2.8 Bentonite fining

Bentonite fining is chiefly carried out to stabilize beverages against protein hazes. Grapes have a relatively high content of natural protein compared to other fruits. The protein contents vary according to grape sort and cultivation conditions. Grapes grown by high cultivation methods - using large amounts of fertilizers - are particularly high in protein.

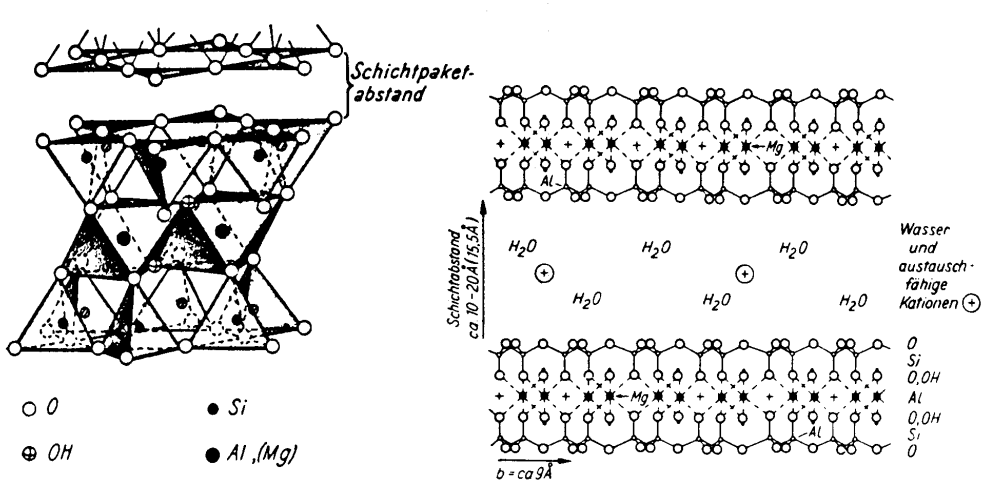
The bentonite dosage must therefore be adjusted to the respective protein content of the beverage to be filtered. The required quantity is determined in a preliminary test (see 2.8.2.1).

2.8.1 What is bentonite?

2.8.1.1 Structure

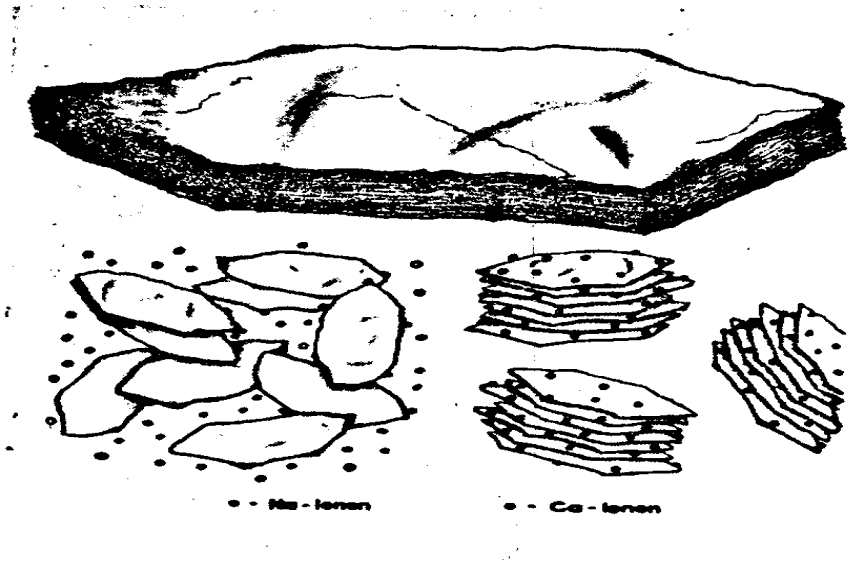
The main constituent of bentonite, which also determines the properties of bentonite, is the clay mineral montmorillonite, a hydrated silicate of aluminium having a laminar structure.

Fig. 2.8.1.1.a) Crystal lattice of bentonite



Excessive negative charges, caused by defects in the crystal lattice, are present on the surfaces of the layers. These negative charges are equalized by positive charges of exchangeable calcium ions, magnesium ions or sodium ions. The ions are deposited between the layers and hold these more or less firmly together, depending on their charge.

Fig. 2.8.1.1.b) Layer structure of bentonite



The ions strive to hydratize by the absorption of water, whereby the spacing of the layers increases - more in the case of singly positively charged sodium and less with doubly positively charged calcium.

