Beer Compendium

Good beer needs the best ingredients

ERBSLÖH

Progress is our future

www.erbsloeh.com

A widely recognised standard for beer production has been established since 1516, with Germany's Purity Law. International technologies and consumer trends, such as craft beers, alcohol-free products and beer cocktails have increased the range of variants.

The ERBSLÖH Beer Compendium provides an overview of our full range. Our treatment agents can be used at different stages in the brewing process and can help your beer to achieve its full potential.

The recent focus has been on sustainable and cost-effective production.

Our beer compendium introduces resource-saving alternatives and explains the advantages and disadvantages of the various products

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Modern brewing

The consumer assesses a beer according to aroma, flavour, clarity, head retention and colour. The rise in global beer production and consumers' expectations dictate that these qualities must be maintained for at least one year.

After the beer is bottled the appearance, odour, taste and clarity are what indicate the beer's chemical and physical stability. One primary critical factor is chill haze.

Chill haze occurs when the beer is cooled and is a consequence of the interaction between proteins and flavonoid polyphenols, which may form complexes, as the case arises. If the beer's temperature is raised then the chill haze dissipates again. Over time, the number and scale of the complexes increase and a permanent, persistent haze may form.

In addition to proteins and polyphenols, polysaccharides, alkaline earth salts, oxygen and heavy metals play a major role in the formation of hazes in beer. This depends on temperature.

Attention should be paid to the following points to remove potential causes of haze and extend the beer's life:

- Choice of suitable raw materials
- Correct brewing technology
- Use of special stabilisation measures

Where subsequent stability of the beer is concerned, attention should be paid to adequate degradation of proteins and starches in the brewhouse. Where the wort boil is concerned, it is first and foremost a question of extensive elimination of macromolecular nitrogen components by means of heat coagulation. This process is supported by anthocyanogens. A low wort pH value (5.2– 5.0) promotes protein elimination. Hot break separation is indispensable for wort treatment. Adequate ventilation of the starter wort and the use of fresh, strongly fermenting yeast associated with rapid fermentation are also important. Temperatures of -2–0 °C must be maintained during storage, towards the end of a period of freezing. The beer should not be warmed between cellar and filtration to prevent the chill haze components dissolving again.

The following products delay or prevent haze formation:

BrauSol

Silica sol to improve clarification, stabilisation and filterability.

KiGel®

Top-quality silica gel to optimise chemical and physical stability.

Erbslöh PVPP

Optimisation of beer's colloidal stability.

Beerzym® CHILL

Vegetable protease for cold and protein stabilisation.

Bentonites

For optimising beer stability.

Tannivin® Galléol

To optimise chemical and physical shelf life.

Use of these products counteracts proteins and tannins bonding by adsorption or biochemically.

Use of silica sol and silica gels provides an opportunity to have a positive influence on chemical and physical stability and to reduce proteins.

KiGel®

For clear, stable beers

From a specific pH value, when sodium tetrasilicate (water glass) reacts with a dilute acid, such as sulphuric acid, the result is an aqueous, gel-like silicon dioxide, known as silica sol.

The silica sol gels are washed off, the water separated off and the gels dried without enlarging the particles. The resulting product is adjusted to a specific degree of fineness by grinding. Depending on the precipitation, drying and grinding, the silica sols result in hydrogels, hydrated silica gels or xero silica gels. As a result of the surface formation, macromolecular proteins, which are regarded as potential causes of turbidity, are adsorbed from the beer. The grind and the average particle size are particularly important for the silica gels' adsorptive capability and filtration behaviour. The pore radius and the available pore volume are decisive for the silica gels' effect.

KiGel® products are set to an optimum pore radius of 3.0–3.5 nanometers.

Addition during kieselguhr filtration

The use of **KiGel®** during kieselguhr filtration is the simplest way to improve shelf life. The grain size distribution and the **KiGel®** products' overall structure produce excellent stabilisation and very good filtration.

KiGel®-addition during kieselguhr filtration

The use of highly effective **KiGel®** products reduces the kieselguhr dosage by up to 30%. We recommend 30–50 g/m² filter area during the second pre-coating, so that the first beer is immediately fully stabilised.

Addition of KiGel® during transfer to buffer tank

Stabilisation during transfer to maturation

In the event of poor-quality malt or beers with higher fermentation temperatures, approximately 1/3 of the necessary quantity of silica gel can be added during piping. As a result, the beers clarify faster and storage times are reduced. Haze-forming protein is adsorbed and filtration-inhibiting substances are sedimented with the **KiGel®** products. Addition of the rest takes place during subsequent kieselguhr filtration.

Stabilisation using a buffer tank

Adding **KiGel®** products to the beer stream using a dosing device optimises effectiveness and makes stabilisation more economic. The dosing vessel and the buffer tank are upstream of kieselguhr filtration. The buffer tank size should be around 50% of the kieselguhr filter's hourly output to ensure a minimum contact time of 15 minutes between the stabiliser and beer.

KiGel® addition with buffer tank

Combination of KiGel® and Beerzym® CHILL

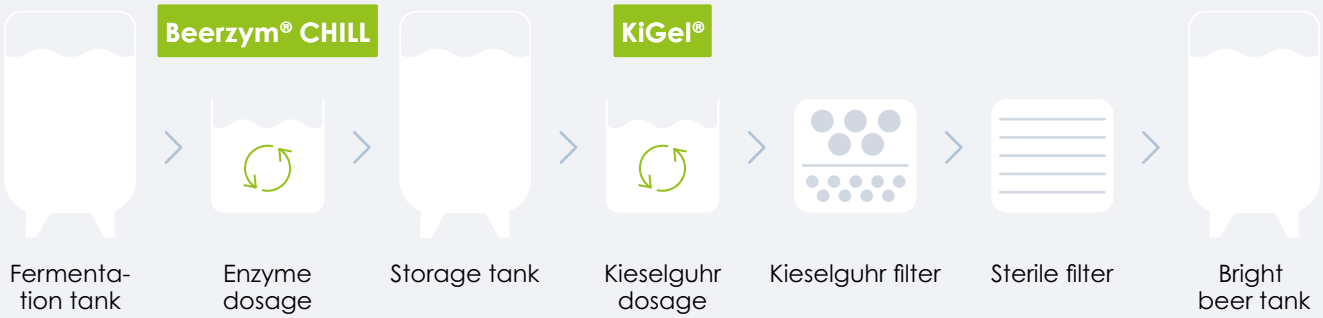
Does not comply with the German Purity Law

The combination of **KiGel®** and **Beerzym® CHILL** is an effective stabilisation technique. **KiGel®** product dosage can be reduced by 25–50%.

