Review process for the Glass Manufacturing Industry BREF

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The GLS BREF and its review process

- The work on the original GLS BREF began in January 1998; the document was officially adopted by the European Commission on December 2001

- The review process started in 2006 under IPPC Directive 96/61/EC and will finalise under new Industrial Emissions Directive 2010/75/EU (IED)

- GLS BREF will be the first revised reference document (together with IS BREF) to be adopted under IED

Workflow for the revision of the GLS BREF

Main steps	Date
TWG reactivation and call for wishes	February – March 2006
Kick-off meeting	January 2007
Collection of information (deadline)	July 2007
Draft 1 (1043 comments)	February 2008
Revised Draft 1	September 2008
Interim TWG meeting	October 2008
Draft 2 (1660 comments)	July 2009
Final TWG meeting	December 2009
Final draft under IPPC Directive	October 2010
BAT conclusions under IED	March 2011
Final draft under IED	June 2011

Next steps before official adoption of the GLS BREF

- **12-13 September 2011: Forum meeting**
  - Forum to provide its opinion on the full final draft GLS BREF
- **21 November 2011: IED Article 75 Committee meeting**
  - To give its opinion on the BAT conclusions for GLS

Scope of the GLS BREF

- Manufacture of glass including glass fibre with a melting capacity >20 tonnes/day
- Melting of mineral substances including the production of mineral fibres with a melting capacity >20 tonnes/day

