Wir begleiten Ihre erfolgreiche Getränkeherstellung

SCHLIESSMANN SCHWÄBISCH HALL
☎ 0791 97191-0 · 0791 97191-25
service@c-schliessmann.de
www.c-schliessmann.de

Brennereitechnologie

Spirits fault

-Causes, prevention, elimination -

Last update 09_2021

This information sheet briefly and concisely describes the most common faults in spirits from small-scale production in our experience, based on modern specialist literature ("Technology of Fruit Distillery", "From Fruit to Distillate", "Fruit Distillery Today") and supplemented by our own experience. **The treatment agents and rapid tests in our range mentioned in the text are listed alphabetically on page 6**.

Index of faulr (page number):

Acetaldehyd → Lead time (5)
Acrolein → (3)
Bitter almond → (5)
Bubble tone → Overrun (5)
Prussic acid → (5)
Böcksер → Hydrogen sulphide (4)
Brown tint → (2)
Protein turbidity → (6)
Vinegar, Acetic esters, esters → (3)
Ethylcarbamat → (5)
Color cast → (2)
Fuselöl → Overrun (5)
Gelation, gel formation → Pektin (6)
Grassy, tart taste → Stielton (5)
Crystal opacity → (5)
Overrun → (5)
Oil turbidity, opalescence → (6)
Pectin turbidity → (6)
"Sulphur", sulphur dioxide, hydrogen sulphide → (4)
Steinton → Bitter almond (5)
Stielton → (5)
Lead time → (5)

Explanation of frequently used terms:

- **Stitch**
Sensory, this means a spirits fault that can be perceived in terms of smell, taste or appearance.

- **Fining agent / treatment agent**
Generic term for filter aids, processing aids and food additives for the correction of defective beverages or intermediate products.

- **Beautification / treatment**
The insoluble / soluble treatment agent is first mixed / dissolved in a small partial quantity of the liquid to be treated. This suspension / solution is then stirred homogeneously into the main quantity.

- **Hold in suspension / reaction time (exposure time)** The effectiveness of insoluble fining agents is based on binding undesirable substances dissolved in the beverage to their surface. This is facilitated by occasionally stirring the fining agent during fining. Soluble fining agents may require a reaction time.

- **Sedimentation / stripping**
Insoluble fining agents settle on the bottom of the container by themselves if left to stand still; they form a "sediment". "Drawing off" means "lifting off" the excess liquid, the more or less clear "supernatant" from above (siphon, pump) or allowing it to drain from the "clear drain" of the treatment container, i.e. via a tap positioned slightly above the sediment, into another clean container.

- **Filtration**
Filtration is used for the complete removal of lees. It depends on the composition and fineness of the lees (e.g. particles of insoluble fining agents, oil droplets from essential oils of the distilled fruit, from yeast or fusel oils, slimy protein-tannin lees from wooden barrel storage) how and how sharply filtration must be carried out.

- **Burning / cleaning firing**
Re-distillation of refined / treated distillates. In addition to (re)fortifying the alcohol, the aim is to remove residues of soluble treatment agents, dissolved reaction products (e.g. sulphuric acid, copper cyanide) or other undesirable contaminants (e.g. water hardness) by ensuring that they are not volatile (they remain in the residue ("Lutter") in the bubble) or that they can be enriched by distillation upstream/ downstream. (e.g. acetaldehyde / ethyl carbamate). This purification distillation itself consists of diluting the treated distillate to be distilled with water to 20-30% vol. and then distilling it as usual with careful fractionation (separation of pre- and post-distillation).

Error prevention or error correction?
Only very few spirit defects are so rare and unexplored that their cause is not precisely known (example: color casts in the distillate). They can hardly be avoided and can only be corrected by chance with the help of preliminary tests.
The vast majority of errors, on the other hand, are very easy to avoid. They sometimes occur inadvertently (e.g. switching to overrun too late during distillation), but much more frequently as a result of backward working methods, convenience or frugality (inadequate technical equipment, too little specialist knowledge, omission of important auxiliary materials).
The defects that enter the mash invisibly with the visually and aromatically flawless raw material are treacherous. This applies to most spoilage phenomena caused by bacteria in fermenting mashes ("faulty fermentation"). ***They can be avoided by the sensible selection and preventative use of additives such as pure yeast and mash protection acids.***
Once a spirit is faulty, it must be weighed up what effort is worthwhile for a correction and what the best result is. Complex preliminary tests with different treatment agents must be carried out to determine the optimum dosage. The aim is to reduce the defect without weakening the desired aroma. The correction may then improve the aroma, perhaps even restore the palatability, but a top-quality product can no longer be expected.
Avoiding most spirits errors is cheaper and more successful than correcting them.

