Micro-brewing learning and training program

(LdV Beer School)

Program izobraževanja v mikro-pivovarstvu
(projektno gradivo)

Beer styles

Raw materials

Brewhouse technology

- *mashing and mashing in*
- *lautering and wort boiling*
- *main fermentation and maturation*
- *filtration, filling and stabilization*

Filtration objectives

- Filtration generally refers to clarification of beer through several stages to produce a crystal-clear product. The purpose is to remove suspended material and residual yeast, which would otherwise cause the beer to be hazy. The particle size of suspended material in beer is 0.5–4 mm. Particle size information is necessary for the brewer to set filtration parameters.

Two purposes of filtration

- Primary – filtration stage removes the bulk of yeast and suspended material.

- Secondary – polish or final filtration removes any additional suspended solids resulting from lagering at cold temperatures and any adsorbents added for stabilization.

Filtration aids 1/2

- **Kieselguhr** is a diatomaceous earth, which is mined from Miocene period deposits in Europe and North and South America. It consists of skeletons of marine algñae containing silicon dioxide. Kieselguhr powders for use in brewing are prepared by drying and milling the mined raw material. Most effective filtration was achieved with the use of calcined kieselguhr prepared by heating the raw material in rotating drums at 600 to 800 °C (1,100±1,450 °F).

Filtration aids 2/2

- **Perlite** is a volcanic material, mostly composed of aluminium silicate, obtained from Greek islands. Raw perlite is heated to about 750 °C (1,400 °F), which causes bursting of the particles yielding glassy structures. These are milled to a free flowing powder, which is about 30% lighter per unit volume than kieselguhr. At low pH values (<5.0) perlite can release iron and so its use was formerly restricted to some systems of wort clarification.

Principles of filtration

- *Surface filtration* - particles are blocked at the surface of the filtration medium because the particles are larger than the pores in the medium.
- *Depth filtration* - particles pass into the filtration matrix; the particles are either mechanically trapped in the pores or adsorbed on the surface of the internal pores of the filtration medium.

Types of filters 1/4

Plate and frame filters are one traditional type used in the industry. They consist of a series of parallel plates covered with filter sheets used to support the filter bed. The frames between the plates control the bed depth. Different numbers of plates can be used, depending on requirements.

Most filters allow beer to pass through both sides of the plates, thus doubling the surface area per plate.

Types of filters 2/4

Leaf filters consist of series of circular, stainless steel leaves as perforated support plates. The leaf configuration can be horizontal or vertical. The leaves in horizontal filters have a stainless steel woven septum to support the bed, while vertical filters use the septum on both sides.

Their operation is quite similar to plate and frame filters.