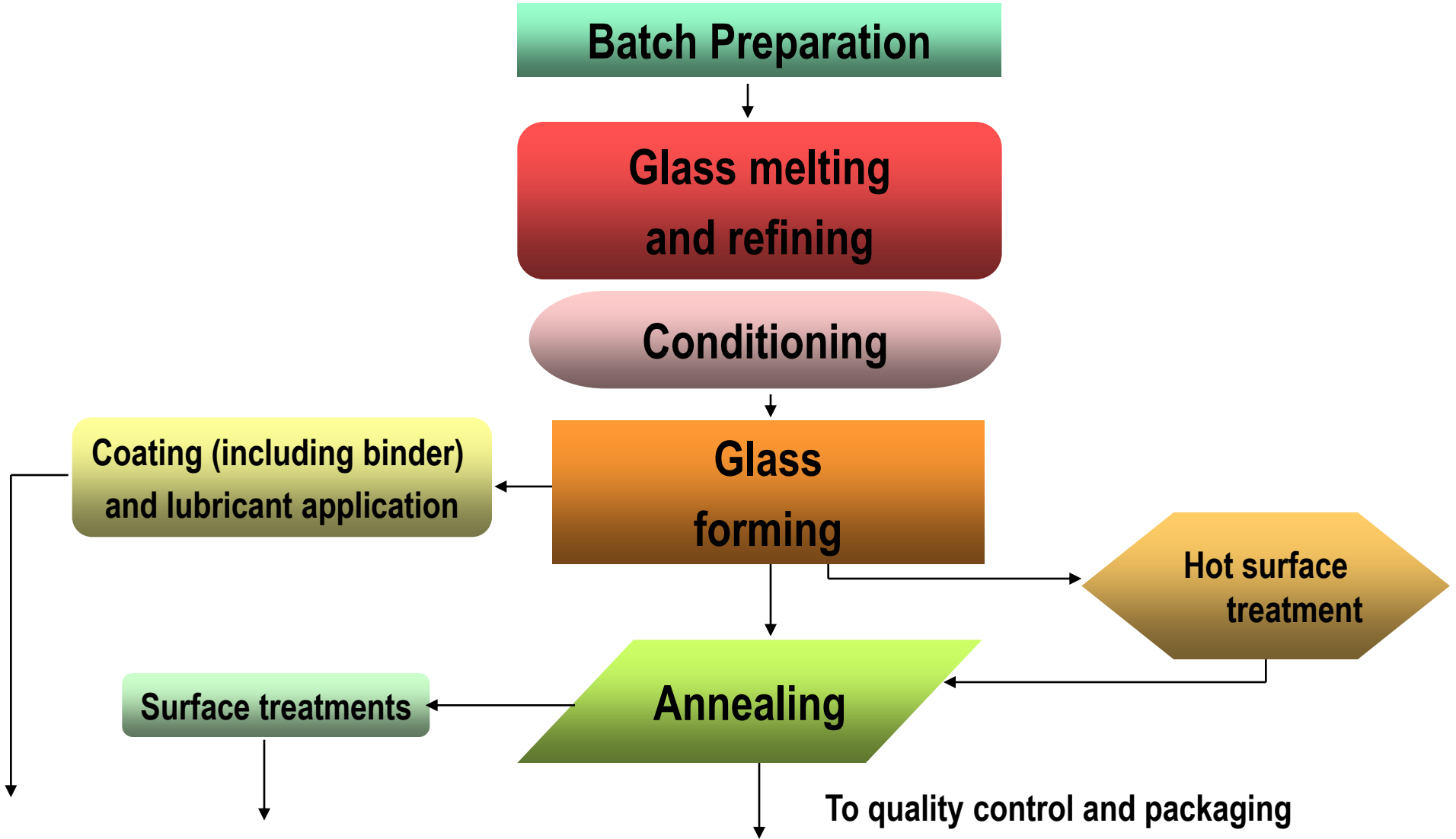
Not covered by the GLS BREF

- Production of water glass (Large Volume Inorganic Chemicals – Solids and Others industry - LVIC-S BREF)
- Polycrystalline wool
- Production of mirrors (Surface Treatment using Organic Solvents - STS BREF)

Structure of the Glass Manufacturing Industry

- **Eight sectors based on the products manufactured:**
  - Container glass
  - Flat glass
  - Continuous filament glass fibre
  - Domestic glass
  - Special glass
  - Mineral wool (glass wool and stone wool)
  - High temperature insulation wools (AES and ASW/RCF)
  - Frits

Typical production flowchart for the manufacturing of glass



Main environmental issues for the Glass Manufacturing Industry

- **Energy intensive process**

  22 million tonnes CO_2 direct emissions (estimated for 2005 in EU-27)

- **Air emissions from the melting process**

  Dust (evaporation from glass melt)

  Nitrogen oxides (NOx) from combustion and/or nitrates

  Sulphur oxides (SOx) from raw materials and/or fuel

  Other substances (HCl, HF, metals from raw materials)

- **Air emissions from downstream activities** (more relevant for mineral wool and continuous filament glass fibre production)

- **Emissions to water** are relatively low

Revised GLS BREF versus original GLS BREF

- General update of the document (from EU-15 to EU-27)
- New topics introduced in the document (e.g. diffuse/fugitive emissions, noise, EMS)
- The main differences concern Chapters 3, 4 and 5
- When available, example installation data have been included
- Completely new text in Chapter 6 (Emerging Techniques)

Main changes in Chapter 3 (Consumptions and emissions levels)

- A general section on diffuse/fugitive emissions and material handling and storage and a short section on diffuse/fugitive emissions for each sector
- For some sectors, emission data are given in more detail (container glass, mineral wool, frits)
- Downstream activities are complemented with additional information and emission data
- A new, general (short) section concerning noise emissions

Main changes in Chapter 4 (Techniques to consider in the determination of BAT)

- Same techniques as in the existing GLS BREF (except for Reburning)
- In addition: environmental management system (EMS), operation and maintenance of furnaces, wet scrubbers for acid gaseous emissions
- Additional information on cross-media effects
- Extensive economic data mainly based on a study made by TNO and on a ENTEC document (for mineral wool only)
- Example installation data provided by Member States (Germany, Austria, Italy, France, Portugal, Spain)

Main changes in Chapter 5 (BAT conclusions)

- Compared to the original GLS BREF, substantial changes in the structure of the chapter, due to adaptation to IED 2010/75/EU
- The chapter is designed to be a standalone document (legally binding)
- BAT conclusions agreed at the final TWG meeting are reported in full
- A short description of techniques and information to assess their applicability are given (derived from Chapters 3 and 4 of the revised GLS BREF)

New IED requirement: description of BAT

- A technical description may provide important elements:
  - to explain the associated emission levels (BAT-AELs)
  - to justify some limitations to the applicability of the technique, e.g.:
    - Dimensions of the necessary structure
    - Required temperature
    - Physical and/or chemical characteristics of the released materials (air, water and soil emissions) consequent to the use of the technique