2.8.1.2 Mode of action

When bentonite comes in contact with water, the water is taken up between the layers and enlarges the spacing between the single lamina. The enlargement is less in the case of calcium bentonite than with sodium bentonites due to the higher binding force of the calcium. In the case of sodium bentonite the bond between the single layers is partly completely released. This means that an aqueous suspension of a sodium bentonite contains 15 to 20 times more thin lamina with a correspondingly larger effective surface than a calcium-bentonite suspension. The reason for the different swelling properties of the two bentonites is the higher binding force of the double positive charge of the calcium onto the negatively charged lamina. Through the enlarged surface of the sodium bentonite its binding capacity in respect of positively charged colloids contained in the beverage such as e.g. protein substances of the beverage or gelatines is increased.

2.8.1.3 Activation of calcium bentonites

It is technically possible to replace the exchangeable calcium present in calcium bentonites by sodium ions in order to change the bentonite properties. This process is carried out on a large scale; it is called bentonite activation. Hereby any number of activated bentonite grades - from pure calcium bentonite to highly activated Na/Ca-bentonite can be produced.

2.8.1.4 Bentonite types

Considering the above mentioned properties, the commercially available bentonites are now allocated to three types. These are listed in the following table together with their properties and areas of application:

Bentonite types	Ca-bentonite (SIHA-Ca-Bentonite)	Ca/Na-bentonite (SIHA-Must-Bentonite	Na/Ca-bentonite (SIHA-Active-Bentonite)
Absorptive power	**low**	**medium**	**high**
Swelling property	**low**	**medium**	**high**
Lees volume	**low**	**medium**	**high**
Na extraction [1)]	**keine**	**low**	**medium**
Clarifying power	**low**	**medium**	**high**
Dosage	**high**	**medium**	**low**

[1)] : limited by German wine law

Pure sodium bentonites may not be used in Germany under the German wine law because of the increased release of sodium into the beverage. For this reason calcium bentonites are only activated with sodium to a certain limit, which is defined by the sodium extraction limit.

2.8.1.5 Which bentonite type for which purpose ?

Grape wine

The use of activated bentonite is always recommended for clarifying and stabilizing grape wine, especially wines having a high pH (< 3.5). The adsorptive capacity of pure calcium bentonites for protein substances is too low, and their clarifying power too low in a pH range > 3.5. Since grape wines usually have a high protein content, the quantity of bentonite to be used should always be determined in a preliminary test (see 2.8.2.1). As bentonite also adsorbs colour, the preliminary test is also useful when processing red wines to determine the lowest possible bentonite dosages for protein stabilization which protect the valuable colour.

Fruit juices and fruit wines

The choice of bentonite type for fining fruit juices and fruit wines depends on:

- the protein content of the beverage
- the pH value (acid content) of the beverage
- the fining temperature

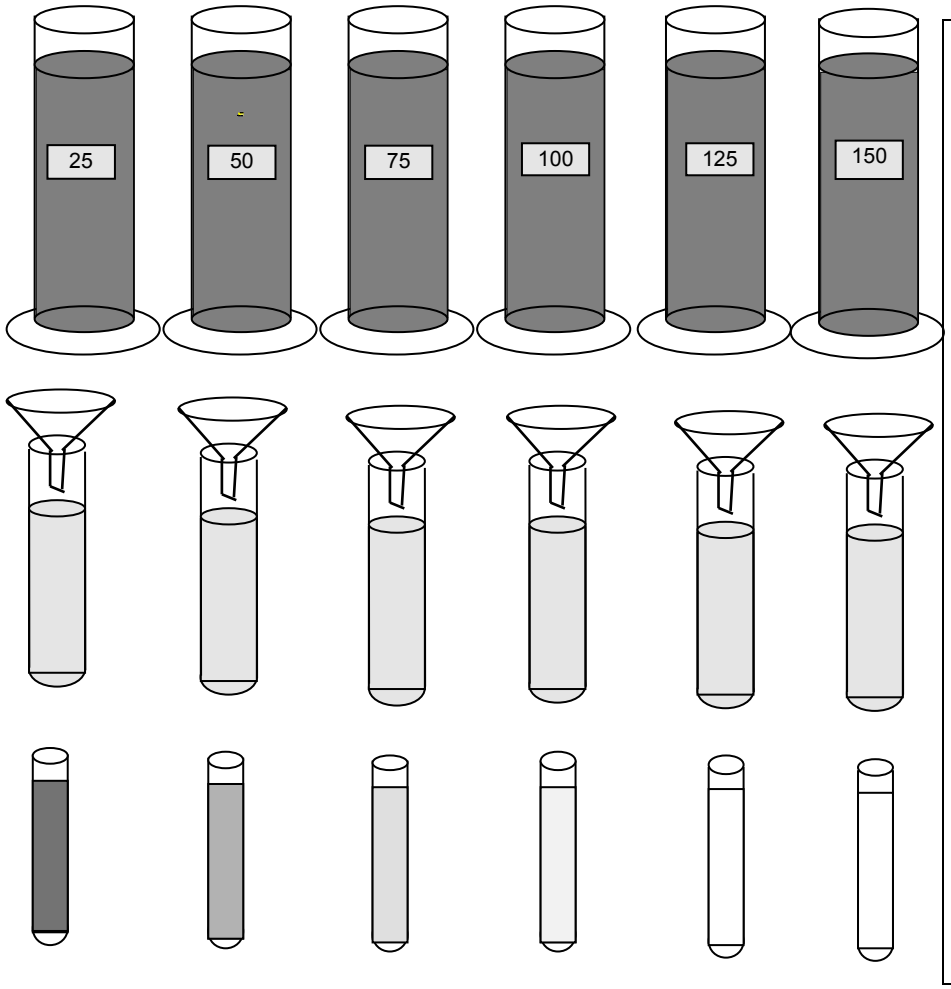
With the exception of gooseberries, the protein content of domestic fruits - especially those containing high amounts of tannin - is relatively low. In this case, bentonite is basically used to remove the added enzyme preparations which can cause secondary haze as protein substances. As a reagent for low-molecular gelatine components, bentonite improves the clarification and stability of the beverage - especially in hot fining processes. We recommend activated bentonite for hot fining, and Ca-bentonite for cold fining.

