amyloglucosidase produces glucose from both linear and branched dextrins.

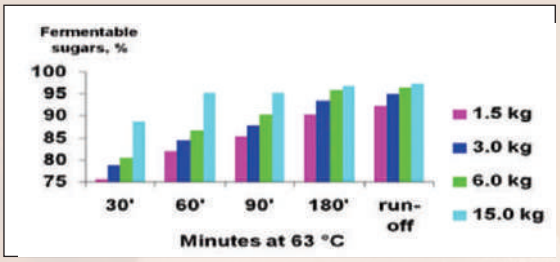


Figure: Total fermentable sugar production with different dosages of Attenuzyme® (kg per ton malt) and extended mashing at 63°C

Diacetyl control

An important question for brewers is "When exactly is a beer mature?", because this determines when they can "rack" the beer to make way for the next batch. The simple answer to the above question is when the diacetyl level drops below a certain limit (about 0.07 ppm). Diacetyl gives beer an off-flavour like buttermilk and one of the main reasons for maturing a beer is to allow the diacetyl to drop to a level where it can't be tasted. Diacetyl is formed by the non-enzymatic oxidative decarboxylation of α-acetolactate, which is produced by the yeast during primary fermentation. The yeast removes the diacetyl again during the beer maturation stage by conversion to acetoin, which has a much higher flavour threshold value. In fact, acetoin is almost tasteless compared with diacetyl.By adding the enzyme α-acetolactate decarboxylase (ALDC) (e.g. Novozymes' Maturex) at the beginning of the primary fermentation process, it is possible to bypass the diacetyl step and convert α-acetolactate directly into acetoin.

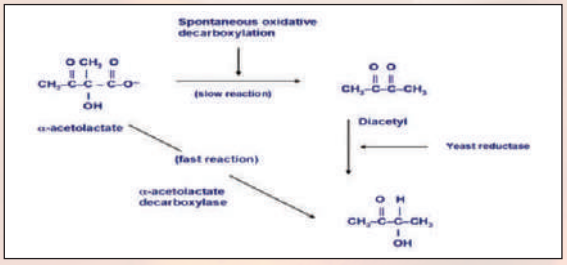


Figure: The removal of α-acetolactate during fermentation.

Conclusion and future perspectives

Today several brewing groups use exogenous enzymes as a strategic tool to optimize the brewing process and the brewing capacity. More and more breweries also think in enzyme solutions for development of new products.The role of enzymes in tomorrows brewing industry, we do not know, but a lot of new opportunities are now provided for the breweries.:

- No aging of beer within one year: Exogenous enzymes might prevent development of aging components due to oxidation, keeping the taste of fresh beer for extended time regardless of the storage conditions.
- Beer made from all-barley with the same taste as from all-malt: An "enzyme package" might completely substitute the endogenous enzymes produced during malting. Elimination of the malting process and less transportation can obviously save a lot of energy and CO2 emission.
- Re-thinking the way of making beer: An efficient and inexpensive process for production of wort and beer was patented in 2004. The mash liquefaction process was a jet-cooking and application of microbial enzymes.
- Better waste water control: Water and wastewater management constitutes a practical problem for the brewing industry, and exogenous enzymes can play a significant role in waste water treatment.

Reference: www.biokemi.org

Six Thinking Hats

Looking at a Decision From All Points of View

Monika Chaudhary, HR Department

Changing your thinking style could help you to find new solutions to tricky problems.

What is your instinctive approach to decision making? If you're naturally optimistic, then chances are you don't always consider potential downsides. Similarly, if you're very cautious or have a risk-averse outlook, you might not focus on opportunities that could open up.

Often, the best decisions come from changing the way that you think about problems, and examining them from different viewpoints.

"Six Thinking Hats" can help you to look at problems from different perspectives, but one at a time, to avoid confusion from too many angles crowding your thinking.

It's also a powerful decision-checking technique in group situations, as everyone explores the situation from each perspective at the same time.