New IED requirement: information to assess applicability of BAT

- A technique which is successful in one application may have very different implications if used in a different sector or even at a different installation in the same sector
- Restrictions to the applicability may be associated with:
  - Plant age (new or existing installation)
  - Plant size (large or small)
  - Type of product or quality requirements
  - Factors involved in retrofitting (e.g. space availability)
  - Technical restrictions (temperature window, waste gas composition)
  - Limitations due to availability of raw materials and fuels

Structure of the GLS BAT conclusions

- General BAT conclusions for the glass industry
  - BAT conclusions for container glass
  - BAT conclusions for flat glass
  - BAT conclusions for continuous filament glass fibre
  - BAT conclusions for domestic glass
  - BAT conclusions for special glass
  - BAT conclusions for mineral wool
  - BAT conclusions for high temperature insulation wools
  - BAT conclusions for frits
- Glossary with description of techniques

General BAT conclusions for the glass manufacturing industry

- BAT conclusions which may apply to the whole industrial sector, in particular:
  - Implementation of an environmental management system
  - Prevention/minimisation of diffuse dust and gaseous emissions from material storage and handling
  - Reduction/minimisation of the energy consumption by constant monitoring of the operational parameters and a programmed maintenance of the furnace, equipment, etc.
  - Careful selection of substances and raw materials
  - Monitoring of emissions and/or other relevant process parameters
  - Operation of waste treatment systems at full capacity during normal operating conditions

General BAT conclusions for CO and NH_3

- BAT is to limit carbon monoxide (CO) emissions from the melting furnace when applying primary measures or chemical reduction by fuel, for the reduction of NOx emissions

BAT-AEL: <100 mg/Nm^3

- BAT is to limit ammonia (NH_3) emissions when applying selective catalytic reduction (SCR) or selective non-catalytic reduction (SNCR) techniques for a high efficiency emissions reduction

BAT-AELs: <5 – 30 mg/Nm^3

General BAT conclusion on boron emissions

- BAT is to reduce boron emissions from melting furnaces, when boron compounds are used in the batch formulation, by using one or a combination of techniques:
  - Filtration system at a suitable temperature
  - Dry or semi-dry scrubbing + filtration
  - Wet scrubbing
- The applicability of a suitable filtration system to existing plants may be limited by technical constraints
- Deposition of boron on the surface of dry alkaline reagent
- Specific waste water treatment plant for wet scrubbing residues

General BAT conclusions on solid waste

- BAT is to reduce the production of solid waste to be disposed of by using one or a combination of the following techniques:
  - Recycling of waste batch materials (quality constraints)
  - Minimising material losses
  - Recycling internal cullet from rejected production (not applicable to some sectors)
  - Recycling of filter dust (limitations to the applicability)
  - Valorisation of waste (e.g. sludge from lead crystal glass)
  - Valorisation of end-of-life refractory materials
  - Applying cement bonded briquettes of waste (for hot blast cupola furnaces)

General BAT conclusions on emissions to water

- BAT is to reduce water consumption by using one or a combination of the following techniques:
  - Minimisation of spillages and leaks
  - Reuse of cooling and cleaning waters after purging
  - Operate a quasi-closed loop water system

- BAT is to reduce the emission loads of pollutants in the waste water discharges by using one or a combination of the following techniques:
  - Standard pollution control techniques (e.g. settlement, screening, skimming, etc.)
  - Biological treatment systems (for sectors with use of organic substances)
  - Discharge to municipal waste water treatment plants (where further reduction of pollutants is necessary)
  - External reuse of waste waters (i.e. frits sector)

Sectoral BAT conclusions

- **BAT-AELs** are given for each BAT conclusion
- In most cases, both **concentrations** (mg/Nm^3) and **mass emissions** (kg/tonne melted glass)
- **Daily average values or average over the sampling period** (three samples of at least 30 minutes or two firing reversals)
- **Reference oxygen** for emissions from melting furnaces
  - 8 % O_2 for **continuous** furnaces
  - 13 % O_2 for **discontinuous** furnaces
  - 15 % O_2 for **frit melting** furnaces

BAT and BAT-AELs for dust emissions

- The use of a secondary technique (filtration systems) is BAT for all sectors

BAT-AELs: <10 – 20 mg/Nm^3

BAT-AELs: <1 – 10 mg/Nm^3

When using dangerous substances

- Some distinctions for continuous filament glass fibre (primary measures) and domestic glass (economic considerations)

BAT and BAT-AELs for dust emissions – Container glass

4. BAT is to reduce dust emissions from the waste gases of the melting furnace by applying a flue-gas cleaning system such as an electrostatic precipitator or a bag filter.