2.8.2 Recommended dosage (guide):

Beverage	pH value	Fining temperature	Bentonite type	Approx.dosage (g/hl)
Wines				
White wine	3-4	cellar temp.	Activated bentonite	100-200
Red wine	3-4	cellar temp.	Activated bentonite	50-100
Red fruit wine	3-3,5	cellar temp.	Ca-bentonite	25-50
Red fruit winet	>3,5	cellar temp.	Activated bentonite	25-50
White fruit wine	3-4	cellar temp.	Ca-bentonite	100
White fruit wine	>3,5	cellar temp.	Activated bentonite	100
Fruit juices				
Pome fruits	3-3,5	10- 20°C	Ca-bentonite	50-100
Pome fruits	>3,5	10- 20°C	activated bentonite	50-75
Pome fruits	3-4	50-55°C	activated bentonite	100
Gooseberries	3-4	10-20°C	Ca-bentonite	100-150
Gooseberries	3-4	50-55°C	activated bentonite	100-150
Coloured juice	3-4	10-20°C	Ca-bentonite	25-50
Coloured juice	3-4	50-55°C	activated bentonite	25-50

The recommended quantities are given as a guide only. They must be adjusted to suit the respective beverage and the processing requirements with respect to desired stability, colour or clarification. The preliminary test as described below is strongly recommended, especially when clarifying and stabilizing beverages with a high protein content.

2.8.2.1 Determination of the bentonite quantity for beverages with a high protein content by a preliminary test



Fill glass flasks with 100 ml beverage each

← Bentonite dosage (g/hl)

Mix
1 ml 10%bentonite supension
with 100 ml beverage, corresponding 100 g / hl

After a stand time of 15 minutes:

Filter through filter paper

Mix 5 ml filtrate with 0.5 ml bento test reagent. The bentonite dosage which produces no cloudiness should be used in practice.

2.8.3 Benefits of using bentonite

Thanks to its large surface, with negative surface charges and positive edge charges, bentonite possesses the following important properties:

- Increased beverage stability through
  - adsorption of protein substances
  - reduction of polyphenols

- Enhanced clarification through
  - reaction with positively charged colloids
  - reaction with proteins in the wine
  - reaction with gelatines

- Accelerated lees sedimentation by increasing the specific weight of the lees particles

- Improved wholesomeness of beverages through
  - adsorption of biogenic amines
  - adsorption of residual pesticides

2.8.4 Time of application

2.8.4.1 During fermentation

Benefits:
- accelerated fermentation by increased inner surface of the must
- improved yeast sedimentation after fermentation

Disadvantages:
- increased extraction of sodium, calcium and iron ions from the bentonite

2.8.4.2 After fermentation, in combination with gelatine and silica sol

Benefit:
- low extraction of ions from the bentonite

2.8.4.3 During and after fermentation

Recommendation:

- approx. 50 g activated bentonite during fermentation
- required quantity for final protein stabilization (determined in preliminary test) after fermentation

2.8.5 Practical application

Bentonite requires a pre-swelling time in water of approx. 8-12 hours in order to unfold its optimum efficiency.

For this, the bentonite is stirred into approx. 5 times the amount of water, and the water remaining after the swelling time is decanted.

The bentonite suspension is stirred into the wine. After approx. 15 minutes the remaining fining agent can be added.

Through preliminary swelling of the bentonite in warm water at 50-60 °C the swelling time can be reduced to approx. 2-4 hours.