Good beer demands the best ingredients

- KiGel® products for clear and stable beers
- BrauSol – special silica sol for beer production
- Kieselguhrs, perlites and cellulose
- Erbslöh filter sheets and filter cartridges
- Activated carbons in beer production
- Erbslöh beer yeasts
- Foam stabilisation with SweetGum
- Yeast nutrients
Smell, taste, clarity, foam and colour are the criteria by which the consumer judges a beer. The increase in the global beer production and in customer demands require safe quality parameters for at least one year.

The chemical-physical stability is indicated after bottling through appearance, smell, taste and clarity. A particularly critical factor is chill haze.

Chill haze is formed when beer is cooled and is a result of the interaction between proteins and flavanoid polyphenols which are able to form complexes. Chill haze dissolves with higher beer temperatures. In the course of time quantity and size of the complexes increase and permanent haze may form.

Besides proteins and polyphenols, also polysaccharides, alkaline-earth salts, oxygen and heavy metals play an important role in the haze formation of beer, always depending on temperature.

The following criteria must be observed to remove potential haze-forming substances and to extend the shelf life of beer.

- Selection of suitable raw materials
- Appropriate technology during beer production
- Use of special stabilisation measures

To assure beer stability, proteins and starch must be sufficiently degraded in the brewhouse. During wort boiling it is important to precipitate to the largest possible extent high-molecular nitrogen compounds by heat coagulation. Anthocyanogens support this process. A low wort pH (5.0 – 5.2) promotes protein precipitation.

During wort treatment hot break removal is crucial. It is also important to aerate the pitching wort sufficiently and to use fresh, actively fermenting yeast together with a rapid course of fermentation. By the end of storage, a deep cooling period of minus 2°C to 0°C should be kept.

Beer must not be warmed when transferred from the storage cellar to filtration to prevent substances responsible for chill haze to redissolve.

The following products prevent, respectively delay the formation of haze:

- BrauSol
- KiGel® Clear, KiGel® Xero, KiGel® Brilliant, KiGel® Medi,
  KiGel® Hydro and KiGel® Sensitive
- Erbslöh PVPP
- Beerezym Chill
- Bentonite

These products counteract adsorptively or biochemically the protein-tannic substance bonding. By the application of silica sol and silica gels it is possible to positively affect chemical-physical stability. Proteins are reduced.

Silica gels

In the reaction of water glass with diluted acid (e.g. sulphuric acid), a gelatinous silicon dioxide is formed at a certain pH. This is the so-called silica sol. The silica gel jelly is washed out and is dried by separation of water without increase of particle size. By grinding the product is adjusted to a defined degree of fineness. Dependent on precipitation, drying and grinding, hydrogels, hydrated silica gels or xero silica gels are made from silica sols. Due to the formation of the surface, high-molecular proteins with haze-forming potential are adsorbed from the beer.

Of special importance for the adsorbency and the filtering behaviour are grinding degree and average particle size. Pore radius and pore volume are crucial for the effectiveness of the KiGel® products. All KiGel® products are produced with an optimal pore radius of 3.0 – 3.5 nanometer.
**Addition of KiGel® during kieselguhr filtration**

The application of KiGel® during kieselguhr filtration is the easiest way to improve shelf stability. The particle size distribution and the overall structure of the KiGel® products include excellent stabilisation capacity and very good filtration properties. The use of highly effective KiGel® products reduces the kieselguhr dosage by up to 30%. Recommended is an addition of 30 – 50 g/m² filter area during the second pre-coating to assure full beer stability from the start.

**Stabilisation with buffer tank**

By the addition of the KiGel® products into the beer flow through a dosing unit efficiency is optimised and stabilisation is made more economic. Dosing unit and buffer tank are placed in front of kieselguhr filtration. The size of the buffer tank should amount to 50% of the kieselguhr filter capacity per hour to assure a minimum contact time of 15 minutes between stabiliser and beer.

**Stabilisation during the transfer**

With bad malt qualities or with beers with higher fermentation temperatures approximately 1/3 of the required amount of KiGel® is added during the transfer. Beers clarify quicker and storage time is reduced. Haze-forming protein is adsorbed and filtration-inhibiting substances settle together with the KiGel® products. The remaining amount is added during subsequent kieselguhr filtration.