Technique ([1])	Applicability
The flue-gas cleaning systems consist of end-of-pipe techniques based on the filtration of all materials that are solid at the point of measurement	The technique is generally applicable
([1]) A description of filtration systems (i.e. electrostatic precipitator, bag filter) is given in Section 1.10.1.	

Table 1: BAT-AELs for dust from the melting furnace in the container glass sector

Parameter	BAT-AEL	
	mg/Nm^3	kg/tonne melted glass
Dust	<10 – 20	<0.015 – 0.06

BAT conclusions for NOx emissions

- Primary techniques are BAT for all glass sectors:

➢ Combustion modifications ➢ Electric melting ➢ Special furnace design	➢ Oxy-fuel melting ➢ Fenix process

- Secondary techniques are BAT for the main sectors:

➢ Selective catalytic reduction (SCR)
➢ Selective non-catalytic reduction (SNCR)
➢ Chemical reduction by fuel (only for flat glass)

- Special BAT conclusions for the use of nitrates in the batch composition

BAT conclusions for NOx emissions – Applicability issues (examples)

Technique	Applicability
Reduction of air/fuel ratio	Applicable to air/fuel conventional furnaces Full benefits are achieved at normal or complete furnace rebuild, when combined with optimum furnace design and geometry
Electric melting	Not applicable for large volume glass productions (>300 tonnes/day) Not applicable for productions requiring large pull variations The implementation requires a complete furnace rebuild
Oxy-fuel melting	The maximum environmental benefits are achieved for applications at the time of a complete furnace rebuild
Selective non-catalytic reduction (SNCR)	The technique is applicable to recuperative furnaces Very limited applicability to conventional regenerative furnaces, where the correct temperature window is difficult to access or does not allow a good mixing of the flue-gases with the reagent It may be applicable to new regenerative furnaces equipped with split regenerators; however, the temperature window is difficult to maintain due to the reversal of fire between the chambers that causes a cyclical temperature change

BAT-AELs for NOx emissions in the container glass sector

Parameter	BAT	BAT-AEL	
		mg/Nm^3	kg/tonne melted glass
NO_X expressed as NO_2	Combustion modifications, special furnace designs ([1]) ([2])	500 – 800	0.75 – 1.2
	Electric melting	<100	<0.3
	Oxy-fuel melting	Not applicable	<0.5 - 0.8
	Secondary techniques	<500	<0.75

([1]) The lower value refers to the use of special furnace designs, where applicable.
([2]) These values should be reconsidered in the occasion of a major retrofitting or a rebuild of the melting furnace.

BAT-AELs for the use of nitrates and/or special oxidising combustion conditions (for short campaign or melting capacities <100 t/d)

Parameter	BAT	BAT-AEL	
		mg/Nm^3	kg/tonne melted glass
NO_X expressed as NO_2	Primary techniques	<1000	<3

BAT-AELs for NOx emissions in the flat glass sector

Parameter	BAT	BAT-AEL ([1])	
		mg/Nm^3	kg/tonne melted glass
NO_X expressed as NO_2	Combustion modifications, Fenix process ([2])	700 - 800	1.75 – 2.0
	Oxy-fuel melting	Not applicable	<1.25 - 2.0
	Secondary techniques ([3])	400 - 700	1.0 – 1.75

([1]) Higher emission levels are expected when nitrates are used occasionally for the production of special glasses.
([2]) The lower levels of the range are associated with the application of the Fenix process.
([3]) The higher levels of the range are associated with existing plants until a rebuild or a major retrofitting of the furnace. The lower levels are associated with newer/retrofitted plants.