Types of filters 3/4

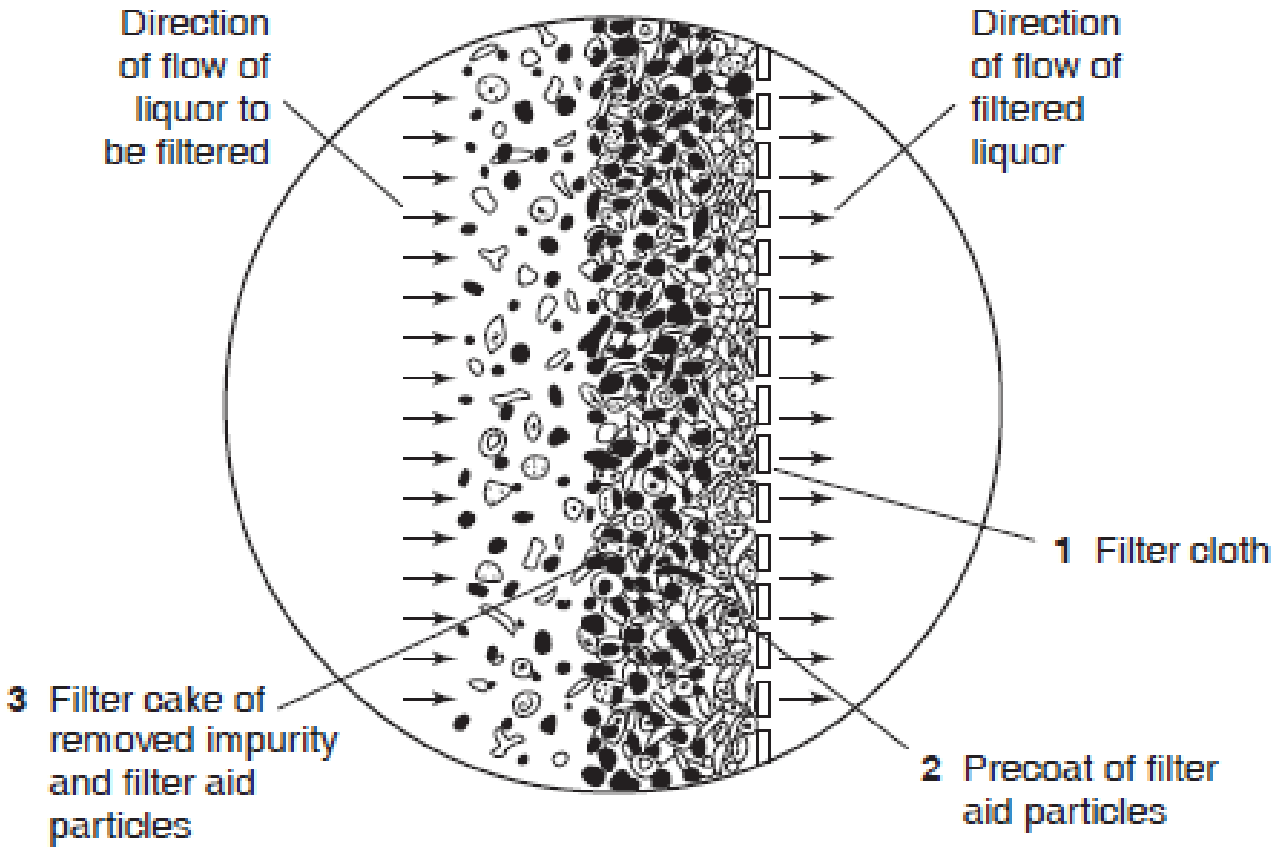
Candle filters are of a different design entirely, although the filtration principle is the same. Candles are porous ceramic and perforated or fluted, stainless steel tubes covered or surrounded by a stainless steel support of various types. This rigid septum is easier to clean than filter leaves used in the powder filters. There is also an operational advantage. The beer is fed to the outside of the candles and the filtrate collected through the inside. The circular design means that the increase in bed thickness during operation is less than other filters, and the pressure drop increase occurs at a slower rate. A ceramic filter can be used for sterile filtration of beer.