**Combination of KiGel® products and Beerzym Chill**

The combined use of KiGel® and Beerzym Chill is a very effective stabilisation method. KiGel® amounts can be reduced by 25–50%. Beerzym Chill can be added either to the filtrate or to the storage tank during the transfer from the fermenter. The dosage is 2 – 4 g/100 L. When dosing Beerzym Chill directly to the filtrate, the beer should be pasteurised or short-time heat treated, since otherwise residual enzyme activities may be present in the finished beer.

It is more effective to add Beerzym Chill into the storage tank because contact time is longer and product activities are almost fully degraded. The remaining activity is adsorbed by the addition of KiGel® products during filtration.

When using Beerzym Chill, observe laws and regulations of the individual country.
Stabilisation with KiGel® and PVPP
High- and medium-molecular protein compounds and polyphenols (chill haze reaction partner) are eliminated through this procedure. KiGel® and PVPP are added during kieselguhr filtration. In the course of PVPP addition, the volume may increase by an up to 8-fold amount of the weighed portion. We recommend to preswelling PVPP about 20 minutes in water (20 – 30°C). By this measure PVPP develops its full adsorbeny and is able to bind polyphenols directly.

Stabilisation with regenerable PVPP
After kieselguhr filtration PVPP treatment follows. PVPP is retained in the stabilisation filter and is later regenerated with NaOH. When using PVPP, oxygen rates in the beer must be carefully observed since oxygen affects taste stability in a negative way.

KiGel® – application in practice
Optimal dosages depend on the parameters of the respective brewery:

• desired chemical-physical stability
• technology used in the brewery
• clarification and filtration process engineering
• base stability of the beer variety

<table>
<thead>
<tr>
<th>Shelf life</th>
<th>3 months</th>
<th>6 months</th>
<th>&gt;12 months</th>
</tr>
</thead>
<tbody>
<tr>
<td>KiGel® Clear</td>
<td>35 g/100 L</td>
<td>55 g/100 L</td>
<td>90 g/100 L</td>
</tr>
<tr>
<td>KiGel® Sensitive</td>
<td>25 g/100 L</td>
<td>40 g/100 L</td>
<td>75 g/100 L</td>
</tr>
<tr>
<td>KiGel® Medi</td>
<td>40 g/100 L</td>
<td>60 g/100 L</td>
<td>100 g/100 L</td>
</tr>
<tr>
<td>KiGel® Xero</td>
<td>30 g/100 L</td>
<td>50 g/100 L</td>
<td>80 g/100 L</td>
</tr>
<tr>
<td>KiGel® Brilliant</td>
<td>25 g/100 L</td>
<td>40 g/100 L</td>
<td>75 g/100 L</td>
</tr>
</tbody>
</table>

The indicated dosages are without obligation and are given as general instructions. With a combined application of PVPP or Beerzym Chill dosage amounts must be accordingly reduced.

BrauSol capacity during the brewing process
When BrauSol is added to the wort or beer and under suitable pH conditions the SiO₂ molecules cross-link and transform into an insoluble hydrogel. Together with adsorbed haze-forming particles it flocculates and settles at the bottom of the tank.

Application of BrauSol in the brewhouse
For optimal hot trub separation BrauSol is already added in the brewhouse. It is dosed into the hot outcast wort approximately 5 – 10 minutes before the end of the boil and the silica gel flocculation which forms in the whirlpool is separated together with the hot trub. Dosage: 30 – 50 mL/100 L wort.

• accelerates fermentation
• optimizes filter throughput
• strong hot trub precipitation
• formation of very compact trub

Application of BrauSol in the fermentation or storage cellar
During this process BrauSol is dosed into the cooled finished wort or into the fermented beer using a special dosing unit.

• green beer clarifies quicker
• no impact on fermentation
• yeast crop is increased
• filter throughput during final filtration is increased

The dosage of BrauSol during transfer from fermenter to storage cellar provides good results particularly when used in final fermented beer which is hosed with a temperature around the freezing point. Dosage: 40 – 50 mL BrauSol/100 L green beer.