1. Color defects

1.1 Brown tinge (base spirits / fruit liqueurs)

Description

- Browning of originally bright colors of spirits with fruit extract during storage
- Smell and taste no longer fresh and fruity

Cause
Oxidation of vegetable coloring, tanning and aroma substances under the influence of time, light and air ("aging"), accelerated by metal traces and heat.

Prevention

- Adjust the size of production batches to sales demand, keep stock levels low;
- Only chop fruit with tools and equipment made of stainless steel; only store mashes and batches in containers made of stainless steel, earthenware, glass or food-grade polyethylene;
- **Ascorbic acid** (10-20g/hl) in combination with something
  Citric acid (10g/hl) and dark, preferably cool storage delay ageing.

Treatment
Slight browning can be treated by treating the spirit with **PVPP** (polyvinylpolypyrrolidone) at a rate of 60g/hl (keep in suspension for 1-2 days, sedimentation, filtration of the supernatant).

1.2 Color sting (distillates)

Description of the distillate

- Orange, yellow, beige, green, brown or bluish discoloration of the distillate, which can be so inconspicuous that it only becomes noticeable when the filter layer is colored after filtration of the end product
- Smell unremarkable, taste possibly metallic, bitter

Possible causes
Distillates can initially invisibly dissolve and absorb traces of these metals when they come into contact with base metals (copper, iron, zinc, aluminum in the descending part of the combustion device (possibly spirit tube, cooler) or when stored in metal vessels). Waste water containing iron can also be the cause. Only over time can coloring or clouding occur. The taste impairment caused by traces of metal, on the other hand, occurs immediately depending on the concentration.
However, there is no connection between the use of the greenish-gray copper salt CYANUREX® to bind hydrogen cyanide in the distillation of stone fruit and a green tinge in the distillate because this additive is not volatile.

It is not uncommon for volatile plant dyes to cause a color cast in the distillate, for example in wild cherries, sloes, raspberries, aronia or elderberries. More often, however, contamination in the distillation device, rancid fusel oils and resinous terpenes in the cooler show up during the next distillation in a clouding of the flow tip, sometimes also in a yellow tinge, which can extend into the middle course.

Quick test for traces of metal
Detecting invisible traces of metal can be done in just a few minutes using the following simple test in a test tube:
Five drops of **ferrocyanium potassium solution** in 5 ml of distillate at 30% vol react with blue copper, red with iron and zinc to form a gray-white flocculation.

prevention

- Only bring distillates into contact with suitable materials (stainless steel, glass, glazed earthenware, wood, and briefly also food-grade polyethylene);
- regular cleaning of firing devices;
- rust- and iron-free blended water.

Distillate treatment
Metal-contaminated distillates can be reburned successfully because metals are not volatile.
Color casts caused by plant pigments usually disappear during filtration at the latest. It also happens that during or after blending to drink strength they turn into colored cloudiness, which is completely removed during filtration. The situation is similar with color casts from dirt in the firing device. If they also impair the taste, treatment with **activated carbon** at drinking strength (10-20 g/hl according to a preliminary test, kept in suspension for a maximum of 2 days, sedimentation and filtration) can provide relief. If not, it must be refired on the perfectly cleaned firing device.

2. Smell/taste defects

2.1 Vinegar-Stitch

Description of the distillate

- Smell of acetic acid or solvent-like ethyl acetate
- Taste unpleasantly sour, possibly biting

Possible causes

Acetic acid enters the mash via fruit that is already rotten with vinegar (cherry vinegar fly) or through the metabolic activity of lactic and acetic acid bacteria during mash fermentation and storage. Acetic acid enters the mash as a “volatile acid” under normal distillation conditions and reaches the middle course of the distillate.

prevention

- Processing only healthy, flawless fruits;
- Use of pure yeast for fermentation;
- Fermentation under acid protection (pH 3 for fruit and Jerusalem artichoke; pH 4.5 for starchy raw materials)
- no storage of the fermented mash/as cool as possible with exclusion of air; unavoidable storage for several weeks under the additional protection of **glucose oxidase** (powdered enzyme preparation, added towards the end of fermentation);
- Distillation of vinegary mash only after the pH value has been raised to 5.6-5.8 immediately beforehand (gradual addition and stirring in of up to 800g of **wine deacidifying lime** or up to 800ml **sodium hydroxide solution 15%** to 1hl of mash with simultaneous pH control).