Beerzym® CHILL can be added to the filtrate and during piping from the fermentation to the storage tank (**Beerzym® CHILL** dosage: 2–4 g/hL). When dosing directly into the filtrate, care should be taken that no residual **Beerzym® CHILL** activity is present in the finished beer. Beers should therefore be pasteurised or treated with flash pasteuriser.

Dosage of **Beerzym® CHILL** to the storage tank is more effective, as a longer contact time is assured here and the product's activity can be almost fully eliminated. The residual activity is adsorbed by the addition of **KiGel®** products during filtration. When using **Beerzym® CHILL** please follow the regulations in the countries in question (Purity Law).

Combined addition of Beerzym® CHILL and KiGel®



Stabilisation with KiGel® and Erbslöh PVPP

This technique removes macro and medium molecular protein compounds and polyphenols (chill haze reaction partners).

KiGel® and **ERBSLÖH PVPP** are added during kieselguhr filtration. The addition of PVPP can lead to an eight times increase in volume compared to the actual weight. We recommend pre-swelling **ERBSLÖH PVPP** in water for approximately 20 minutes (20–30 °C). This allows the PVPP to develop its full adsorption ability and bond with polyphenols directly.

Stabilisation with reclaimable Erbslöh PVPP

Kieselguhr filtration is followed by treatment with **ERBSLÖH PVPP**. PVPP is retained in the stabilisation filter and later reclaimed using sodium hydroxide (NaOH). When using **ERBSLÖH PVPP** it is essential that attention is paid to the to the oxygen levels, as oxygen contamination can have a negative effect on flavour stability.

Combined addition of KiGel® and Erbslöh PVPP

KiGel® dosage in practice

The optimum dosage depends on the operating parameters chosen:

- Desired chemical and physical stability
- Brewery technology
- Process technology for clarification and filtration
- Fundamental stability of beer type

This information is non-binding and is for reference purposes only. The quantities used should be reduced accordingly when combining **KiGel®** with **ERBSLÖH PVPP** or **Beerzym® CHILL**.

	Shelf life in months		
	3	6	> 12
KiGel® Clear	35 g/hL	55 g/hL	90 g/hL
KiGel® Sensitive	25 g/hL	40 g/hL	75 g/hL
KiGel® Medi	40 g/hL	60 g/hL	100 g/hL
KiGel® Xero	30 g/hL	50 g/hL	80 g/hL

SweetGum®

Gum arabic for stable foam

Does not comply with the German Purity Law

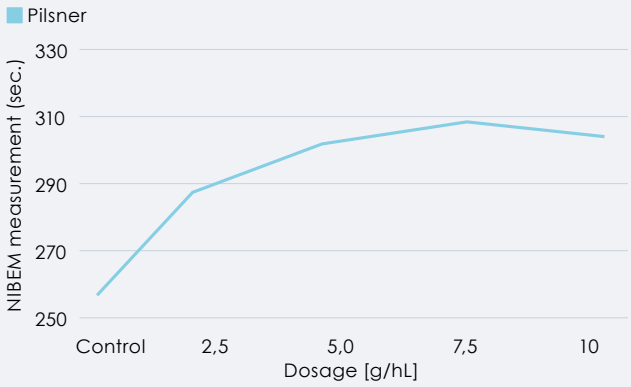
SweetGum® (gum arabic, E414) is a natural exudate from the African acacia tree (Acacia seyal). It consists of a hydrocolloid (arabinogalactan II), composed of a polysaccharide and a protein fraction. This structure gives gum arabic its stabilising effect on unstable colloids that affect turbidity.

SweetGum®

Freely filterable, liquid gum Arabic from Acacia seyal.

When used in brewing, even minuscule doses significantly improve beer foam. Also, its addition does not affect the beer's tendency to haze, which is why it can be added to the pressure tank after filtration too.

Influence of SweetGum® on beer foam at various dosages



IsingClair-Hausenpaste

Hausenblase gel for clarification

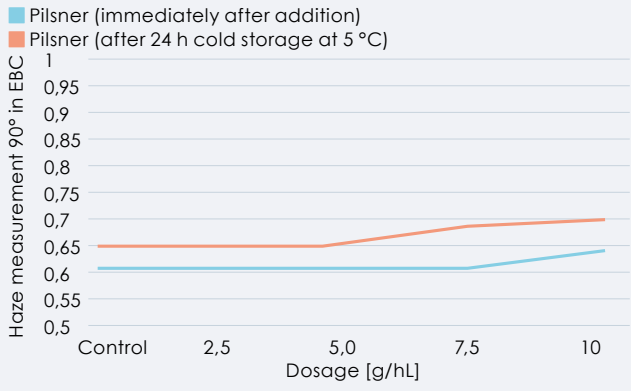
When distributed in the beer, **IsingClair-Hausenpaste** causes relatively fast flocculation of the sediment particles. After they have precipitated, these form a compact deposit in the tank and are easily separated by filtration or separation.

IsingClair-Hausenpaste

Isinglass gel for the clarification of beer.

Isinglass's consistency is heavily influenced by the temperature at which it is stored and used. The consistency is not decisive for effectiveness. If IsingClair gel has become viscous due to lower temperatures, this will become more liquid again when stored in a warmer place. However, this process will take a few days. It is easier to dilute IsingClair gel with a little warm water and to shake it hard, or stir it with a whisk. Afterwards it is easier to use.

Influence of SweetGum® on beer's haze stability (90°)



BrauSol

BrauSol P and BrauSol Special – the silica sol all-rounders

BrauSol is a specific colloidal solution of silicic acid in water that creates clear conditions that promote filtration.

What does BrauSol do during brewing?

When **BrauSol** is added to the wort or beer with suitable pH, silicon dioxide (SiO_2) particles link to form an insoluble hydrogel. Floccules and sediments form on the tank floor.