The main portion of the chill haze forming particles is insoluble at low beer temperatures. Together with other filtration-inhibiting substances they are eliminated from the beer in a rapid sedimentation process. The brew-master must take into account that settling time is around 1.1 – 1.3 m/day.

Special applications of BrauSol
With beers difficult to filtrate, for instance Weizen-, Kölsch- or Altbier (German top fermentation beers), an addition of 30 g/100 L BrauSol during fermentation leads to good results. Protein compounds resulting from the wheat malt are adsorbed and filterability is significantly improved. It is advisable to proceed in the same way with beers which pose filtration problems due to variations in the malt raw material.

BrauSol is a specific colloidal solution of silicic acid in water. It provides for clarity and promotes filtration.
**IsingClair-Hausenpaste**

Isinglass gel for the clarification of beer
When dissolved in the beer, IsingClair-Hausenpaste leads to a rapid flocculation of haze-forming particles. These settle as a compact layer at the tank bottom and are separated/filtrated.
The temperature during application or ageing has a strong impact on the consistency of the Hausenpaste. Higher temperatures lead to a thinner consistency whereas lower temperatures result in thicker solutions. Yet the consistency does not affect the effectiveness. If IsingClair-Hausenpaste is thick due to low temperatures it is getting thinner when stored in a warm place. This process takes several days.
Therefore it is easier to dilute IsingClair- Hausenpaste with some warm water and to shake it vigorously or to stir with a whisk.
After that, the product can be used without problems.

**Bentonite – the alternative protein stabilisation**

In the beverage industry, specially selected and refined types of bentonite are used as clarifying and protein stabilising agents. Application in beverages requires a high product standard which is assured by thorough and consistent quality assurance in Geisenheim.

In the field of beer treatment bentonites with strong swelling capacities with small alkali ion or alkaline earth ion portion are applied. Mainly alkali bentonites are used to improve beer stability since these bentonites with high swelling capacity have a high adsorbency. Bentonites contain exchangeable cations.

The ion-exchange capacity amounts to up to 100 mval/100 g bentonite. Bentonites used in the brewing industry, must be low in iron, since iron negatively affects beer taste and stability. Erbslöh low-iron bentonites selectively eliminate high-molecular proteins which together with tannic substances can cause chill haze.
Although the full range of proteinaceous compounds are adsorbed to a certain extent, the high-molecular proteins are most affected by a bentonite treatment. Polyphenols and anthocyanogens which together with proteins can lead to chill haze, are reduced too.

Above all bentonite is used to optimize the stability of export beers. By pumping over the beer into a stabilisation tank, the required bentonite amount can be uniformly added.

Dosage is made exclusively in the storage cellar. Bentonite of more than a week do not result in improved stability, since the bentonite settles at the bottom of the stabilisation tank.
The bentonite should be added about one week prior to subsequent filtration and depends on the initial base stability of the beer and the desired shelf life.
The dosage ranges between 20 –150 g/100 L. Very high amounts may have an impact on beer foam.

**Kieselguhrs, perlites and cellulose**

Since customers demand American low-in-calcium kieselguhrs, we extended the Erbslöh portfolio and offer kieselguhrs (diatomaceous earth), perlites and cellulose for beer filtration:

**DICALITE-KIESELGUR:**
- Dicalite 215 (very fine)
- Dicalite Superaid (fine kieselguhr)
- Dicalite KG-UF (finest medium kieselguhr)
- Dicalite Speedflow (medium coarse kieselguhr)

**DICALITE-PERLITE-REIHE:**
- Dicalite Speedplus (coarse kieselguhr)
- Dicalite 418 (fine)
- Dicalite BF (fine-medium)
- Dicalite 4108 (medium)
- Dicalite MF2 (coarse)

**Cellulose**

- CelluFluxx® F15 (extra coarse)
- CelluFluxx® F30 (coarse)
- CelluFluxx® F75 (medium coarse)
- CelluFluxx® P30 (medium)
- CelluFluxx® F45 (fine)
- CelluFluxx® F25 (extra fine)
Erbslöh filter cartridges

The single product types are available with different nominal retention rates, respectively different absolute pore sizes and with any kind of adapter type.

