



GYPSUM TO GYPSUM

GTOG: From production to recycling:
a circular economy for the European gypsum Industry with the
demolition and recycling Industry

Results for subaction B2:

“The valorisation and qualification of gypsum waste”

Final guidelines for:

B2.1 Waste Acceptance Criteria
and
B2.2 Specification for recycled gypsum

Conclusion provided by:

Gypsum Recycling International



Action B2

As part of the B2 action of the GtoG-project gypsum waste has been collected from 5 demolition sites and send to the recyclers for recycling. The recycled gypsum that was obtained from this was supplied to the manufacturers for testing.

The manufacturers did not observe any chemical or toxicological issues when re-incorporating the recycled gypsum. On the other hand some issues with production equipment have been reported; e.g. the need to invest in broader conveyor belts to cope with the input of a higher volume of recycled powder than the plants are used to. However, these issues have no relation to the quality of the gypsum waste and recycled gypsum and hence did not influence the specification for these.

The acceptance, sorting, processing and re-incorporation of the gypsum waste within the G2G-project has resulted in the following Waste Acceptance Criteria and Powder Specification:

1. Subaction B2.1 Waste Acceptance Criteria

	Accepted by GRI, NWGR, SINIAT SA	After approval by specific recycler	Not accepted GRI, NWGR, SINIAT SA
Gypsum Blocks	x		
Gypsum ceilings, floors, walls, stucco..	x		
Gypsum waste with nails and screws, wallpaper, glass tissue and other wall coverings	x		
Plaster in bags	x		
Cove	x		
Glass reinforced gypsum products (GRG)	x		
Boards with tinfoil and polystyrene		X	
Gypsum Fibre boards		X	
Moulds		X	
Plasterboard with glass fiber netting		X	
Gypsum based ceiling tiles		X	
Plasterboard with insulations (EPS-PS)		X	
Hazardous materials, e.g. asbestos			X
Autoclaved aerated concrete (AAC)			X
Cement bound boards			X



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2. Subaction B2.2 Guidelines for powder specification for recycled gypsum

2.1 . Technical parameters

Parameter	Powder spec	Test method
Particle size	0 - 15 mm	UNE-EN 933-1
Free moisture	< 10%	VGB serial number 1
Purity (CaSO ₄ 2H ₂ O)	> 80%	VGB serial number 2.3
TOC	< 1.5%	Gigt 3.1.3.2 DepV DIN EN 13137
Magnesium salts, walter sol.	< 0.1%	VGB serial number 8.1.2
Sodium salts, walter sol.	< 0.06%	VGB serial number 8.2.2
Potassium salts, water sol.	< 0.05%	VGB serial number 8.3.2
Sol. Chloride	< 0.02%	VGB serial number 8.8.3
pH	6-9	VGB serial number 4



2.2 Toxicological parameters

Element [mg/kg]	Powder spec	Test method
As	< 4	DIN EN ISO 11885 Determination of selected elements ICP-OES (acc to DepV)
Be	< 0,7	
Pb	< 22	
Cd	< 0,5	
Cr	< 25	
Co	< 4	
Cu	< 14	
Mn	< 200	
Ni	-*	
Se	< 16	
Te	< 0,3	
Tl	< 0,4	
V	< 26	
Zn	< 50	DINEN 1483 AAS-DINEN 12338-Mercury process after enrichment by amalgamation. DIN ISO 1785 atomic fluorescence spectrometry (acc to MateIVO)
Hg	< 1,3	
Radioactivity Index	< 0,5	RP 112 Document (EC)
Asbestos	none	atomic absorbance-method and PLM **

*** Ni (Nickel):**

For Nickel, the maximum concentration in the Beckert dataset was 13 mg/kg. The values from the Beckert-study are widely recognized as reference values for heavy metal concentrations in FGD and natural gypsum. However, these values do not represent the concentrations above which a human health risk occurs. These "risk-based threshold values" have not been defined. Further study in relation to the toxicological parameter of FGD Gypsum is currently being carried out by the Gypsum Industry. After the Life-project, the results of the study can be analyzed for the recycled gypsum. The quality criteria would then be revised in 2017.

**** see guideline below**



2.3 Guidelines to powder specification

Purity

From a manufacturing point of view, it is preferable to work with a purity level as high as possible. The purity of recycled powder is mainly influenced by the market where the boards were originally produced, i.e. the type of gypsum that has been used to produce these boards. For markets where FGD has been used many years, a purity of 85% or more can be reached and the target value may be increased accordingly .

Test frequency

The frequency of testing needs to be agreed between the recycler and the manufacturer. In general, toxicological parameters are recommended to be tested monthly or quarterly, depending on volume of recycled powder that is supplied.

Technical parameters are recommended to be tested either weekly or monthly. Some parameters may have to be tested daily, depending on location, e.g. moisture and chloride.

Asbestos testing method

It is recommended to use the atomic absorbance-method and if asbestos is found, then to use PLM to confirm the type of asbestos.

Sampling

Outcomes of testing can be uncertain as powder composition varies. It is important that samples are taken correctly; i.e that the samples are homogenized and prepared in the laboratory using a riffle splitter (VGB M-701). In the recycling environment one sample is not representative; the sample that is forwarded for testing, should consist of min. 10 individual samples that have been homogenized into one that is sent to the laboratory.

Comments by the Eurogypsum Recycling Working Group

The Eurogypsum Recycling Working Group added the following comments to the technical parameters which were decided in the G2G-project:



Parameter	Test Method	GtoG Powder spec	Recycling Group Comments
Particle size	Granulometry	0 - 15 mm	Particle size ok, depending on plant specifics
Free moisture	VGB serial number 1	< 10%	≤ 5% (up to < 10%) ²⁾
Purity (Calcium Sulphate CaSO ₄ 2H ₂ O)	VGB serial number 2.3	> 80%	> 85% (at least 80%) ³⁾
TOC	Gigt 3.1.3.2 DepV DIN EN 13137	< 1.5% w/w	≤ 1,0% (≤ 1,5%)
Magnesium salts, walter sol.	VGB serial number 8.1.2	< 0.1% w/w	≤ 0,02% (≤ 0,1%) ⁴⁾
Sodium salts, walter sol.	VGB serial number 8.2.2	< 0.06% w/w	≤ 0,02% (≤ 0,04%) ⁴⁾
Potassium salts	VGB serial number 8.3.2	< 0.05% w/w	< 0,02% (< 0,06%); water sol.
Sol. Chloride	VGB serial number 8.8.3	< 0.02% w/w	< 0,01% (< 0,02%) ⁵⁾
Ph	VGB serial number 4		pH, 5-9 ⁴⁾
Fluoride		< 0.02% w/w	
Radioactivity	Radioactivity Lab specific method (Bq/kg)		

1) Values in (): Plant specific deviations after special agreement permitted.

2) The 10 % comes from wet flue gas desulphurisation and is inherent in the system. In contrast it is possible without any technical or logistical problems to meet at least the 5%. Increased moisture contents incur costs for the gypsum industry.

3) Low purity compared with FGD gypsum (≥ 95%) considers the lower purity of natural gypsum.

4) According to EUROGYPSUM/ECOPA/VGB Quality Requirements on FGD gypsum.

5) Depending on water quality in plasterboard production.

The Eurogypsum recycling WG considers that the frequency of testing should be left at the plant level decision.