BrauSol reaction

Before

After

BrauSol in the brew house

The product is added to the hot wort, ideally after the knockout pump and before it enters the whirlpool. If this is not possible, we recommend addition to the whirlpool, when this is 75–80% full. Dosage: 30–50 mL/hL wort.

- Accelerated fermentation
- Optimised filter life
- Strong hot sediment separation
- Very compact sediment formation

BrauSol in the fermentation or storage cellar

In this process, **BrauSol** is added to the cooled cast wort or the fermented beer using a special dosing device. Dosage: 40–50 mL **BrauSol** /hL wort.

- Faster clarification of young beers
- No effect on fermentation
- Increased yeast yield
- Increased filter life during final filtration

Dosing of **BrauSol** between the fermentation and storage cellars produces good results, especially in the case of beer that has finished fermenting, which is piped at a temperature around freezing. Dosage: 40–50 mL **BrauSol** /hL of young beer.

At a low beer temperature, the majority of the chill haze formers are insoluble. The haze particles are captured together with other filtration-inhibiting substances and removed from the beer during a rapid sedimentation process. The sedimentation rate is around 1.1–1.3 m/day, to which the technicians must pay attention.

Special applications of BrauSol

Addition of 30 g/hL during fermentation has proved to be successful for difficult-to-filter beers, such as wheat beers, kölsch Cologne-style beers, or top-fermented dark beer. The gluten compounds ensuing from the wheat malt are adsorbed and filterability significantly improved. This procedure is also recommended for beers that experience filtration problems due to fluctuations in the quality of the malt.

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Granucol®

Activated charcoal for brewing

The various activated charcoals of vegetable origin differ - depending on the intended use - in the choice of raw material, production method and the inner surface. This achieves a selective adsorption capacity for various brewing technology requirements.

Granucol® GE

Removal of undesirable odours and flavours and thus elimination of sensory defects, off-flavour.

Granucol® FA

Adsorption of dark melanoids (formed by Maillard reaction) and elimination of colour changes and tanning reactions.

Use of Granucol® GE and Granucol® FA activated charcoal:

Batteries of tests have shown that an increased dosage of both activated charcoals (> 50 g/hL) reduces the total polyphenols in beer by > 15%.

This is why we recommend a laboratory test before use on a wide scale.

Granucol® activated charcoal is added during kieselguhr filtration. The dosage is 10–50 g/hL. Adding the product to the storage tank improves the effectiveness of **Granucol®**.

Bentonite

Alternative protein stabilisation

In the beverages industry, specially selected and treated bentonite is used for clarification and protein stabilisation. A higher standard of bentonite is required for use in beverages; ERBSLÖH guarantees this through detailed quality assurance and selection of appropriate raw materials.

Bentonite that swells a lot with a low proportion of alkaline or alkaline earth ions is used in beer. These alkaline bentonites are mainly used to improve beer's stability. Their great swelling capacity means they are very adsorbent.

Bentonites contain exchangeable cations. These free ions can be replaced by other groups of atoms. This exchange capacity is up to 100 mval/100 g bentonite.

As iron impairs beer's flavour and stability, it is very important that the bentonites used are low in iron. Low iron bentonites selectively remove macromolecular proteins which, in combination with tannins, can be responsible for chill haze, from the beer.

Protein stabilisation using bentonite

Before

After

Bentonite's nitrogen adsorption includes all protein fractions, but mainly macromolecular proteins. Up to 10% of polyphenols and anthocyanogens, which can also be responsible for chill haze when combined with proteins, are also removed.

Bentonite is used particularly to optimise beer stability in beers for export. By pumping over the beer in a stabilisation tank it is possible to evenly add the quantity of bentonite required. Dosing takes place in the storage cellar only. Bentonite's effectiveness depends on the sedimentation speed.

When the stabilisation tank temperature is -1 °C, this requires a storage time of at least four days. Comparable stabilisation results are achieved with shorter storage times, but the beer loss increases. Storage times of more than one week are of no benefit, as the bentonite settles on the stabilisation tank bottom.

The following bentonites are used in beer brewing:

SodiBent Supra

Natural, finely ground sodium bentonite powder for the beer clarification and stabilisation.

GranuBent PORE-TEC

Sodium-bentonite granulated with PORE-TEChnology.

Bentonite should be added around one week before subsequent filtration and is governed by the beer's fundamental stability and the desired shelf life. The dosage is 20–150 g/hL. If very high doses are used this may affect the foam.

Tannivin® Galléol

High purity gallotannin for beer stabilisation

Does not comply with the German Purity Law

Tannins are vegetable tannins. **Tannivin® Galléol** is a specially selected and purified gallotannin.

Tannivin® Galléol is particularly suitable for beer clarification and stabilisation a result of its very high potential charge. Combined treatment with **BrauSol** causes significantly larger protein floccules and more compact sedimentation to form.

Addition to the mashing-in water

Gallotannin **Tannivin® Galléol** should be added direct to the mashing-in water in the brew house before addition to the grist. We recommend a dosage of 2 g/hL.

The advantages of mashing in with **Tannivin® Galléol** include increasing extraction in a commercial brewery by up to 2% and faster clarification of up to 30%, which reduces formation of a film and potential formation of a bacterial biofilm in theLauter tun or mash filter.

Addition at the end of boiling

Tannivin® Galléol can also be used at the end of boiling. It can be the sole addition at this juncture, or in addition to previous dosages. We recommend a dosage of 2–3 g/hL.

If the tannin is added approximately 10 minutes before the end of boiling, it is possible to achieve better whirlpool performance, better hot separation as the result of a more compact hot sediment and a clearer wort. There is also less loss during fermentation as a result of reduced chill haze and increased chemical and physical stability of the treated wort.

Addition at the start of storage

Besides addition during mashing-in and at the end of boiling, **Tannivin® Galléol** can also be used at the start of storage. The advantages of adding the tannin at this stage are a shorter maturation time, bond complexation of heavy metals, especially iron and aluminium, and longer filtration times. This also achieves a significant improvement in the treated beer's chemical and physical stability.

Another advantage of using **Tannivin® Galléol** is particularly worthy of mention: use of the gallotannin in brewing reduces the need for silica gel and PVPP.