Erbslöh filter sheets, B-series
Erbslöh filter sheets are produced according to the newest technical findings and knowledge using best raw materials. Erbslöh’s experience made with special cellulose fibres contributes to improve the production process, which also applies to the special care dedicated to the selection of high-quality innovative raw materials.

The Alternative: Kieselguhr-free precoat filtration with VarioFluxx PreCoat 1 and 2 (Cellulose-Perlite-Mixture)
• The advantage of filter cellulose is, that by targeted milling and fibrillation of selected fibres, its structure can be modified in a way that it forms a voluminous and strongly branched special texture
• In this structure perlites of different fineness are embedded, which determine density and compactness of the filter cake formed
• A first precoat of the filter cake with the new mixed product VarioFluxx® PreCoat 1 forms a well structured and stable „filter layer“ which reliably retains haze particles and microorganisms
• The second precoating with VarioFluxx® PreCoat 2 forms a fine clarification layer, for increased haze reduction
• The continuous dosage (body feed) is without exception conducted with special perlites, which matches beer-specific requirements

Erbslöh-activated carbons for beer production: Granucol® und Ercarbon
The activated carbons of vegetable origin differ in their raw materials, in the production process and in their inner surface and thus a selective adsorptive capacity for the different requirements in brewing technology is achieved:
• for the removal of undesirable off-flavours, consequently elimination of sensory defects: Granucol® GE and Ercarbon GE
• for the adsorption of dark-coloured melanoidine (formed through Maillard reaction) and elimination of colour changes and browning reactions: Granucol® BI and Ercarbon BI

Longer contact times lead to optimal efficiency of action. In particularly difficult treatments dosages are divided into two portions: 40 % of the total amount of either Granucol® or Ercarbon are added to the storage tank and 60 % during final filtration.

Application of Granucol® GE and Granucol® BI:
Trials have showed that increased dosages of the two activated carbons (> 50 g/100 L) can result in a reduction of total polyphenols in beer of > 15 %.
We therefore recommend to conduct laboratory tests prior to large-scale application.

Ercarbon and Granucol® are added to the beer during kieselguhr filtration. Dosage is 10 – 50 g/100 L. To optimize efficiency Ercarbon and Granucol® are already added into the storage tank.
Enzymes

Firstly starch is gelatinised by heat treatment (heating, cooking). Only then enzymatic process steps follow: liquefaction, subsequently saccharification to maltose respectively glucose. The liquefaction of the thermally gelatinised starch is done by α-amylases, the saccharification of the liquefied starch by β-amylases or gluco-amylases. Dependent on the raw materials used different gelatinisation temperatures and thus different requirements of the liquefaction enzymes result. In infusion mashing with barley, wheat and rye liquefaction of the gelatinised digested starch is conducted at temperatures of up to 75 °C. Beerzym Amyl shows optimal activity at a temperature optimum of 70 °C and with natural mash pH. In decoction mashes the application of Beerzym HT is recommended. The digestion of starch in the adjunct cooker requires the use of thermo stable bacterial α-amylases.

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The degradation of digested, liquefied starch and dextrins to fermentable sugars is performed either with Ener-Zyme HT or with Beerzym Crystal. With Erbslöh amylases complete starch digestion and iodine normality of the wort is assured.

Enzymes in the brewing process

In brewing enzymes play a central role. In the brewing process with barley malt enzymes are formed during malting. Malt is a vegetable enzyme concentrate with several enzyme activities of which amylases, proteases and glucanases are most important. Alpha and beta-amylases produce dextrins and fermentable sugars from starch. Proteases and peptidases break down proteins into low-molecular peptides and amino acids and β-glucanases control glucan degradation. The effect of the mentioned enzyme activities controls the time course of the brewing process.

When combining malt and adjuncts in the mash, the enzyme activity of the raw materials is limited to the malt portion. The activity of the malt is sufficient for the processing of an adjunct portion (unmalted barley, rice, corn, millet, etc.) of up to 30 %. The addition of technical enzymes therefore significantly accelerates the brewing process and better and lasting balances variations in raw material.

When using greater portions of adjuncts this absolutely requires the addition of food grade enzymes since otherwise the process would not run. Mashing processes can be divided into infusion and decoction methods. Technical amylolytic, proteolytic and cytolytic enzymes are used solely or combined in these mashes with adjuncts. The enzymes degrade starch, proteins and skeletal substances of the applied adjuncts.