Six Thinking Hats was created by Edward de Bono.

It forces you to move outside your habitual thinking style, and to look at things from a number of different perspectives. This allows you to get a more rounded view of your situation.

You can often reach a successful solution or outcome from a rational, positive viewpoint, but it can also pay to consider a problem from other angles. For example, you can look at it from an emotional, intuitive, creative or risk management viewpoint. Not considering these perspectives could lead you to underestimate people's resistance to your plans, fail to make creative leaps, or ignore the need for essential contingency plans.

Here , we explore how to use the Six Thinking Hats technique, and show an example of how it can work.

How to Use the Six Thinking Hats Model

You can use Six Thinking Hats in meetings or on your own. In meetings, it has the benefit of preventing any confrontation that may happen when people with different thinking styles discuss a problem, because every perspective is valid.

						
What is the current information on the issue or problem?	How does everyone feel about the current situation, issue or problem?	What are the positive aspects of the current situation, issue or problem?	What are the negative aspects of the current situation, issue or problem?	What are new creative ideas or alternatives in solving the issue or problem?	How does everyone feel now that we have worked on the issue or problem?	What conclusions or summaries can we make in moving forward on the issue or problem?

Each "Thinking Hat" is a different style of thinking. These are explained below:

- **White Hat:** with this thinking hat, you focus on the available data. Look at the information that you have, analyze past trends, and see what you can learn from it. Look for gaps in your knowledge, and try to either fill them or take account of them.
- **Red Hat:** "wearing" the Red Hat, you look at problems using your intuition, gut reaction, and emotion. Also, think how others could react emotionally. Try to understand the responses of people who do not fully know your reasoning.
- **Black Hat:** using Black Hat thinking, look at a decision's potentially negative outcomes. Look at it cautiously and defensively. Try to see why it might **not** work. This is important because it highlights the weak points in a plan. It allows you to eliminate them, alter them, or prepare contingency plans to counter them.
  Black Hat thinking helps to make your plans "tougher" and more resilient. It can also help you to spot fatal flaws and risks before you embark on a course of action. It's one of the real benefits of this model, as many successful people get so used to thinking positively that they often cannot see problems in advance. This leaves them under-prepared for difficulties.
- **Yellow Hat:** this hat helps you to think positively. It is the optimistic viewpoint that helps you to see all the benefits of the decision and the value in it. Yellow Hat thinking helps you to keep going when everything looks gloomy and difficult.
- **Green Hat:** the Green Hat represents creativity. This is where you develop creative solutions to a problem. It is a freewheeling way of thinking, in which there is little criticism of ideas. (You can explore a range of creativity tools to help you.)
- **Blue Hat:** this hat represents process control. It's the hat worn by people chairing meetings, for example. When facing difficulties because ideas are running dry, they may direct activity into Green Hat thinking. When contingency plans are needed, they will ask for Black Hat thinking.

An Example of Six Hat Thinking

The directors of a property company are considering whether they should build a new office block. The economy is doing well, and the vacant office spaces in their city are being snapped up. As part of their decision-making process, they adopt the Six Thinking Hats technique.

Wearing the White Hat, they analyze the data that they have. They can see that the amount of available office space in their city is dwindling, and they calculate that, by the time a new office block would be completed, existing space will be in extremely short supply. They also note that the economic outlook is good, and steady growth is predicted to continue.
Thinking with a Red Hat, some of the directors say that the proposed building looks ugly and gloomy. They worry that people would find it an oppressive or uninspiring place to work.

When they think with the Black Hat, they wonder whether the economic forecast could be wrong. The economy may be about to experience a downturn, in which case the building could sit empty or only partially occupied for a long time. If the building is unattractive, then companies will choose to work in other, more attractive premises.
Wearing the positive Yellow Hat, however, the directors know that, if the economy holds up and their projections are correct, the company stands to make a healthy profit. If they are lucky, maybe they could sell the building before the next downturn, or rent to tenants on long-term leases that will last through any recession.