Summary

Thanks to its versatile uses, **Tannivin® Galléol** proves to be a genuine all-rounder in brewing. The gallotannin is particularly suitable for clarifying and stabilising beer, but also helps to reduce the brewery's environmental footprint. The possibility of saving silica gel and PVPP not also removes the need for long lead times for raw materials, but also lots of lengthy shipments.

Filtration

ERBSLÖH filter sheets

Filter sheets for beer filtration

ERBSLÖH filter sheets are manufactured according to the state of the art, using the best raw materials. ERBSLÖH pays great attention to selection of high-quality, innovative raw materials and experience with special cellulose fibres. The quality of ERBSLÖH filter sheets is ensured by comprehensive quality control.

EL-PES, EL-PP and EL-TFK

ERBSLÖH filter cartridges

The individual product types are available with different nominal deposition rates, a variety of absolute pore widths and an adapter.

Pleated filter cartridge

Kieselguhr, perlite and cellulose

Due to the demand for American kieselguhr, we have expanded our portfolio at ERBSLÖH and offer a variety of kieselguhr's perlites and celluloses for beer filtration:

Dicalite

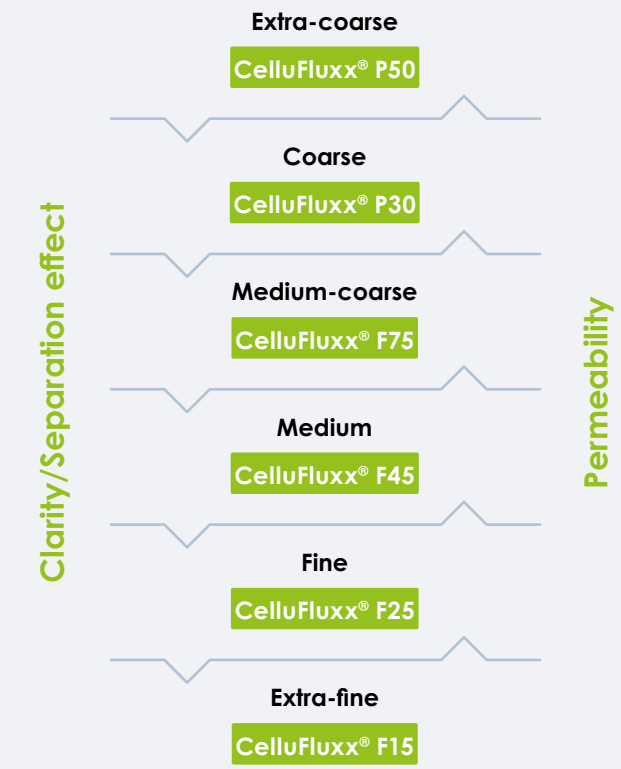
Kieselguhr and perlite

- Dicalite 215 (very fine)
- Dicalite Superaid (fine kieselguhr)
- Dicalite KG-UF (fine-medium kieselguhr)
- Dicalite Speedflow (medium kieselguhr)
- Dicalite 231 (medium kieselguhr)
- Dicalite 341 (coarse kieselguhr)
- Dicalite Speedplus (coarse kieselguhr)
- Dicalite 418 (fine)
- Dicalite BF (fine-medium)
- Dicalite 4108 (medium)
- Dicalite MF2 (coarse)

CelluFluxx®®

Cellulose-based filtration aid

CelluFluxx® portfolio



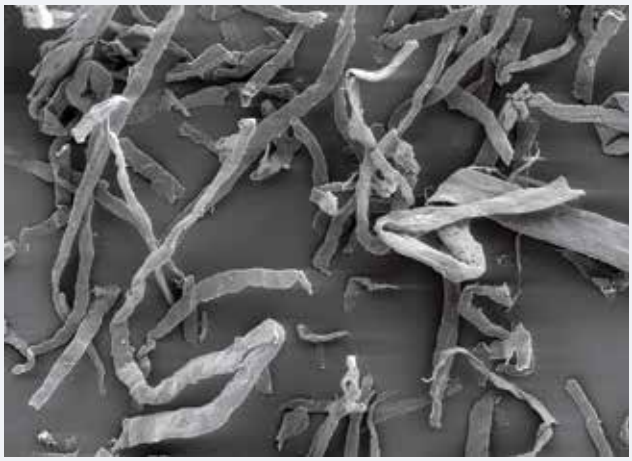
Kieselguhr-free filtration

Consumers are increasingly focussing on sustainability. With our kieselguhr-free filtration solution ERBSLÖH is able to meet its customers' increased expectations because our products have a decisive advantage: the raw materials used – perlite and cellulose – come from Germany and Europe.

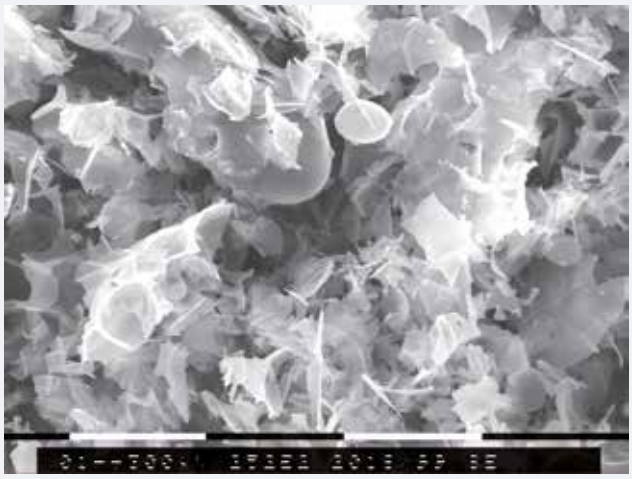
The shorter shipping distances therefore considerably reduce the associated CO_2 footprint. At the same time, dependence on global trade and availability of overseas containers is also reduced, as carriage can be by land. The ensuing waste from kieselguhr-free filtration can also be disposed of in agriculture all year round.

Filter celluloses offer the option of modifying the filter medium's structure by intentional milling and fibrillation of selected fibres, such that they form a voluminous and strongly branched spatial structure. Perlite of different finenesses is embedded in this spatial structure and this dictates the density and compactness of the filter cake formed in this way. Basically, the principle of filter sheet production is applied.

Cellulose



Perlites



VarioFluxx® PreCoat

Filter cellulose and perlite

To meet the high expectations of beer filtration, two filtration aid mixed products have been developed for use specifically in first and second pre-coating.