BAT-AELs for the use of nitrates for the production of special glasses in a limited number of short campaigns

Parameter	BAT	BAT-AEL	
		mg/Nm^3	kg/tonne melted glass
NO_X expressed as NO_2	Primary techniques	<1200	<3

BAT conclusions for SOx emissions (example)

Technique ([1])	Applicability
i. **Dry or semi-dry scrubbing, in combination with a filtration system**	**The technique is generally applicable**
ii. **Minimisation of the sulphur content in the batch formulation and optimisation of the sulphur balance**	**The minimisation of the sulphur content in the batch formulation is generally applicable within the constraints of quality requirements of the final glass product.** **The application of sulphur balance optimisation requires a trade-off approach between the removal of SO_X emissions and the management of the solid waste (filter dust)**
iii. **Use of low sulphur content fuels**	**The applicability may be limited by the constraints associated with the availability of low sulphur fuels and the prevailing economic conditions and energy policy of the Member State**
([1]) A description of the techniques is given in Section 1.10.3.	

BAT-AELs for SOx emissions

- Different BAT-AELs for gas-fired and oil-fired furnaces
- For some sectors, specific BAT-AEL for electric melting
- Main issues: sulphur balance and cross-media effects (waste production)

Gas: <200 – 500 mg/Nm^3
Oil: <500 – 1200 mg/Nm^3 ← Container glass

Gas: <300 – 500 mg/Nm^3
Oil: 500 – 1300 mg/Nm^3 ← Flat glass

Gas: <200 – 300 mg/Nm^3
Oil: <1000 mg/Nm^3
Electric melting: <100 mg/Nm^3 ← Domestic glass