Distillate treatment

Only slightly vinegary distillates are treated with **magnesium oxide** (dosage approx. 300-500g/hl) after being reduced to drinking strength and thoroughly mixed (dosage approx. 300-500g/hl) (stir in and keep in suspension for approx. 6 hours). After sedimentation, the supernatant is removed and filtered.

Distillates with a distinctly vinegary tinge are treated in a similar way with **wine deacidifying lime** (up to 200g/hl) and stripped off. If the supernatant is sensory-perfect, cleaning firing is not necessary. However, when determining the alcohol content, it must be taken into account that the calcium acetate formed during the treatment remains in dissolved form in the distillate and causes a falsification of the measurement result.

If an even higher dosage of **wine deacidifying lime** is necessary to mitigate the sour taste of strongly vinegary distillates, it must be refired after treatment.

More information:

Without treatment, the vinegar tint turns into an ethyl acetate defect when the distillate is stored. This ethyl acetate is the reaction product of ethanol (alcohol) and acetic acid. The specialist literature does provide treatment recommendations for this. However, in our experience, the result does not justify the effort.

2.2 Acrolein-Stitch

Particularly noticeable

During distillation, the combustion chamber fills with the highly volatile acrolein (pronounced acrole-in), which has a tear gas-like effect. The substance is carcinogenic, which is why distillation should be stopped immediately and the mash and distillate should be disposed of.

Description of the distillate

- Extremely pungent, tear-inducing smell
- Taste: Completely inedible

Caused

Certain lactic acid bacteria enter the mash via soil dirt, but also via dust on grains, potatoes, Jerusalem artichokes and fruit that is not visible to the naked eye, where they develop during fermentation and form the precursor to acrolein. The acrolein itself only forms in the heat of the distillation and partly reaches the room air uncondensed, but also into the middle reaches.

prevention

- Particularly careful cleaning of pome fruit (pears, apples, quinces) and Jerusalem artichoke tubers, fermentation of fruit and Jerusalem artichoke always under acid protection at pH 3;
- Processing of grain and very carefully cleaned potatoes according to our recommendations of the “mashing process at gelatinization temperature” and fermentation of the mash under acid protection at pH 4.5;
- Details in our information sheets “Caution – Acrolein”, “Alternatives for using formalin” and our various instructions for mash preparation.

Examination of suspicious mashes

It happens that only individual barrels of a larger, apparently uniformly prepared and fermented fruit mash are affected by the acrolein sting. Mash samples can be tested for acrolein formation before distillation by bringing them to a boil in a cooking pot with the lid initially closed and then testing the vapor for the extremely nose-pungent, tear-inducing smell.

Distillate treatment

The specialist literature does provide treatment recommendations with calcium hydroxide. In our experience, they are not recommended at all, at least in fruit brandies, because they completely change the actual aroma.

More information:

In view of the particular toxicity of acrolein, the distiller should not only think about his own health, but also be aware of his responsibility as a food business operator: even a distillate with only a slight acrolein tinge does not become marketable by extending it by blending it with perfect distillate .

2.3 Sulfur dioxide Stitch (SO_2)

When called “sulphur stitch” there is a risk of confusion with the hydrogen sulphide fault (Böckser)! ➔

Description of the distillate
- Smell of sulfur dioxide (smoke from burning sulfur cuts in barrique barrels or dust from potassium pyrosulfite for wine sulphurization)
- Taste on the palate is typical of ink killer

Possible causes
Sulfurized material (wine, winemaking residues, fruit mash) that has been intentionally or accidentally treated with sulfur dioxide, potassium pyrosulfite or sulfurous acid contains dissolved sulfur dioxide. Microbial formation pathways for SO2 from sulfuric acid or sulfate are also known, primarily in pear mashes, but also other pome fruit mashes that were acidified with sulfuric acid for fermentation or provided with ammonium sulfate to feed yeast. Residues of pesticides and difficult fermentation conditions also play a role. Contents of over 50 mg total SO2 per liter of fuel allow the pungent-smelling gas to pass into the middle reaches in a concentrated form.

prevention
- Do not “sulfurize” the fired material with SO2 or pyrosulfite;
- Use of PM or MS acid instead of sulfuric acid to acidify fruit mashes;
- Use of a robust, undemanding pure yeast for fermentation;
- thorough cleaning of the fruit;
- reasonable nutrient supply to the fermenting yeast with DAP or fuel mash nutrient;
- Distillation of sulphurized mash, wines and residues from winemaking directly after raising their pH value with 500-800ml **sodium hydroxide solution 15%** per hl to pH 5.6-5.8 to bind the sulfur dioxide in the stillage.