Initial precoating of the filter cake with the new **VarioFluxx® PreCoat 1** mixed product forms a well-structured and stable "filter sheet" that reliably retains sediment particles and microorganisms.

The second precoating with **VarioFluxx® PreCoat 2** forms a fine clarifying layer for intentionally increased turbidity reduction.

Continuous dosage takes place with perlite only, whose fineness is determined by the individual operating requirements.

Existing systems such as frame filters, candle filters or centrifugal discharge filters can still be used. This does not require any adaptations to the operating process and filtration can be carried out as usual. There is no need for expensive new purchases and familiarisation with new operating processes.

Discontinuation of use of the respirable, carcinogenic cristobalite mean that no high-level, cost-intensive protective measures, such as full masks, are required any more during filtration.

Example of a dosage:

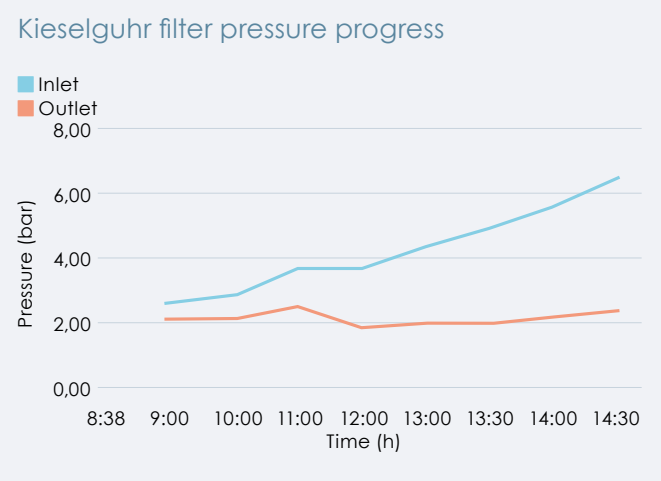
	1st PC	2nd PC	Body feed dosage
Kieselguhr (classic)	Kieselguhr	Kieselguhr	Kieselguhr
Kieselguhr-free (example)	VarioFluxx® PreCoat 1	VarioFluxx® PreCoat 2	Perlite

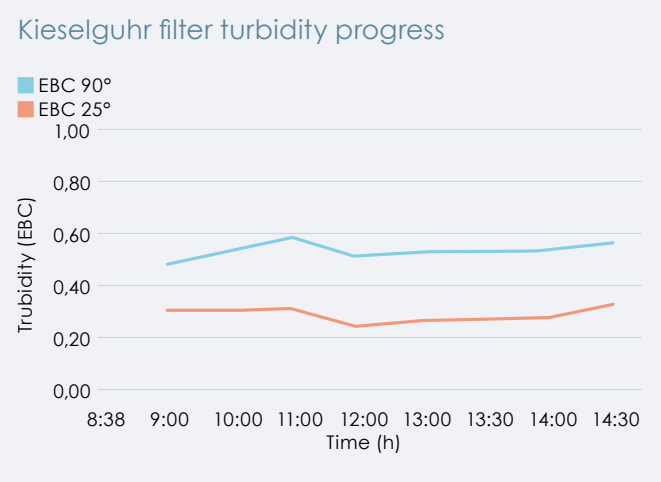
- 24.8 m² centrifugal discharge filter (CDF)
- Output: 100 hl/h; lifetime: 616 hL
- Turbidity (Pils): 0.53 EBC (90°) and 0.27 EBC (25°)
- Filtration time: 6.5 hours
- Pressure difference (end): 4.2 bar
- Filtration was just enough for a CDL, but was never achieved with the KG filtration.

The kieselguhr filtration output will be retarded from 12:30 (80 hL/h), with the kieselguhr-free filtration output, on the other hand, being consistently 100 hL/h.

Benefits of VarioFluxx® PreCoat:

- Comparable result with kieselguhr filtration
- Improved filtration performance
- Reduce air/sea/land miles (CO_2 footprint)
- Regional goods from Germany and Europe
- No hazardous waste
- No investment costs
- Familiar working method
- Greater filter lifetimes possible (up to 30%)
- Improved safety at work





Filter cartridge regeneration

If filter cartridges are used in breweries during the filtration process, to replace a sheet filter for example, or even as sterile cold filtration before bottling, we are talking about a process stage that is expensive to purchase. The filter cartridges must have a long service life to make this stage more economic for the business. Every user endeavours to extend the filter cartridges' life to the maximum by gentle cleaning to ensure this.

If classic cleaning solutions, such as sodium hydroxide (NaOH), plus a booster (usually hydrogen peroxide, $H2O_2$) are used, this may remove the organic deposits, but also attack the filter materials due to the aggressive nature of the media. The same thing happens when cleaning using an acid, which intended to target the anorganic contamination.

The filter cartridges currently in use on the beer market are usually either made from polyethersulfone (PES) or polypropylene (PP), as pleated or meltblown deep filter cartridges, for example, depending on the model. These are plastic versions which, necessarily, over time, become brittle.

Filter cartridge with pleated membrane

Here at ERBSLÖH we intentionally tackle blockages caused by malt or yeast with enzymes.

Substances such as ß-glucans, starches or proteins are broken down into the filter media by enzymes, whilst being as gentle as possible on the material.

Beerzym® COMBI and **Beerzym® SAPHIR** can be used in the filter cartridge enzymatic regeneration process.

Meltblown depth filter cartridge

Beerzym® COMBI and **Beerzym® SAPHIR** are used as a 0.3–0.5% solution (70% **Beerzym® COMBI** and 30% **Beerzym® SAPHIR**) and pumped repeatedly through the filtration system.

100% enzyme activity can be assumed when calculating the batch quantity. Adjustment of the pH value to 4.5–5.5 is very important.

Adjustment can be achieved by means of an organic acid, diluted anorganic acid, or even with sodium hydroxide (NaOH) or potassium hydroxide (KOH). The solution's optimum temperature range is between 45–55 °C. Ideally, the solution should be run at intervals. As a trial we recommend starting with 0.5% and optimising the solution at the next stage.

Another important parameter that is usually forgotten is the batch water's calcium content. This should be between 35–50 mg/L, as the enzyme requires calcium as a co-enzyme to develop its activity fully. If necessary, adjustment can be by means of calcium chloride ($CaCl_2$).