Types of filters 4/4

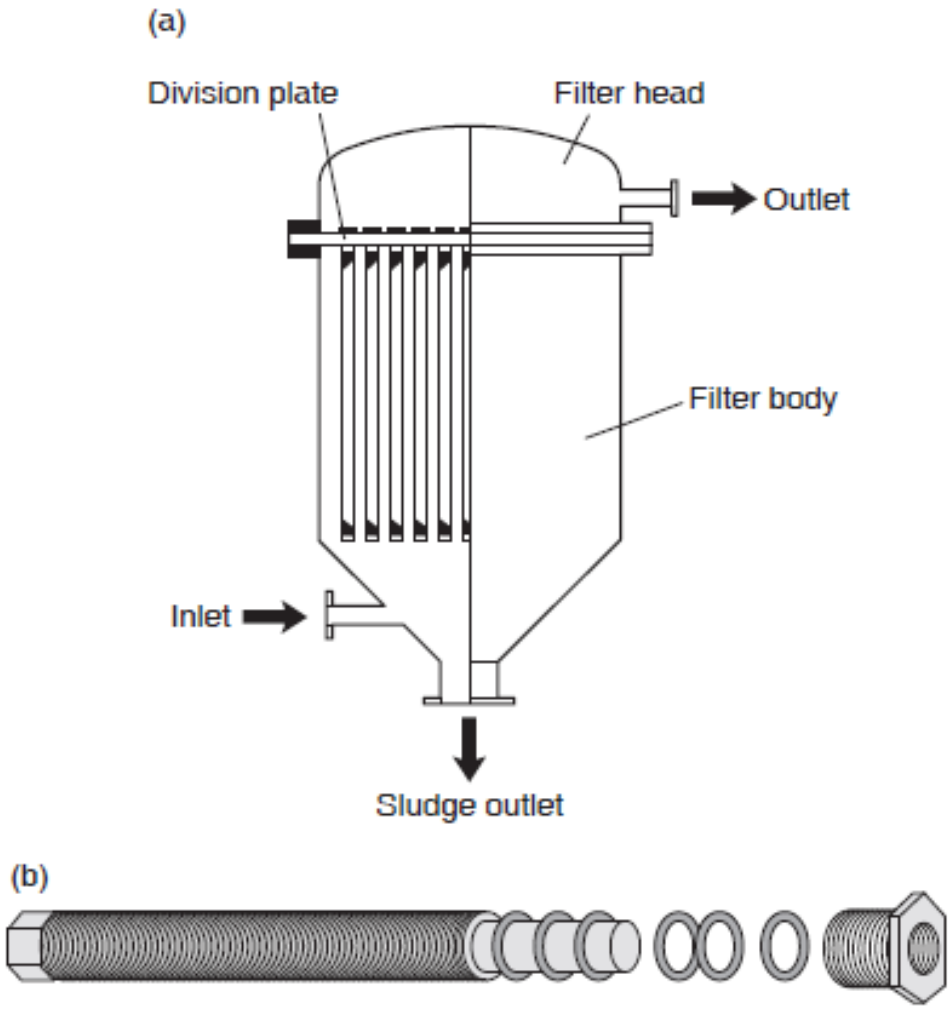
Sheet filters are similar in design to plate and frame filters. Whereas the sheet used in powder filters acts as a septum to hold the precoat, in the sheet filter, the sheet acts as the filtration medium. The sheet is usually made of cellulose impregnated with kieselguhr. Other materials can be added to achieve both the desired liquid permeability and solids retention. These filters have wide applicability, but are generally used after a primary kieselguhr filter because they do not have the capacity of the powder filters. They are also suitable for sterile filtration. Such filters can be easily backwashed and several runs can be made before replacing the sheets. They are often used for keg beer.

High labor costs of handling the sheets, lack of automation (!).

Principles of kieselguhr filtration



Candle filter



Stabilization of beer

- Competition between brewers is intense and the quality and consistency of their beers is paramount. This demands that the beers following maturation should not only have desirable, stable flavours but must also display stability with respect to haze, i.e., the beers must be bright and remain so during the period from dispatch from the brewery to drinking. Therefore, in addition to removing yeast, beers must have the precursor constituents of haze removed to ensure long-term stability.

A range of substances can cause non-biological haze in beer

- β-glucans, which can often lead to hazes not easily seen by eye but which cause high levels of light scattering in 90ë haze meters
- α-glucans (starch), which can behave similarly to β -glucans
- pentosans, which may be derived from wheat based adjuncts
- dead bacteria from malt
- oxalate from calcium deficient worts.

Forms of stabilization

- **Proteins**
  - Hydrolysis – using enzymes (papain)
  - Precipitation – anionic tanic acid
  - Adsorption – Silica gels
- **Polyphenols**
  - Adsorption – PVPP (polyvinylpolypyrrolidone)
  - Proanthocyanidin free malt (not commonly used)

Filling

- Beer must be packaged before it is sold. To ensure the best possible quality of the product, packaging must be carried out with skill and care. Only if packaging is effectively performed will the product be acceptable. Beer can be put into a number of packages. The most important world-wide is the bottle. Bottles are of two types: returnable and non-returnable.

Goals of filling

- Principles of packaging remain unchanged: to protect the product from shipping damage; to shield the product from spoilage over a reasonable shelf life; and to be economically attractive to use.
- Prevent the beer from oxidization.

Steps during filling to bottles

- depalletizer
- decrater
- washer
- empty bottle inspection
- flash pasteurization or sterile filtration
- filler
- crowner
- tunnel pasteurization
- full bottle inspection
- labeller
- crater
- palletizer

Important steps during filling

- Bottle evacuation, counter-pressure – one of most important step to prevent oxygen uptake of beer. In modern filling line is uptake of oxygen lower than 100 µg/l.
- Filling of beer – must be quick and calm, no foaming of filled beer to prevent lost.
- Over foaming – short impact of hot water to the neck of bottle – beer foam prevent the oxygen stay in the neck of bottle.

Filling of a bottle