Distillate treatment
“Perhydrol treatment”, the oxidation of sulfur dioxide to sulfate by adding 30% hydrogen peroxide (H2O2), is often practiced: 15ml of this per hl of distillate reduces its (previously determined) total SO2 content by around 100mg/L. The sulfuric acid that is formed must then be burned to remove it.
According to new studies at LVWO Weinsberg (Hofmann: “Effectively separating sulfur dioxide during distillation”, small distillery 6/2021), the reburning of contaminated distillates and the fine distillation of contaminated rims using a sodium citrate buffer at pH 5.7 show significantly better results:
Approximately 300g of **citric acid** and approximately 600ml of **sodium hydroxide solution 15%** are stirred into the distillate, diluted with water to approximately 30% vol. per hl. Both treatment agents are carefully dissolved in this ratio in about 5 liters of water in a stainless steel bucket and mixed (protective clothing!). If the pH in the distillate is not already between 5.6 and 5.8 after adding this buffer, it must be corrected accordingly with a little additional **citric acid** or **caustic soda**. The disadvantage, however, is that this citrate buffer leads to a visible separation of copper from the still (corrosion).

2.4 Hydrogen sulfide fault (H_2S, Böckser)

When called “sulfur stitch” there is a risk of confusion with the sulfur dioxide stitch

Description of the distillate
- Smell of hydrogen sulfide (putrefaction gas similar to that from muddy waterholes in the forest, swampy edges of ponds)
- Taste foul

Possible causes
Hydrogen sulfide is a metabolic product of yeast, which it forms from proteins when there is a lack of nutrients or in the presence of high concentrations of sulfuric acid (for example “yeast residue” in large-scale distilleries). In addition, this gas is released when the yeast self-decomposes, for example in long-stored fermented mash, pomace and, above all, wine yeast lees. Small amounts of H2S in the firing material do not pollute the distillate because they react during distillation in contact with bare copper to form the non-volatile copper sulfide. However, H2S passes into the distillate when there is more of it in the firing material than the metallic inner copper surface of the firing device is able to bind. Conversely, excessive contamination of the copper can also enable the transfer of H2S from only slightly contaminated mashes into the distillate. There the further reaction takes place to produce even fouler-smelling mercaptan and disulfide.

prevention
- Use of pure yeasts with low nutritional requirements;
- Nutrient supply for the fermenting yeast in fruit materials and sugar molasses that are low in nitrogen or, as experience has shown, difficult to ferment;
- no storage of the fermented mash / as cool as possible for a short time;
- Distillation on an internally bare still with all trays switched on and, if available, clean catalyst;
- If experience shows that contact with the bare copper of the existing burning device is not sufficient, 3-8g of **copper sulfate** / hl of fuel, which are stirred into the mash in crystalline form or as a 10% aqueous solution directly before distillation, are sufficient to bind the hydrogen sulfide.

Distillate treatment
Weak bockser in fresh distillates can be alleviated by extensive ventilation.
Strong bockser in fresh distillates can be treated by dissolving and stirring in about 0.2 -1g **copper sulfate** per hl. If the exact application rate is determined in advance in a specialist laboratory, it is sufficient to remove the insoluble black copper sulfide that forms during the three-hour exposure period during filtration. However, it is advisable to additionally check the distillate for excess dissolved **copper sulfate** with ferrocyanium potassium solution (see “Quick test for traces of metal” on page 4/4).
If, on the other hand, **copper sulfate** has been dosed at a flat rate or overdosed, it must be burned after treatment in order to safely rule out heavy metal contamination of the distillate.
Treating older distillates that already contain mercaptan and disulfide in addition to H2S is hopeless.

2.5 Lead fault (Acetaldehyd)

Distillate treatment
- Easily recognizable as typical for the experienced taster
- Can be analytically proven by the inexperienced distiller using the flow separation test.

Caused
Switching from pre- to middle-run too late during distillation (“improper fractionation”).

Prevention/Treatment
- Proper fractionation, even when reburning.