With Green Hat thinking, they consider whether they should redesign the building to make it more appealing. Perhaps they could build prestige offices that people would want to rent in any economic climate. Alternatively, maybe they should invest the money in the short term, then buy up property at a lower cost when the next downturn happens.

The chairman of the meeting wears the Blue Hat to keep the discussion moving and ideas flowing, encouraging the other directors to switch their thinking between the different perspectives.

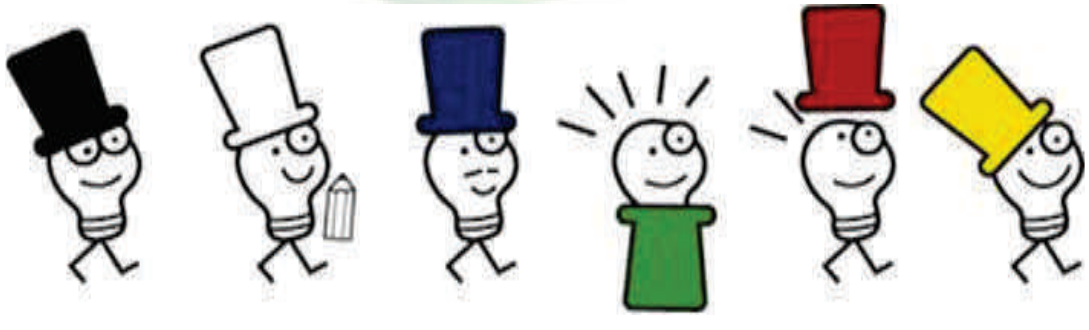
Having examined their options from numerous viewpoints, the directors have a much more detailed picture of possible outcomes, and can make their decision accordingly.

Key Points

De Bono's Six Thinking Hats is a powerful technique for looking at decision making from different points of view.

It allows emotion and skepticism to be brought into what might normally be a purely rational process, and it opens up the opportunity for creativity within decision making.

Decisions made using the Six Thinking Hats technique can be sounder and more resilient than would otherwise be the case. It can also help you to avoid possible pitfalls before you have committed to a decision.



Manage Stress
Be Happy and Effective at Work

Feeling stress is a fact of life practice these technique to become happy.

Feeling stress is a fact of life for most people. But it affects everyone differently. What causes stress for you may not be stressful for someone else. That's because how you view a situation affects how much stress it causes you. Only you can figure out whether you have too much stress in your life.

Ask yourself these questions to find out what is causing your stress:

What job, family, or personal stress do you have?
Stress can be caused by an ongoing personal situation such as:

- Problems in your family or with a relationship.
- Problem in your Job/Career

Ways to Relieve Stress
The best way to manage your stress is to learn healthy coping strategies. You can start practicing these tips right away. Try one or two until you find a few that work for you. Practice these techniques until they become habits you turn to when you feel stress..

- **Write.** It may help to write about things that are bothering you. Write for 10 to 15 minutes a day about stressful events and how they made you feel. Or think about tracking your stress. This helps you find out what is causing your stress and how much stress you feel.

- **Let your feelings out.** Talk, laugh, cry, and express anger when you need to. Talking with friends, family, a counselor, or a member of the clergy about your feelings is a healthy way to relieve stress.

- **Do something you enjoy.** You may feel that you're too busy to do these things. But making time to do something you enjoy can help you relax. It might also help you get more done in other areas of your life. Try: A hobby, such as gardening/ A creative activity/ Playing with pets.

- **Focus on the present.** Meditation and guided imagery are two ways to focus and relax your mind.

- **Meditate.** When you meditate, you focus your attention on things that are happening right now. Paying attention to your breathing is one way to focus. Mindfulness-based stress reduction is one form of meditation that is very helpful with managing stress and learning how to better cope with it.