It can be added directly to the batch with the enzymes, but the quantity of enzymes should be diluted in advance with five times the volume of water.

Beerzym® COMBI

Enzyme combination for glucan and starch degradation

Beerzym® SAPHIR

Thermotolerant special enzyme for the degradation of protein and ß-glucans from yeast

Example of a cleaning cycle:

A cleaning cycle can be divided into three stages. Cleaning ends with regeneration of the filter cartridges and subsequent, complete deactivation of the enzymes used.

Stage 1

Regeneration

Cleaning starts for approximately 30 minutes with pumping in the flow direction. This is followed by a standing time of 15–20 minutes.

The total cycle is geared to how dirty the membrane or filter system is. This can be tracked by reduction of the pressure differences. We recommend setting the complete cycle to four hours. The time is optimised at the next stage.

Stage 2

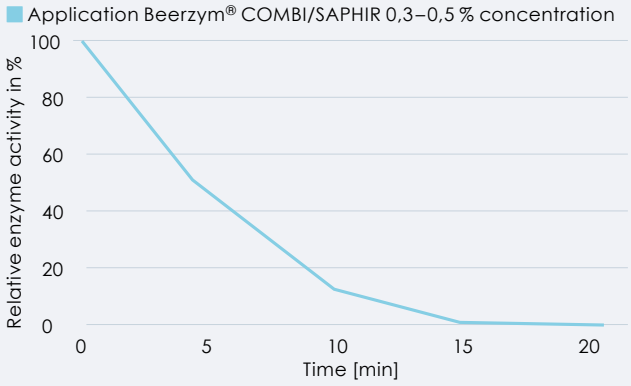
Deactivation of the enzyme and sterilisation

To deactivate enzyme activity, we recommend reducing the cycle medium pH value to below 2.0 at the end of the cleaning cycle. This denatures the enzyme's protein structures and it is fully deactivated.

The following figure clearly shows enzyme deactivation by a downstream acid stage (pH reduction) using a specimen wash curve

If the enzyme solution accumulates, we recommend rinsing the cycle with warm water (30–40 °C) for five minutes with 1–1.5 times the filtration speed before the acid stage.

Enzyme deactivation curve with pH reduction at a pH value < 2.0 and 1 to 1.5 times filtration speed



Step 3

Procedure after the acid step

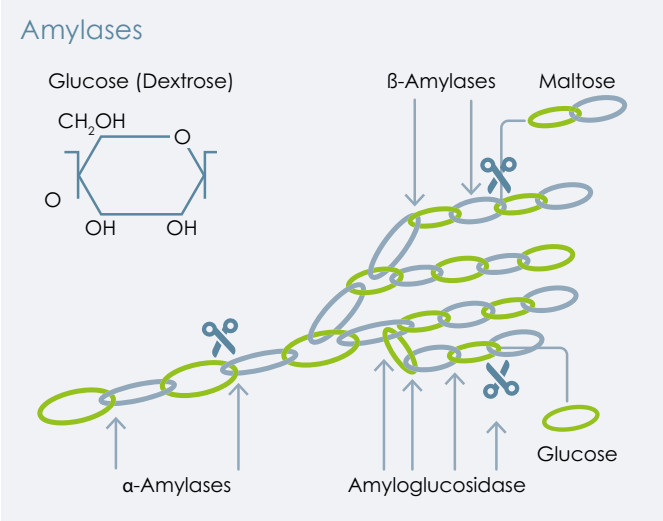
The filter elements should then always be sterilised. This can be done using hot water (82–85 °C) for at least 30 minutes or by steaming the elements with saturated steam.

If the processes are carried out in accordance with the manufacturer's instructions, the enzyme used is guaranteed to be fully deactivated.

Beer production enzymes

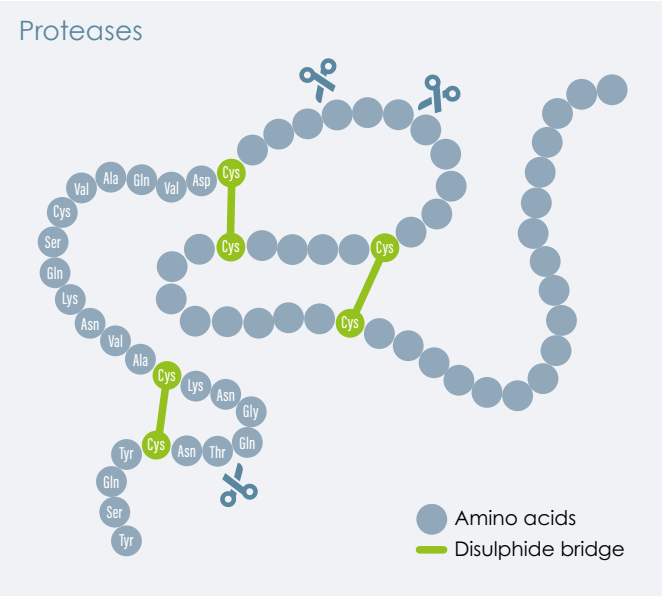
Enzymes are key when brewing beer. During the brewing process using malted barley, the malts form enzymes. Malt is a vegetable enzyme concentrate with multiple enzyme activities, of which amylases, proteinase and glucanases have the most important roles.

The α- and β-amylases use starches to form dextrines and fermentable sugar. Proteinases and peptidases split proteins into low-molecular peptides and amino acids, glucan degradation is managed by β-glucanases. The effect of the enzyme activity controls the time the brewing process takes.



When malt and adjuncts are brewed together, the raw materials' enzyme activity is limited to the malt. The malt's activity is sufficient to process a proportion of adjuncts to a maximum of 30% unmalted barley, rice, corn, millet, etc. The addition of enzymes accelerates the brewing process and is better at smoothing out fluctuations in raw materials more permanently.