Beerzym products for starch hydrolysis

The hydrolysis of starch can be divided into three steps:

• starch gelatinisation
• starch liquefaction
• starch saccharification

Gelatinisation temperatures of different adjuncts

<table>
<thead>
<tr>
<th>Adjunct</th>
<th>Temperature</th>
</tr>
</thead>
<tbody>
<tr>
<td>Barley</td>
<td>53 – 58 °C</td>
</tr>
<tr>
<td>Barley malt</td>
<td>61 – 65 °C</td>
</tr>
<tr>
<td>Wheat</td>
<td>55 – 65 °C</td>
</tr>
<tr>
<td>Rye</td>
<td>58 – 70 °C</td>
</tr>
<tr>
<td>Corn</td>
<td>68 – 80 °C</td>
</tr>
<tr>
<td>Rice</td>
<td>70 – 90 °C</td>
</tr>
<tr>
<td>Sorghum</td>
<td>80 – 92 °C</td>
</tr>
<tr>
<td>Corn rich in amylase</td>
<td>68 – 105 °C</td>
</tr>
</tbody>
</table>
Beerzym products for glucan degradation (with malt or adjuncts)

High-molecular β-glucan causes problems during lautering followed by wort cloudiness. During the mashing process, endo-glucanases from the malt are continuously degrading glucan until they are thermally inactivated. At the same time, the malt glucan-solubilase makes insoluble glucan soluble and additionally releases hemicelluloses.

Malt endo-glucanase is inactivated at temperatures above 55°C. The malt glucan solubilase is active up to a temperature maximum of 80°C and releases undesirable β-glucan which is not further degradable. As a result, problems during lautering occur, filter capacity is reduced and cloudiness in the final beer develops.

Besides β-glucans, above all, pentosans are released when processing wheat or rye and lead to significant filtration problems. The addition of Beerzym Penta or Beerzym Amber95 is recommended.

### Beerzym HopFlower

**Aroma enhancement with the addition of Beerzym HopFlower**

![Chemical structure](image)

