7.40 Beer production

7.40.1 Coverage

Breweries with a production capacity of 300 tonnes finished product per day are covered by this section on beer production. Here, the sector of beer production includes the malting stage, even though these two process steps are carried out in different locations. [1] [2]

7.40.2 Emission sources

Cereals used in the production of beer and some spirits are usually allowed to germinate before use. This process is called malting, and results in the conversion of starch into sugars. Germinated cereals may then be roasted. The length of roasting varies depending on the type of grain and the type of beverage to be produced. Before fermentation, cereals are often boiled in water to produce wort, which is then filtered to separate out the solid residues.
Fermentation occurs in large fermenting vessels and typically lasts one to three weeks. Normally, vessels are sealed, recirculating the carbon dioxide. Others, normally in smaller plants, vent to atmosphere via a water trap. [3]

7.40.3 BAT, Associated Emission Levels (AEL)

In order to reduce energy consumption, BAT for breweries is to reuse hot water from wort cooling, recover heat from wort boiling and from condensing vapours (this also reduces odour emissions) to preheat the next batch or process water. Where applicable, CO_2 should be recovered by cleaning, compressing, drying and purifying it from the beer fermentation gas. [1] [2] [4]

7.41.1.1 SO_2

As a measure to reduce SO_2 emissions, it is recommended to use commercially available low-sulphur fuels. [5]
However, SO_2 emissions are not considered to be very significant for the sector of beer production and are not discussed further; information on emissions from energy generation can be found in the part on industrial boiler plants.

7.41.1.2 NOx

As a measure to reduce NO_X emissions, the use of low NO_X burners and regular maintenance of the boiler is recommended. [5]
However, these emissions are not considered to be very significant for the sector of beer production and are not discussed further; information on emissions from energy generation can be found in the part on industrial boiler plants.

7.41.1.3 Dust

If necessary, cyclones, fabric filters or electrostatic precipitators should be used on exhaust air to remove particulates. [3] [5]
However, these emissions are not considered to be very significant for the sector of beer production and are not discussed further; information on emissions from energy generation can be found in the part on small combustion plants. [6]

[comment: Corinair 2006 : "These activities are not believed to be a significant source of PM2.5 (as of December 2006)."]

7.41.1.4 VOC

Beer production is generally responsible for odorous emissions. Considerable emissions of VOCs can be released from larger breweries, appropriate abatement techniques for odour and VOC should be used and exhaust gases should be reused where possible. VOC emissions are partly controlled as a result of odour reduction requirements and can be reduced by working in closed cycles, e.g. by CO_2 recirculation. If the exhausted air from the brewhouse is condensed and the gas from fermentation is recovered, there is no need for further emission abatement like biofiltration. If not, Biofiltration is a very useful control measure and is particularly suitable for low NMVOC concentrations in the exhaust air and for odorous emissions. Biofilters reduce odour and VOC emissions by absorbing the pollutants onto the filter material and degrading them by the microorganisms located on the fixed filter medium. They are applicable for a wide range of airflows (up to >100000 m^3/h), but airborne temperature may not exceed 40°C. The investments and operating costs of biofiltration in this case are lower than those of conventional control techniques (e.g. activated carbon adsorption). Alternatively, the organic odour components can be removed by condensing the vapour from boiling vessels combined with energy recovery.

VOC emissions generated by certain process steps may be reduced by applying control techniques like condensation, activated carbon adsorption, or incineration. Selected applicable abatement options and their respective achievable emission factors are given in Table 1 for beer production.

[1] [2] [4]

Table 1: VOC emission levels associated with BAT for beer production

Emission source	BAT associated emission levels[1] mg/Nm^3 or (kg/tonne)	Comments
Beer production (capacity > 1,000 m^3/year)	(0.004) [kg/m^3 beer] [2]	Condensation of exhaust air from the brewhouse and recovery of fermentation gas or Biofiltration of emissions from the malting of grain and CO_2 recovery during fermentation [comment: EMEP/Corinair guidebook 2007 : 0.035 kg/hl beer; no value given in BREF]

[1] The BAT associated emission levels are based on a daily average, standard conditions and represents a typical load situation. For peak load, start up and shut down periods, as well as for operational problems of the flue gas cleaning systems, short-term peak values, which could be higher, have to be regarded.

7.41.1.5 Cross Media Effects

For all mentioned emission reduction and abatement techniques, the cross-media transfer of pollutants and the full range of environmental effects and improvements should be considered. For example additional energy consumption and increased quantities of waste or wastewater residuals may result from individual efforts for pollutant prevention, reduction, or removal.

7.40.4 Emerging Technologies

No major technological breakthroughs are expected for this sector.

7.40.5 Cost data for emission reduction technologies

Characteristics of reference installation	Control options	Investments[a/] [EURO]	Operating costs[b/] [EURO/year]	Abated mass flow [Mg NMVOC/year]
Beer production (malting included)				
Large brewery; production capacity: 150,000 m^3/year beer; operating time: 4,000 h/year	CO_2 recovery during fermentation and biofiltration of emissions from malting of grain	250,000	3,2000	9

VP: vapour pressure.

a/ Depending on e.g. waste gas flow rate, VOC concentration in the waste gas, production capacity. Unless specified otherwise, all investments mentioned represent additional investments if the technology switch occurs in the course of an autonomous technology change.

b/ Depending on e.g. waste gas flow rate, VOC concentration in the waste gas, heat recovery rate.

Table 2: Cost data for biofilters [1]

Installation size (airflow)	Specific investment	Operating cost
Small (200-500 m^3/h)	45-50 €/m^3	0.225-0.3 €/1000m^3 (including 0.15-0.225 €/1000m^3 energy cost, calculated with electricity costs at 0.15 €/kWh)
Larger plants	Down to 10-15 €/m^3	

7.40.6 References used in chapter 7.40

1 European Commission. 2006: “Integrated Pollution Prevention and Control (IPPC) Reference Document on Best Available Techniques in the Food, Drink and Milk Industries.” http://eippcb.jrc.es/pages/FActivities.htm

2 Old version of the guidance document

3 Environmental Protection Agency Ireland. 2006: Draft BAT Guidance Note on Best Available Techniques for the Brewing, Malting & Distilling Sector (Final draft)

4 IFC 2007. International Finance Corporation (World Bank Group): Environmental, Health, and Safety Guidelines for Breweries

5 The Brewers of Europe 2006: Guidance Note for establishing BAT in the brewing industry

6 EMEP/CORINAIR Emission Inventory Guidebook (Activities 040606-040608), December 2006