- **Manage your time.** Time management is a way to find the time for more of the things you want and need to do. It helps you decide which things are urgent and which can wait. Managing your time can make your life easier, less stressful, and more meaningful.

- **Look at your lifestyle** The choices you make about the way you live affect your stress level. Your lifestyle may not cause stress on its own, but it can prevent your body from recovering from it.

- **Find a balance** between personal, work, and family needs. This isn't easy. Start by looking at how you spend your time. Maybe there are things that you don't need to do at all. Finding a balance can be especially hard during the holidays.

- **Have a sense of purpose in life.** Many people find meaning through connections with family or friends, jobs, their spirituality, or volunteer work.

- **Get enough sleep.** Your body recovers from the stresses of the day while you are sleeping. If your worries keep you from sleeping, keep a notepad or your cell phone by your bed to record what you are worried about-to help you let it go while you sleep. For example, if you are worried you might forget to run an errand the next day, make a note so that you can stop worrying about forgetting.

- **Exercise** Even moderate exercise, such as taking a daily walk, can reduce stress.

"Be Happy & Effective at work"

5 Parenting tips to make the journey easier

Parenting is a skill which is enriched with daily experiences. All parents want their child to be the best. Good parenting means a great parent-child relationship. Here are some parenting tips which will help in forging a great bond with your children.

Every parent would love to know how they can be better parents to their precious children. Good parenting skills will help to develop a great relationship between you and your children. Good parenting is important in order to help your children grow into confident and well-adjusted individuals.

Parenting is not easy as many of you parents would have realized by now. These are some tips which will help to make the journey smoother and easier. These tips are not addressing a specific problem, they are just certain guidelines.

Parenting Tips

1. Give Unconditional Love

Firstly you must remember that your children are not going to remain young always. Your child would not remain a baby or a pre-schooler forever. Time flies so fast, that they will grow up soon. Hence, you should make the most of your child's growing years.The childhood of your child is the time when you can spend maximum amount of time with your child and grow close to her. Once, they grow into teenagers and adults, they get so busy with their own lives.

2. Put Yourself in Their Shoes

If any time, you feel irritated by your child's demands or feel that your child is being difficult, put your self in their shoes for a moment. Try to think about the time when you were a child and felt the same way. If your child wants to stay in her friend's house and you do not want to allow her, think about it from your child's point of view.

3. Develop Healthy Eating Habits From a Young Age

Make it a point to feed your child healthy food right from a young age. Give them fruits instead of chips and pizza. If your children eat healthy foods right from a young age, then it is likely that the habit will continue till adulthood. Food habits developed at a young age often stay on till later in life.

4. Have Family-Time!

Many fathers come home late at night, by which time their children are already in bed. Make it a point to have at least one meal together as a family. Basically, you should try and make it a point to do something together as a family. Set aside fifteen minutes every evening, when the entire family will together clean the house!

5. Try to Make Your Children Self-Reliant

Try to make your child independent and self-reliant. Do not do everything for your child as this will make them more and more dependent on you. Children should be given an opportunity to do simple tasks which can be done by them, without the parent doing it for them. Some parents do everything for their children which can cause problems later on in life. When children do things by themselves, they become self-reliant which in turn increases self-esteem.

Also, avoid doing your child's homework. Making your child do a little cleaning of the house, folding of clothes, and washing dishes, etc will help them to learn basic life skills which everybody needs to know.

These are some important parenting tips which can help parents during the journey of parenthood. At the end of the day, remember to be good role models for your child as parents are the biggest role models for children.

How to Sell Combs to Monks

This is a great story to demonstrate how a shift in mindset and attitude can make a significant difference.

The Story:
3 sales professionals applied to work for a huge company. As they were all evenly qualified, the interviewer decided to set a sales challenge and the person who sold the most would be awarded the job.

The challenge was to sell combs to monks of any temple up in the mountains. "You have 3 days, and the person who sells the most will get the job" said the interviewer.