**Linalool-glucoside**
- non-volatile
- odourless

+ Addition of fungal β-Glucosidases

**Linalool**
- lavender, citrus, floral

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**Beerzym**

<table>
<thead>
<tr>
<th>Product</th>
<th>Activity</th>
<th>Conditions</th>
<th>Dosage</th>
<th>Effect</th>
<th>Characteristic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beerzym Amyl</td>
<td>α-amylase</td>
<td>pH-range: 4 – 8; temperature: 30 – 75°C</td>
<td>150 – 350 mL/t adjuncts</td>
<td>for liquefaction of gelatinized starch</td>
<td>• ideal conditions: pH-range: 5.8 – 6.0 and temperature: 30 – 75°C</td>
</tr>
</tbody>
</table>
| Beerzym Amyl HT| α-amylase| pH-range: 5 – 9; temperature: 30 – 100°C | 80 – 240 mL/t adjuncts | for liquefaction of gelatinized starch | • thermostable
  • ideal conditions: pH 6.5 and temperature: 90 – 95°C
  • for a short time the enzyme tolerates temperatures of up to 105°C |
| EnerZyme HT    | glucoamylase | pH-range: 2.5 – 6.5; temperature: 2 – 80°C | 2 – 5 mL/100 L green beer | for saccharification of liquefied starch and dextrins to glucose in a pH-range of 4.2 – 4.5 for Brut IPA | • ideal conditions: pH-range: 3.8 – 4.2 and temperature 65°C
  • during application in the fermenting tank or in the storage tank the attenuation limit can be raised |
| Beerzym Crystal| α-amylase | pH-range: 2.0 – 7.0; temperature range from 20 – 85°C | guide value: 2 – 10 mL/100 hl (addition depends on time of dosage) | prevention and degradation of colloidal haze in green beer (e.g. glycogen) for Brut IPA | • optimal: pH 4.0 – 5.0
  • temperature optimum at 65°C |
| Beerzym Amber95| high concentrated heat stable β-Glucanase up to 95°C; strong Xylanase- and Cellulase side activity | pH-range: 3.0 – 6.0; temperature: 30 – 100°C | 70 – 150 mL/t grist | degradation of β-glucan and laminarin, especially for non-alcoholic beer with high mash in temperature | • optimises the lautering period
  • optimises filter capacity significant
  • for the beer production from cereals rich in pentosans or malts (wheat, rye, oat, barley) |
<table>
<thead>
<tr>
<th>Product</th>
<th>Activity</th>
<th>Conditions</th>
<th>Dosage</th>
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<th>Characteristic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beerzym BG</td>
<td>thermostable endo-β-1.3-glucanase and endo-β-1.3(4)-glucanase complex</td>
<td>pH-range: 2 – 6.5 temperature: 15 – 93 °C, particularly suitable for application in the mashing process</td>
<td>200 – 400 mL/t malt (Beerzym BG); 50 mL/t malt (Beerzym BG-HK4)</td>
<td>degradation of β-glucan and laminarin</td>
<td>• effective against cereal-β-glucans&lt;br&gt; • ideal conditions: pH: 4.5 and temperature: 20 – 85°C&lt;br&gt; • little effect below 30°C, therefore no application in the fermenting room or in tank beer&lt;br&gt; • optimises the lauterling period&lt;br&gt; • optimises filter capacity</td>
</tr>
<tr>
<td>Beerzym BG</td>
<td>thermo-tolerant endo-β-1.3-glucanase/endo-β-1.3(4)-glucanase/hemicellulase complex</td>
<td>pH-range: 2.5 – 7 temperature: 2 – 75°C</td>
<td>0.5 – 1 mL/100 L green beer or 150 – 300 mL/t malt</td>
<td>effective against cereal-β-glucans</td>
<td>• effective at temperatures around &lt;10°C&lt;br&gt; • ideal conditions: pH 5.0 and temperature: 2 – 75°C&lt;br&gt; • no negative impact on beer foam&lt;br&gt; • improved filter capacity</td>
</tr>
<tr>
<td>Beerzym Penta</td>
<td>hemicellulase complex from β-glucanase and pentosanase</td>
<td>pH-range: 2.5 – 6.5 temperature: 4 – 65°C</td>
<td>2 – 20 mL/100 L (dependent on time of addition) 150 – 200 mL/t malt</td>
<td>degradation of β-glucan and pentosan and other hemicellulases at the same time</td>
<td>• effective against β-glucan and other pentosans&lt;br&gt; • ideal conditions: pH 4.5 and temperature: 4 – 70°C&lt;br&gt; • for the beer production from cereals rich in pentosan or malts (wheat, rye, oat)</td>
</tr>
<tr>
<td>Beerzym Saphir</td>
<td>proteinase and a thermotolerant β-glucanase</td>
<td>pH-range from 2.0 – 6.0, temperature range from 20 – 70°C</td>
<td>guide value: 80mL/t malt or barley, 110 mL/t rye, 5 – 25 mL/10 L beer in ageing</td>
<td>for the degradation of haze caused by proteins and β-glucans in beer with fluctuating quality of the crop</td>
<td>• optimal: pH 1.5 – 6.5&lt;br&gt; • temperature optimum at 55 – 60°C</td>
</tr>
<tr>
<td>VP 1506/2 GL</td>
<td>mixture of β-glucanases, cellulases und proteases</td>
<td>pH-range 4.5 – 5.5, temperature range from 45° to 70°C</td>
<td>recommended dosage 0.3 – 0.5 %, based on the total liquid volume</td>
<td>decrease and destroying of cross flow membrane blockage ingredients</td>
<td>• ideal pH: 4.5 bis 5.5&lt;br&gt; • ideal temperature: 45 – 65°C</td>
</tr>
<tr>
<td>Beerzym Combi</td>
<td>mixture of α-amylases, different β-glucanases</td>
<td>pH-range 4.5 – 5.5, temperature range from 45° to 70°C</td>
<td>recommended dosage 0.5 %, based on the total liquid volume</td>
<td>decrease and destroying of filter cartridge blockage ingredients like β-glucanase and α-glucanase</td>
<td>• ideal pH: 5.0 bis 5.5&lt;br&gt; • ideal temperature: 45 – 70°C</td>
</tr>
<tr>
<td>Beerzym Rapid</td>
<td>α-acetolactate-decarboxylase</td>
<td>pH-range from 3.0 – 7.5, temperature range from 4 – 65°C</td>
<td>guide value: 0.8 – 1.0 mL/100 L (addition at fermentation start)</td>
<td>direct conversion of α-acetolactate to acetoin (thus no diacetyl formation)</td>
<td>• optimal: pH 5.5 and temperature&lt;br&gt; • optimum at 45°C</td>
</tr>
<tr>
<td>Beerzym Chill</td>
<td>peptidyl-peptide-hydrolase</td>
<td>pH-range 3.5 – 10.5, temperature range from 4 – 85°C</td>
<td>guide value: 20 – 80 mL/t malt, 2 – 4 mL/100 L beer in ageing, 1 – 3 mL/100 L finished beer</td>
<td>hydrolysis of proteins to amino acids</td>
<td>• optimal: pH 7.5 and temperature&lt;br&gt; • optimum at 60 – 70°C</td>
</tr>
<tr>
<td>EneZyme P7</td>
<td>proteinase from Bacillus subtilis</td>
<td>pH-range 5.0 – 10.0, temperature range from 25 – 70°C</td>
<td>guide value: 150 – 250 mL/t malt, 350 – 700 mL/t malt with adjuncts</td>
<td>release of proteins, during mashing up to 60°C to improve yeast nutrition</td>
<td>• optimal: pH 7.0 and temperature&lt;br&gt; • optimum at 55°C</td>
</tr>
<tr>
<td>Beerzym HopFlower</td>
<td>fungal β-glucosidase</td>
<td>pH-range: 3.0 – 4.5 temperature: 5 – 65°C</td>
<td>10 – 20 mL/hL beer</td>
<td>aroma enhancement from hops, especially dry hopping</td>
<td>• thermostable up to 75°C</td>
</tr>
</tbody>
</table>
### Specialities