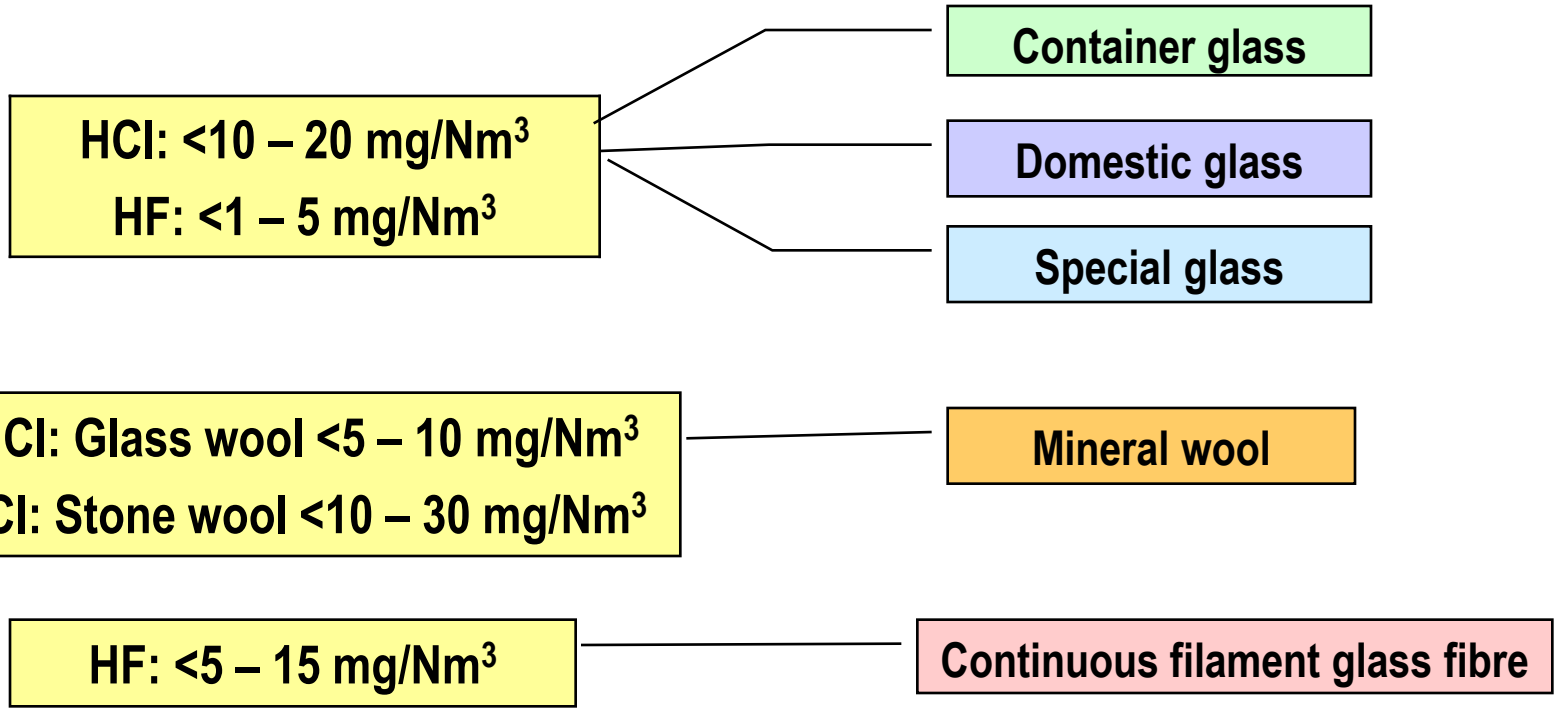
Mineral wool

Stone wool
<350 mg/Nm^3 (gas fired and electric furnaces)
<400 mg/Nm^3 (cupola furnace, no waste recycle)
<1400 mg/Nm^3 (cupola furnace, with waste recycle)

Glass wool
<50 – 150 mg/Nm^3

BAT and BAT-AELs for HCl and HF emissions

- Use of dry or semi-dry scrubbing, in combination with a filtration system a secondary technique
- Selection of raw materials for the batch composition
- Wet scrubbing (for some sectors only)



BAT-AELs for metal emissions

- Metals are grouped on the basis of their potential environmental impact
- Levels refer to the sum of metals in both solid and gaseous phase
- For some sectors, specific BAT-AEL for selenium emissions

Σ (As, Co, Ni, Cd, Se, Cr_{VI}) → BAT-AELs: <0.2 - 1 mg/Nm^3

Σ (As, Co, Ni, Cd, Se, Cr_{VI}, Sb, Pb, Cr_{III}, Cu, Mn, V, Sn) → BAT-AELs: <1 - 5 mg/Nm^3

BAT conclusions on downstream activities

Container glass	Hot-end coating, including SO_3 treatment
Flat glass	Coating operations - SO_2 from annealing lehr
Continuous filament glass fibre	Forming, coating – Cutting and milling
Domestic glass and special glass	Cutting, grinding, polishing – Acid polishing
Mineral wool	Combined forming, curing and cooling – Curing ovens

BAT-AELs for downstream processes in container glass production

Table 12: BAT-AELs from hot-end coating activities in the container glass sector when the flue-gases from downstream operations are treated separately

Parameter	BAT-AEL
	mg/Nm^3
Dust	<10
Titanium compounds expressed as Ti	<5
Tin compounds, including organotin, expressed as Sn	<5
Chlorides, expressed as HCl	<30

Table 13: BAT-AEL for SO_X from downstream activities when SO_3 is used for surface treatment operations in the container glass sector

Parameter	BAT-AEL
	mg/Nm^3
Sulphur oxides, expressed as SO_2	<100 - 200

BAT-AELs for downstream processes in the mineral wool production

Forming area – Combined forming and curing emissions – Combined forming, curing and cooling emissions	
Parameter	BAT-AEL mg/Nm^3
Total particulate matter	<20 - 50
Phenol	<5 – 10
Formaldehyde	<2 - 5
Ammonia	30 - 60
Amines	<3
Total volatile organic compounds	10 - 30

Curing oven emissions		
Parameter	BAT-AEL	
	mg/Nm^3	kg/tonne finished product
Total particulate matter	<5 – 30	<0.2
Phenol	<2 – 5	<0.03
Formaldehyde	<2 – 5	<0.03
Ammonia	<20 – 60	<0.4
Amines	<2	<0.01
Total volatile organic compounds	<10	<0.065
NO_X, expressed as NO_2	<100 – 200	<1

Conclusions

- The revised GLS BREF is the result of an extensive exchange of information and a compromise between different positions expressed by Industry and Member States
- About 3000 comments from different stakeholder have been processed during the review of the GLS BREF
- BAT conclusions for all steps of the glass manufacturing process have been derived from current data, taking into account the different characteristics and requirements of the glass sectors
- However, some BAT conclusions and BAT-AELs will present a challenge for the ingenuity of the glass industry

Thank you for your attention

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