2.6 Overrun fault (Fusel oil, bladder clay)

Description of the distillate
- Even the less experienced taster can easily recognize it if he rubs a few drops of the distillate on the back of his clean hand, allows the alcohol to evaporate for a few seconds and then rubs the back of his hand: unpleasant sourness and a lack of fruitiness indicate a trace.

Caused
Switching from middle to post-run too late during distillation (“improper fractionation”).

Prevention/Treatment
Proper fractionation, even when reburning. Experience has shown that adding around 200g **wine deacidifying lime** per hl of (even healthy fermented) fruit mash can often push back the correct switchover time slightly and thus increase the volume of middle flow.

2.7 Stielton / bitter taste

Description of the distillate
- Smell of green parts of plants, grassy
- Taste somewhat tart, unripe

Caused
Processing of leaves, green, still fresh stems (e.g. cherries) or stems (for example grapes, elderberries). The typical aroma components reach the middle reaches.

prevention

When mashing, pick out the leaves and stems, destem the berries and remove the stems from the pears.

Treatment
After dilution to less than 50% vol, the distillate error is at least mitigated by treatment with as little **activated carbon** as possible (20-100g/hl, kept in suspension for a maximum of 2 days, sedimentation, filtration).

2.8 Bitter almond tone / hydrogen cyanide / ethyl carbamate

A disturbingly intense stone tone in stone fruit distillates is often associated with a food law problem, namely the exceeding of the limit value for hydrogen cyanide or ethyl carbamate. Details on this topic can be found in our product information “Amygdalin – building acid – ethyl carbamate” as well as “CYANUREX process”, “CYANUREX” and “CYANID test”.

3. opacities

3.1 Pectin cloudiness (gelation, gel formation)

Description
- Jelly-like clouds in fruit liqueurs and other spirits with fruit extract (fruit base spirits), which usually only become visible when the alcohol is added, hardly sediment and cannot be removed by filtration due to their sliminess.

Caused
Pectin, which is native to the fruit and is dissolved invisibly in the juice, gels in the presence of alcohol.

prevention
- “Depectinizing” crushed fruits, mashes and fruit juices: This refers to the biochemical breakdown of pectin by adding a pectinase (for example **Natuzym BE**) and then adhering to a reaction time. This “enzymation rest” should either be kept cool overnight or at 40-45°C for about an hour in order to prevent incipient spoilage due to wild fermentation;
- The success of the depectinization can be checked using the **pectin test** in a sample of the juice or some mash filtrate.

Treatment
Spirits that have already become cloudy due to pectin can be depectinized within days to weeks by subsequent enzymation with **Natuzym FILTRATION** (10-15g/hl). The prerequisite for this is that the alcohol content is a maximum of 25% vol or is diluted accordingly by extending it with juice that has already been depectinized (or other non-alcoholic ingredients). After successful treatment, it can be distilled again and filtered after several days of cool storage. For more information, see our recommendation “Making liqueur from fruit”.

3.2 Crystal cloudiness

Description
- Internally stained “fogged” bottle walls (rare but clear phenomenon); Evidence: The deposit in the emptied bottle dissolves immediately under the influence of a few drops of vinegar;
- At least in colorless spirits, white sediments made of crystals that glitter in the light, which settle quickly and compactly at the bottom of the bottle after shaking.

Caused
Use of blended water with more than 2-3°dH (degree of German hardness, total hardness). Calcium and magnesium salts are poorly soluble in the presence of alcohol and form crystal clouds very gradually over the course of months after blending. In contrast to oil cloudiness, this cloudy formation cannot be accelerated by cold.

prevention
Use of soft blend water (<2°dH): Basically, an average sample of the amount of water intended for the blend should be tested for its water hardness (“total hardness”) using the **DUROVAL test**: 1 drop of reagent immediately turns 5 ml of water red (water hardness over 1° dH) or green (below 1°dH).

Without this rapid test, simply relying on the "experience has shown that the water is soft from a known source" or on the sufficient softening of tap water in the ion exchanger is risky. For more information, see our information sheets "CADUREX water softener" and "AQUA compact water softener".

Treatment

Theoretically, after blending to the final alcohol strength, one could wait for months until crystal formation is complete and only then filter. However, it is not clear when this state of natural stabilization is achieved. The short-term and, above all, reliable solution is therefore to burn it down.