<table>
<thead>
<tr>
<th>Product</th>
<th>Components</th>
<th>Conditions</th>
<th>Effect</th>
<th>Characteristic</th>
</tr>
</thead>
<tbody>
<tr>
<td>SweetGum</td>
<td>gum arabic</td>
<td>add during maturation, filtration, or in the BBT before bottling, dosage: 2.5 – 10 mL/L beer</td>
<td>cross-linking of hydrocolloids with the beer’s medium and high-molecular weight proteins</td>
<td>• also extends non-biological storage life as a result of protein binding.</td>
</tr>
<tr>
<td>Ercobin (protection against oxidation)</td>
<td>pure vitamin C, pure ascorbic acid</td>
<td>addition prior to bottling into the filtered beer, dosage: 1 – 5 g/100 L, maximally 8 g/100 L</td>
<td>oxygen reduction by maximally 1.0 mg/L to limit oxidation of beer constituents</td>
<td>• improvement of taste stability • by the application of Ercobin the oxygen present can be reduced by half, since one oxygen molecule in the beer reacts with two ascorbic acid molecules</td>
</tr>
<tr>
<td>Vitamon Cerevisiae</td>
<td>special yeast nutrient preparations</td>
<td>addition into the pitching wort prior to addition to the yeast, dosage: 5 – 15 g/100 L, dissolve product in water and mix thoroughly</td>
<td>• by the ammonium and phosphate portion an additional nutrient basis is provided for the yeast • supports yeast propagation and thus assures quick fermentation onset and complete fermentation</td>
<td>• application into the wort to ferment with lack of phosphate and nitrogen • increase of yeast-utilizable phosphate portion • addition of nitrogen at the same time • increases the vitamin B content for rapid yeast propagation</td>
</tr>
<tr>
<td>BeerProtect</td>
<td>potassium disulphite, ascorbic acid</td>
<td>addition at D.E. filtration, dosage: 1 g/100 L</td>
<td>oxygen reduction and thus increase of taste stability</td>
<td>• improvement of chemical-physical stability</td>
</tr>
</tbody>
</table>

### Foam Stabilisation with SweetGum

SweetGum is a liquid gum arabic (E414) containing stable macro-molecules. Low doses measurably increase beer head retention and foam, while not affecting haze. SweetGum is freely filterable and can be added to the maturation tank prior to filtration or directly to bright beer.