After 3 days, the 3 applicants returned, and reported their results.

Candidate 1 said "I managed to sell one comb. The monks scolded me, saying I was openly mocking them. Disappointed, I gave up and left. But on my way back, I saw a junior monk with an itchy scalp; he was constantly scratching his head. I told him the comb would help him with his scratching and he bought one comb"

Candidate 2 said "That's good, but I did better. I sold 10 combs." Excited, the interviewer asked "How did you do it?"

Candidate 2 replied "I observed that the visitors had very messy hair due to the strong winds they faced while walking to the temple. I convinced the monk to give out combs to the visitors so they could tidy themselves up and show greater respect during their worship."

Candidate 3 stepped up "Not so fast, I sold more than both of them." "How many did you sell" asked the interviewer.
"A thousand combs"

"Wow! How did you do it?" the interviewer exclaimed.

"I went to one of the biggest temples there, and thanked the Senior Master for serving the people and providing a sacred place of worship for them. He was very gracious and said he would like to thank and appreciate his visitors for their support and devotion. I suggested that the best way would be to offer his visitors a momento and the blessing of

Buddha. I showed him the wooden combs which I had engraved words of blessings and told him people would use the combs daily and would serve as a constant reminder to do good deeds. He liked the idea, and proceeded to order a thousand combs"

"You got lucky," one of the other candidates said bitterly.

"Not really," the interviewer countered. "He had a plan, which was why he had the comb engraved prior to his visit. Even if that temple did not want it, another one surely would."

"There is more," the third candidate smiled. "I went back to the temple yesterday to check on the Master. He said many visitors told their friends and family about the comb with the Buddha's blessing. Now even more people are visiting every day. Everyone is asking for the comb, and giving generous donations too! The temple is more popular than ever, and the Master says he will run out of the combs in a month... and will need to order more!"

Learning Points:
The three different candidates show us the different levels of sales performance:

Candidate 1 displayed the most basic level, which is to meet the prospect's personal needs. The monk with the itchy scalp had a personal need; it was specific to him only.

Candidate 2 shows the next level - anticipating and creating new needs for the prospect. Perhaps the monk doesn't have an obvious need for the comb, but how can it still be beneficial to him? When you can educate the prospect on new possibilities and benefits for his business, you are already outperforming your competitors.

Candidate 3 demonstrates the best level of all; an ongoing relationship resulting in repeat sales and referrals. Everyone was a winner, the monk, the devotees, the 3rd candidate and the interviewer. Help your prospects benefit their prospects, to create maximum value. View each prospect not as individuals, but also their contacts and network beyond them. See each customer as lifetime clients instead of one time sales.

"Our beliefs and thoughts shape our actions and ultimately, our results. When faced with a challenge, how do you respond? And how big do you think?

How can you create new needs for your prospect and benefit their customers?

CONFERENCES

Technical Paper Presentation @ NISSTA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Department : Customer Solutions

Name : Devendra Pal
Department : Store

Name : Manish Kumar
Department : Business Development

Name : Mandeep Phogat
Department : Research & Development

Name : Umesh Prite
Department : Accounts

WHO WE ARE

Catalysts was established in 2003. Having its corporate office in the largest state of Uttar Pradesh in India and Manufacturing units in the Hill state of Uttrakhand. It is a leading research and quality certified Biotech company. We are engaged in delivering enzyme based eco-friendly solutions to many industry verticals. We are a multilevel quality certified company having certification of ISO 9001:2008, FSSC 22000 and HALAL.

Our Process expertise based enzyme formulation are a key competitive advantage for Catalysts and thus for our customers. We have a modern fully-equipped technology centre, where application research is done extensively using substrates received from client side.

Our technical team provides real time process and troubleshooting support to various industries like Molasses Ethanol, Grain Ethanol, Carbohydrates processing, Malt extraction, Brewing process and sugarcane juice processing.

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