The addition of enzymes is essential when brewing beer with elevated proportions of adjuncts. It is these enzymes that make the process at all possible. Now, essentially, a distinction is made when mashing in the mash house between the infusion process and the decoction process. In the process, during mashing of adjuncts, enzymes are used individually or in combination with starch degrading, cytolytic and proteolytic primary activities. The enzymes are tasked with splitting the starches, proteins and framework substances in the used adjunct



Beerzym®

Products for starch hydrolysis

Starch hydrolysis can be divided into three stages:

- Starch gelatinisation
- Starch liquefaction
- Starch saccharification

	Gelatinisation temperature
Barley	53–58 °C
Malted barley	61–65 °C
Wheat	55–65 °C
Rye	58–70 °C
Corn	68–80 °C
Rice	70–90 °C
Sorghum	80–92 °C
Amylose-rich corn	68–105 °C

First the starch is gelatinised by heat treatment (heating, boiling). The enzymatic process stages do not occur until after this: liquefaction and subsequent saccharification to maltose or glucose. Liquefaction of the starch gelatinised by heat is

carried out using a-amylases. Saccharification of liquefied starches is carried out with ß-amylases or with glucoamylases.

Beerzym® Amyl HT

Thermostable bacteria a-amylase for starch liquefaction in beer production.

Beerzym® CRYSTAL

Special enzyme for the removal of starch turbidity in green beer.

EnerZyme® HT

Optimisation of the chemical-physical shelf life.

Beerzym® Brilliance

Vegetable protease for cold and protein stabilisation and improved filterability.

Different gelatinisation temperatures and therefore different requirements of the liquefaction enzyme ensue depending on the raw material used.

When using barley, wheat or rye, liquefaction of the gelatinised, digested starch occurs at temperatures up to 95 °C. **Beerzym® Amyl HT** exhibits optimum activity with a natural mash pH and a temperature range of 45 – 95 °C.

Use of **Beerzym® Amyl HT** is recommended for the boiled mash process. Starch breakdown in the raw fruit boiler requires the use of heat-stable a-amylases.

Degradation of the broken down, liquefied starches and dextrines into fermentable sugar takes place using either **EnerZyme® HT** or **Beerzym® CRYSTAL**.

ERBSLÖH amylases achieve complete starch breakdown and safely attain normal iodine in the wort.

Glucan degradation in malt and adjuncts

Macromolecular β-glucan leads to purification problems in the mash and subsequent wort turbidity. During the mashing process, malt endoglucans degrade dissolved glucan until they are thermally deactivated. At the same time, the malt glucan solubilase dissolves insoluble glucan and releases additional hemicelluloses.

Malt endoglucanases cease to be effect at temperatures in excess of 50 °C. The malt's glucan solubilase acts up to a maximum temperature of 80 °C: Unwanted β-glucan, which can no longer be degraded, is released. The result is purification problems which reduce filter output and cause turbidity.

It is mainly pentosans, which can lead to considerable filtration problems, which are released in addition to β-glucans when processing wheat and rye. We recommend the use of **Beerzym® PENTA** or **Beerzym® Amber95**.

Beerzym® Brilliance

The new stabilisation method

Beerzym® Brilliance is a protease preparation for preventing the formation of haze in beer caused by the reaction of proteins with polyphenols during storage. It is also used to improve filterability. **Beerzym® Brilliance** exhibits good foaming stability and can also be deactivated slightly by heat.

Enzymes

	Activity	Conditions	Dosage	Effect
Beerzym® Amber95	Highly concentrated β-glucanase, heat stable up to 95 °C, strong xylanase and cellulase side activity	pH range: 3,0–6,0 Temperatures: 30–100 °C	70–150 mL/t (Bulk)	Degradation of filtration-inhibiting contents, clear reduction in β-glucan concentration, perfect for the Hochkurz (stepped) mash process, significant filtration improvement in the mash house and during final filtration
Beerzym® Amyl HT	a-amylase	pH range: 4,0–8,0, optimum: 5,8–6,0 Temperatures: 30–90°C, optimum: 70–80°C	150–350 mL/t (Adjuncts)	Liquefaction of gelatinised starch
Beerzym® BG	Thermostable endo-β-1,3–glucanase and endo-β-1,3(4)-glucanase	pH range: 2,0–6,5, optimum: 4,5–5,5 Temperatures: 15–95°C, optimum: 20–85	200–400 mL/t (Malt)	Degradation of β-glucan and laminarin, good effect against cereal β-glucans, slight effect below 30 °C, therefore no use in the fermentation cellar or for tank beer, optimised purification time and filter performance, especially suitable for use in the mash process
Beerzym® BG Super	Thermotolerant endo-β-1,3–glucanase/endo-β-1,3(4)-glucanase/ hemicellulase complex	pH range: 2,5–7,0 , optimum: 4,2–5,0 Temperatures: 2–75°C	0,5–1 mL/hL (Green beer) 150–300 mL/t (Malt)	Good effect against cereal β-glucans without impairing the beer foam, improved filter performance, good effect also at temperatures around <10 °C
Beerzym® Brilliance	Combination of proteases and glucanases	pH range 3,5–6,0, optimum: 5,0 Temperatures: 2–25°C, optimum: 50°C	2–10 mL/hL	Proline-degrading enzyme to improve the chemical and physical shelf life and filterability of the treated beers.
Beerzym® CHILL	Peptidyl-peptide hydrolase	pH range: 3,5–10,5, optimum: 7,5 Temperatures: 4–85°C, optimum: 60–70°C	20–80 mL/t (Malt) 2–4 mL/hL (Lager beer) 1–3 mL/hL (Bulk beer)	Hydrolysis of proteins into amino acids
Beerzym® COMBI	a-amylase, various β-glucanases	pH Bereich: 4,0–5,5, optimum: 5,0–5,5 Temperatures: 45–70°C	0,5 % Concentration, based on container volume	Degradation of filtration-inhibiting contents that can block the filter cartridge
Beerzym® CRYSTAL	a-amylase	pH range: 2,0–7,0, optimum: 4,0–5,0 Temperatures: 20–85°C, optimum: 65°C	2–10 mL/hL (Addition depends on dosage point)	Prevention and degradation of colloidal haze in young beer (e.g. glycogen)
Beerzym® HopFlower	Fungal ß-glucosidase	pH range: 3,0–4.5 Temperatures: 5–65 °C	10–20 mL/hL (Beer)	Release of glycosidically bonded compounds, such as linalool. Thermostable to 75 °C