- • Improvement of head retention with low dosages
- • When added to bright beer there is no impact on haze
- • When added to the maturation tank there is no influence on filterability
- • Low dosage additions significantly increase foam

### Trial Results Head retention Foam, with the use of Gummi Arabicum

![Graph showing head retention foam with the use of Gummi Arabicum.](image)

### Trial Results influence of Gummi Arabicum, related to final beer haze

![Graph showing influence of Gummi Arabicum related to final beer haze.](image)
<table>
<thead>
<tr>
<th>Product</th>
<th>Characteristic</th>
<th>Aroma profile</th>
<th>Settling behaviour</th>
<th>Fermentation degree</th>
<th>Special features</th>
</tr>
</thead>
<tbody>
<tr>
<td>BrewMasters German Classic W34/70 3G</td>
<td>this bottom fermenting yeast strain is the most used strain for classical fermented lager beers, worldwide temperature range (6 – 16 °C)</td>
<td>neutral in smell and taste low ester profile</td>
<td>highly flocculating and settling down after fermentation</td>
<td>high</td>
<td>ideal for all bottom fermented beers like Pilsner, Export, Hell or Lager-style, alcohol tolerance up to 9%</td>
</tr>
<tr>
<td>BrewMasters Lager Yeast</td>
<td>bottom yeast strain (lager yeast), strong and rapid fermentation, broad applicable temperature range (9 – 24 °C)</td>
<td>neutral in smell and taste low ester profile</td>
<td>very high flocculating and settling down after fermentation</td>
<td>medium-high (depending on fermentation temperature, see TDS)</td>
<td>strong diacetyl reduction for classical Pilsner and lager beer, alcohol tolerance up to 8%</td>
</tr>
<tr>
<td>BrewMasters Pilsner Style Yeast</td>
<td>bottom yeast strain, strong and rapid fermentation, broad applicable temperature range (9 – 16 °C)</td>
<td>neutral in smell, typical lager taste</td>
<td>highly flocculating and settling after fermentation and thus „good clarification“</td>
<td>high</td>
<td>for classical Pilsner and lager beer, alcohol tolerance up to 8%</td>
</tr>
<tr>
<td>BrewMasters Ale Yeast</td>
<td>top fermenting yeast strain, English Ale, strong and rapid fermentation, broad applicable temperature range (16 – 28 °C, ideal 16 – 24 °C)</td>
<td>&gt; 22 °C higher ester profile, tropical fruits</td>
<td>good flocculation after fermentation</td>
<td>medium</td>
<td>alcohol tolerance up to 8.5%, individually applicable for IPAs, Stout and Porter</td>
</tr>
<tr>
<td>BrewMasters Wheatbeer Yeast</td>
<td>top fermenting yeast strain, strong and rapid fermentation, broad applicable temperature range (18 – 26 °C)</td>
<td>phenolic, estery aroma components, fruity, banana flavour</td>
<td>with extreme cooling, strong sedimentation</td>
<td>medium</td>
<td>for classical Bavarian Weizenbier and fruity, special beers, alcohol tolerance up to 8%</td>
</tr>
<tr>
<td>BrewMasters FruitAle</td>
<td>active dried top fermentation brewing yeast for fruit and ester style beers, for instance, Saison, IPA, DIPA, Belgium styles beers and fruit based styles, applicable temperature range (16 – 28 °C)</td>
<td>strong, fruity flavours build at temperature level &gt; 22 °C</td>
<td>medium to high flocculating</td>
<td>high (80 – 83%)</td>
<td>strong diacetyl reduction, alcohol tolerance up to 8.5%</td>
</tr>
<tr>
<td>BrewMasters USAle</td>
<td>active dried top fermentation brewing yeast for American style beers, for instance, Ale, IPA, DIPA, Brut-IPA, Stout and Porter, (16 – 26 °C)</td>
<td>low ester profile</td>
<td>high flocculating and settling down after fermentation</td>
<td>very high (85 – 90%)</td>
<td>strong diacetyl reduction, alcohol tolerance up to 11%</td>
</tr>
</tbody>
</table>