Convention on Long-Range Transboundary Air Pollution
48th Working Group on Strategies and Review
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Determination of costs for activities of annex VII
Sector: Glass Industry

Preamble: This document has been composed to fulfil the task of assigning cost parameters to options discussed in the light of revising the Gothenburg Protocol. Providing representative cost data for general use is challenging, as site issues and country-specific issues may affect investment and operating costs severely.

Technical Introduction

The Gothenburg Protocol rules dust emissions from glass productions as the only pollutant in this sector. Most legislations cover SO_2 emissions as well, which is why most plants in glass industry use combined abatement techniques for SO_2 and dust. Therefore, due to emission abatement practices, assigning costs for dust abatement and costs for desulphurisation cannot be discussed independently. BAT for desulphurisation is dry or semi-dry scrubbing, hence injected alkaline substances (mostly $Ca(OH)_2$ or $NaHCO_3$) and acid gas reacted particles are filtered in dedusting equipments. In most cases, filter dust is recycled back to the furnace. Only in special cases filter dust needs to be disposed and cannot be used as raw material. Therefore, cost analysis is presented for the two cases. According to EGTEI industry experts, most plants can recycle their filter dusts and want to obtain high recycling rates to reduce waste and save raw material.

Dedusting equipment used are electrostatic precipitators (ESP) or fabric filters (FF). Most plants in the EU use dry ESPs, as their filter dust is easier to recycle than wet filter dust of wet ESPs. Though technically possible, the use of fabric filters is only found in a few very small installations. ESPs installed are mostly 3-field to 4-field dry ESPs.

Options in Gothenburg Protocol

Table 1 presents the suggested ELVs and the associated techniques to achieve the ELVs. To achieve emission concentrations of 10 or 15 mg/Nm³ (option 1) 4-field ESPs or FFs are required. To achieve option 2, 3-field ESPs can be used. The use of cyclones would result in emission concentrations well above option 3, hence option 3 would result in the installation of option 2 - techniques in many cases, according to EGTEI experts.

Literature cost data

Table 2 reproduces values of specific investment in combined desulphurisation and dedusting abatement equipment. These values have been cited in the 2009 Draft Reference Document on Best Available Techniques in the Glass Manufacturing Industry. Therefore EGTEI industry experts recommend these values, referring to the year 2007. The first column (ESP+$Ca(OH)_2$ & filter dust recycle) is valid for the majority of plants.

Table 1: Suggested options for limit values for dust emissions released from glass production

	Suggested ELV for dust [mg/Nm³]							
	Option 1			Option 2			Option 3	
		Lower BAT AEL	Techniques		Upper BAT AEL	Techniques		Legislation
New installations	10	5	ESP or FF, where appropriate, in conjunction with a dry or semi-dry acid gas scrubbing system	30	30	Same as for option 1	50	Based on an EGTEI group consensus
Existing installations	15	5	ESP or FF, where appropriate, in conjunction with a dry or semi-dry acid gas scrubbing system	30	30	Same as for option 1	50	Based on an EGTEI group consensus

For combustion gases: dry, 8 % oxygen by volume for continuous melters, 13 % oxygen by volume for discontinuous melters.

Table 2: Specific investment for different combinations of filters (dust) and scrubbers (SO_X) for glass furnaces (Evaluation of costs associated with air pollution control for glass melting, Beerkens, 2007)

Type of glass	Production(Tons melt per day)	ESP & dry scrubber ($Ca(OH)_2$) Filter dust recycle [€/t]	ESP & dry scrubber ($Ca(OH)_2$) Filter dust disposal [€/t]	ESP & dry scrubber ($NaHC0_3$) Filter dust recycle [€/t]	ESP & dry scrubber ($NaHC0_3$) Filter dust disposal [€/t]	Bag filter & dry scrubber Filter dust recycle [€/t]	Bag filter & dry scrubber Filter dust disposal [€/t]	Bag filter & semi dry scrubber Filter dust recycle [€/t]	Bag filter & semi dry scrubber Filter dust disposal [€/t]	Wet scrubber [€/t]
Float	500	4.8	6.51				6	7-7.35	9.6 (gas)-13 (oil)	
Float	700	4.27	5.87	4.39	7.75	6.98				
Float	900	3.88	5.44					5.82	8.33	
Container	100-150	11	14							
Container	200		6.7			4.63-5.9	4.8-7			
Container (oil)	200					6.4	9.25			
Container (oil)	300-350	4.52-6	6.31-7.5		7.38-8.33	3.86-5	4.11-7.3	5.3	6.54	
Container	450	3.96-5.2	4.77-6.5			2.9	3.6			
Container (oil)	600	3.58	5.1			2.7	3.37			
Container (gas)	740	4	5.1							
Container (gas)	1,240	3.4	4.6							
Container (oil)	1,240	3.7	6.2							
Tableware	30-35	15.65	16.7			12.85	13.84			

Type of glass	Production(Tons melt per day)	ESP & dry scrubber ($Ca(OH)_2$) Filter dust recycle [€/t]	ESP & dry scrubber ($Ca(OH)_2$) Filter dust disposal [€/t]	ESP & dry scrubber ($NaHC0_3$) Filter dust recycle [€/t]	ESP & dry scrubber ($NaHC0_3$) Filter dust disposal [€/t]	Bag filter & dry scrubber Filter dust recycle [€/t]	Bag filter & dry scrubber Filter dust disposal [€/t]	Bag filter & semi dry scrubber Filter dust recycle [€/t]	Bag filter & semi dry scrubber Filter dust disposal [€/t]	Wet scrubber [€/t]
Tableware	180-200		7.66			3.75-4.35				
E-glass oxy	100-120						11			14.4-21.5*
E-glass air	100-120									15.7-20.5*
* higher value for filter dust disposal 400 Euro/ton										