Enzymes

	Activity	Conditions	Dosage	Effect
Beerzym® PENTA	Fungal pentosanase and ß-glucanase	pH range 2,5–6,5, optimum: 4,5 Temperatures: 4–75°C, optimum: 50°C	0,5–1 mL/hL (Green beer) 150–300 mL/t (Malt)	Hydrolysis of glycosidic compounds into hemicelluloses and pentosans, as well as celluloses, lichenins and other glucans, cleavage of pentoses and hexoses
Beerzym® RAPID	a-acetolactate decarboxylase	pH range: 3,0–7,5, optimum: 5,5 Temperatures: 4–65°C, optimum: 45°C	Benchmark: 0,8–1,0 mL/hL (Addition at fermentation start)	Direct conversion of a-acetolactate to acetoin (no diacetyl formation as a result)
Beerzym® SAPHIR	Proteinases, thermotolerant ß-glucanases	pH range: 1,5–6,5, Temperatures: 20–70°C, optimum: 55–60°C	80mL/t (Malt or Barley) 110 mL/t (Rye) 5–25 mL/hL (Lager beer)	Degradation of hazes caused by proteins and β-glucans in the beer during yearly quality fluctuations or as a booster during filter cartridge regeneration
EnerZyme® HT	Glucoamylase	pH range: 2,5–6,5, optimum: 3,8–4,2 Temperatures: 2–80°C, optimum: 65°C	100–250 mL/t (Bulk) 2–5 mL/hL (Green beer)	Saccharification into glucose of liquefied starches and dextrones in the pH range of 4.2–4.5 can be increased at final fermentation when used in the fermentation tank or storage tank
EnerZyme® P7	Neutral proteinase	pH range: 5,0–10,0, optimum: 7,0 Temperatures: 25–70°C, optimum: 55°C	Benchmark: 150–250 mL/t (Malt) 350–700 mL/t (Malt with adjuncts)	Release of proteins, during mashing up to 60 °C to improve yeast nutrition
EnerZyme® VISCO	Thermostable endo-β-1,3(4)-glucanase	pH range: 2,0–6,5, optimum: 4,5–5,5 Temperatures: 15–95°C, optimum: 20–85	40–150 mL/t (Bulk)	Hydrolysis of glycosidic bonds, cleavage of oligomers from glucose, accelerated lautering or filtration during the brewing process

Beer yeasts

	Characteristics	Aroma profile	Settling behaviour	Degree of fermentation	Use
BrewMasters Lager Yeast	Bottom-fermenting yeast strain, strong and fast fermentation properties, wide temperature range (9–24 °C), strong diacetyl reduction	Low ester formation, neutral aroma	High flocculation and sedimentation after fermentation	Moderate to high 70–82%	For bottom-fermented beers such as European lagers and Pilsner types
BrewMasters Pilsner Style Yeast	Bottom-fermenting yeast strain, strong and fast fermentation properties, wide temperature range (9–16 °C)	Neutral aroma, typically bottom-fermented taste, low ester formation	High flocculation and sedimentation and consequently "good clarification" after fermentation	High 78–81%	For classic Pilsner and lager beers
BrewMasters Ale Yeast	Top-fermenting yeast, British ale type, strong and fast fermentation properties, wide temperature range (16–28 °C, ideally 16–24 °C)	Less ester formation at temperatures > 22 °C, otherwise neutral	Good flocculation after fermentation	Medium 72–75%	Can be used individually for IPAs, stout and porter, alcohol tolerant up to 9.5 % alcohol
BrewMasters German Classic W34/70 3G	Most commonly used top-fermenting yeast strain worldwide, strong, fast fermentation properties, wide applicable temperature range (6–16 °C)	Low ester formation, neutral aroma, typically bottom-fermented taste	Strong flocculation and sedimentation after fermentation	High 80–83%	Suitable for all bottom-fermented beer types
BrewMasters Wheatbeer Yeast	Top fermenting yeast strain, strong and fast fermentation properties, wide applicable temperature range (18–26 °C)	Phenolic, ester aroma components, fruit, bananas	Strong sedimentation in the event of extreme cooling	Low to moderate 68–72%	For classic Bavarian wheat beers and fruity special beers
BrewMasters USAle	Top-fermenting yeast strain for American beer styles, wide applicable temperature range (16–26 °C)	Neutral aroma, low ester formation	Good flocculation	Very high 80–84%	Ideal for beers with alcohol contents > 6.5
BrewMasters FruitAle	Top-fermenting yeast strain, wide applicable temperature range (16–28 °C)	Less ester formation at temperatures > 22 °C	Good flocculation	High 78–80%	Ideal for beers with fruit content or fruity beers

Specialities

	Ingredients	Application	Dosage	Effect	Use
BeerProtect	Potassium metabisulphite, ascorbic acid	Addition during kieselguhr filtration or during storage	1 g/hL	Oxygen reduction and thus increase of the taste shelf life	Oxygen reduction and consequent increase in life of flavour
Ercobin	Pure vitamin C	Addition to the filtered beer before bottling	1–5 g/hL, max. 8 g/hL	Oxygen reduction by a maximum of 1.0 mg/L	Oxygen reduction by a maximum of 1.0 mg/L
SweetGum®	Gum arabic	Addition to storage, during filtration or in the bright beer tank	2,5–10 mL/hL	Cross-linking of hydrocolloid with medium- and high-molecular proteins of the beer	Linking of hydrocolloids with medium and macromolecular weight proteins in the beer
Tannivin® Galléol	High purity gallotannin	Addition to the mash or at the end of boiling or during storage	2–3 g/hL	Protein binding through complex binding, binding of free metal ions, especially iron	Protein binding through complexation, binding of free metal ions, specifically iron
Vitamon® Cereviseae	Special yeast nutrients	Added to yeast: dissolve in water and mix in thoroughly	5–15 g/hL	Additional nutritional basis for the yeast through ammonium and phosphate, Promotion of yeast propagation, Rapid start of fermentation with complete fermentation	Additional nutritional basis for the yeast from ammonium and phosphate, promotes yeast propagation, rapid fermentation onset with complete fermentation
Vitamon® Liquid	Diammonium hydrogen phosphate and thiamine.	Addition to the starter wort	20–80 mL/hL	Liquid yeast nutrient with essential vitamins and phosphates	Liquid yeast nutrient with essential vitamins and phosphates

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