TFTEI

Under the Convention on Long Range Transboundary Air Pollution

Reducing Emissions in Aluminium Production

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Introduction

Overview of aluminium production:

- Primary vs. secondary processes.
- High energy consumption and emissions.

Scope:

- Overview of air emissions and abatement techniques.
- Economic aspects of reduction strategies.

Background informal technical document on techniques to reduce emissions from aluminium production

TFTEI informal background technical document

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Overview of Emission Sources

Key Pollutants and GHG:

- CO_2, NOx, SO_2, fluorides, particulates, and PFCs

Emission Sources:

- Bayer process, anode production, and electrolysis

Major emissions from alumina calcining plants as average numbers per plant

Emission parameter	Emission value
Dust (kg/kg alumina)	$2\text{-}100*10^{-6}$
NO_x (kg/kg alumina)	$90\text{-}330*10^{-6}$
CO_2 (kg/kg alumina)	not reported

Ranges of major air emissions during anode production

Emission parameter	Emission value
Total fluoride (kg/kg anode)	$10\text{-}100*10^{-6}$
Dust (kg/kg anode)	$10\text{-}1000*10^{-6}$
SO_2 (kg/kg anode)	$100 - 6000*10^{-6}$
NO_x (kg/kg anode)	$100 - 400*10^{-6}$
BaP (kg/kg anode)	$0\text{-}3*10^{-6}$

Direct air emissions for the production of 1 kg of primary aluminium based on average values for Germany

Pollutant	Direct emissions	Unit
CO	0.18	kg/kg Al
CO_2	1.4	kg/kg Al
HF	$40*10^{-6}$	kg/kg Al
Perfluoroethane	$25*10^{-6}$	kg/kg Al
Perfluormethane	$250*10^{-6}$	kg/kg Al
SO_2	0.007	kg/kg Al
PM_{10}	$706*10^{-6}$	kg/kg Al
$PM_{2.5}$	$581*10^{-6}$	kg/kg Al

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Emission limit values (ELVs) in the AGP

Dust limit values from non-ferrous metals production and processing plants according to annex X of the Gothenburg Protocol

Limit values for dust emissions released from non-ferrous metals production and processing

	ELV for dust (mg/m³) (daily)
Non-ferrous metal processing	20

1999 Protocol to Abate Acidification, Eutrophication and Ground-level Ozone to the Convention on Long-range Transboundary Air Pollution, as amended on 4 May 2012

Best Available Techniques (BATs)

Key PM abatement methods

- Bag filters
- ESP
- Dry scrubbers

Comparison of ESP and bag filter performance during alumina calcining in a rotary kiln for selected industrial plants in Europe

Average flue gas flow (Nm^3/h)	Abatement technology	Average emission value of dust	
		mg/Nm^3	(kg/t alumina)
220 000	ESP	68	0.1
300 000	ESP	23	0.01
107 000	Fabric filter	23	0.07
93 000	Fabric filter	23	0.05

BATs and associated emission levels for aluminium smelting and electrolysis collected from the electrolytic cells and roof vents (BAT Conclusions 2016)

Emission parameter	BAT defined in the European conclusions	Emission level kg/kg Al	
		existing	new plant
Dust	Dry scrubber using alumina as the adsorbent agent followed by a bag filter (and potentially an additional wet scrubber if applicable)	$1200*10^{-6}$	$600*10^{-6}$
Total fluorides, mainly HF		$600*10^{-6}$	$350*10^{-6}$
SO_2	Use of low-sulphur anodes and wet scrubbing system if applicable	0.0025-0.015	0.0025-0.015
Perfluorocarbons, mainly Perfluoroethane and Perfluormethane	• Automatic multiple point feeding of alumina • Automatic anode effect suppression • Computer control of the electrolysis process based on active cell databases and monitoring of cell operating parameters	not reported	not reported

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Key Findings and Impacts

Achievements:

- Significant reductions in PFCs, fluorides, and energy consumption

Challenges:

- High costs for retrofitting older facilities.
- Regional differences in emission control.

Conclusion and Recommendations

Key Takeaways:

- BATs are critical for achieving regulatory limits.
- Document supports informed decision-making

Recommendations:

- Invest in proven abatement technologies.
- Tailor solutions to specific facility needs.
- Engage with TFTEI for further insights

Thank you very much

Questions?