3.3 Protein cloudiness

Description

- Slight protein cloudiness appears as poorly sedimenting particles or clouds in fruit liqueurs and spirits stored in wooden barrels
- Heavy white cloudiness, typical of honey spirits, forms a dense cloud that hardly settles even after it has stood for several weeks

Caused

Protein from honey, fruit or yeast residues in the wooden barrel, which may initially be invisibly dissolved, coagulate in the presence of alcohol to form microscopically amorphous particles or even slimes.

Prevention in honey spirits

Farchmin ("Spirituosencloudungen", 1957) recommends the following pretreatment of honey:

Fortify and dissolve honey with drinking alcohol or distillate slightly beyond the final alcohol strength. Treating this solution with around 200-400g of **Kieselgur**/ hl forms a quickly sedimenting, compact sludge and at the same time a clarified supernatant, which - possibly. after coarse filtration - is fed to further mixing.

Treatment

Slight protein cloudiness in fruit liqueurs or spirits after contact with wood is usually removed in a similar way to oil cloudiness (see 3.4) by filtration after storing the mixed end product in a cool place for at least 10 days.

3.4 Oil cloudiness

Description of the distillate

- Bluish-milky opalescence, fat eyes on the surface, oil ring in the bottle neck
- Smell and taste perfect

Possible causes

Essential oils and terpenes from fruits and herbs as well as small amounts of fusel oils from yeast metabolism are desirable distillate components and valuable flavor carriers in the middle course if the distillation is carried out correctly on a perfectly cleaned distillation device, but above certain concentrations can form cloudiness when and after blending to drinking strength due to their poor water solubility. However, experience has shown that avoidable heavy oil clouding from a dirty burner or due to switching to overrun too late also damages the aroma.

Distillate treatment

After adjusting the oil to drinking strength and storing it in a cool place for 10 days, most oil cloudiness can be removed by layer or candle filtration without any noticeable weakening of the aroma (see also product information "Gin herbal mixtures" and "CALIDUS spirit filter").

If necessary, particularly stubborn oil cloudiness can be bound beforehand with the following mineral treatment agents (treatment, keeping in suspension for 2 weeks, sedimentation):

Magnesium oxide (100-800g/hl), **Kieselgur** (100-300g/hl), **ALBEX-Bentonit low in iron**(100-200g/hl). Often, **filtration cellulose** (approx. 50g/hl) can at least lighten severe oil cloudiness.

4. Treatment products and rapid tests

Activated carbon GF, granulated:	1kg-Bag	Art. 5247
	10kg Bag	Art. 5248
ALBEX bentonite low in iron:	1kg-Bag	Art. 5208
	10kg-Bucket	Art. 5209
	20kg-Bag	Art. 5210
Ascorbinsäure E300:	125g-Tin	Art. 5388
	1kg-Bag	Art. 5390
CYANUREX:	500g-Tin	Art. 2060
DUROVAL-Test set (for approx. 100 measurements):		Art. 6500
Ferrocyankalium-solution 0,5%ig:	250ml-bottle	Art. 0165
Filtration cellulose CS-Cell 90:	1kg-Bag	Art. 6495/2
	5kg-Bag	Art. 6495/1
	20kg-Bag	Art. 6495
Glucoseoxidase:	20g-Tin	Art. 5069
	250g-Bag	Art. 5067
Kieselgur:	1kg –Bag	Art. 5285
Copper sulphate:	1kg-Tin	Art. 5345
	10kg-Bucket	Art. 5348
Magnesium oxide E530:	500gTin	Art. 0477
Sodium hydroxide E524 (Pearls):	1kg-Tin	Art. 0300
Caustic soda E524, 15%ige Lösung:	1L-bottle	Art. 0350
Natuzyme BE:	100ml-bottle	Art. 5023/1
	1L-bottle	Art. 5023
Natuzym FILTRATION:	100g-Tin	Art. 5081
Pektintest-Set: (for approx. 50 measurements)		Art. 2610 + 0718
Powdered coal GF :	5kg-Bucket	Art. 5245
(Activated carbon)	20kg-Bag	Art. 5246
PVPP, low-dust granulate	450g-Tin	Art. 5296
Lead separation test set (10 measurements)		Art. 6571
-reagent set separately (for 10 measurements)		Art. 6572
Hydrogen peroxide 30%, pure	1L bottle	Art. 0475
Wine deacidifying lime E170	1kg-Bag	Art. 5271
	5kg-Bag	Art. 5269
	25kg-Bag	Art. 527
Citric acid E330	1kg-Bag	Art. 5381
	25kg-Bag	Art. 5382