GYPSUM TO GYPSUM

GtoG Project

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

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DC1 Report of Best Practice Indicators for deconstruction, recycling and reincorporation practices

EXECUTIVE SUMMARY

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Introduction

DC1 report on best practices indicators for deconstruction, recycling and reincorporation practices provides insight on the development of key performance indicator (KPIs) and presents a set of Best Practice Indicators (BPIs) aiming to increase the amount of gypsum waste capable of being recycled, as well as to maximize the quality and percentage of recycled gypsum that can be reincorporated in the manufacturing process.
Practices implemented through the whole End-of-Life (EoL) of gypsum plasterboard have been assessed. That is to say, from the building deconstruction, through the gypsum recycling (processing), to the reincorporation into the manufacturing process. Key Performance Indicators (KPIs) are formulated and used to monitor and compare practices implemented in five pilot projects from the Life+ GtoG Project "From Production to Recycling, a Circular Economy for the European Gypsum Industry with the Demolition and Recycling Industry".

Methodology

The first part of the methodology consists on identifying key areas of influence to be measured from previous preparatory actions, where a thorough review on existing literature, questionnaires distributed among European stakeholders and the gypsum recycling business model are analysed. Such influencing areas correspond to four categories: economic (ECO), social (SOC), environmental (ENV) and technical (TECH); divided into the stages part of the deconstruction, recycling and reincorporation process (Table 2). The classification enables the development of specific indicators per stage and thus precise parameters, which facilitates their use and individual evaluation in a classification breakdown for a more effective analysis.

According to this, a first approach of potential Key Performance Indicators (KPIs) and monitoring parameters is produced. With the KPIs defined, application and interpretation of results is carried out by applying the same in the pilot projects, (table 1).

Table 1. Pilot project locations and operators involved in each of the recycling routes followed.

Route	*Country*	*Demolisher*	*Recycler*	*Manufacturer*
R1	Belgium	RECASS	NWGR	GYPROC
R2	France	PIN	NWGR	PLACOPLATRE
R3	United Kingdom	CANTILLON	NWGR	SINIAT UK
R4	France	OCC	SINIAT FR	SINIAT FR
R5	Germany	KSE	GRI	KNAUFKG

Results

After data collection and analysis, 37 KPIs are generated and refined, out of which best practice indicators (BPIs) are selected, specifically aiming to recognize and encourage best practices through the whole EoL, associated to quantitative or qualitative evaluation criteria, in order to show the degree of compliance with a minimum level of performance. Table 2 shows the final 29 KPIs selected as BPIs.

Whilst for deconstruction and recycling there are several socio-economic BPIs that have not been selected, mainly due to their variability depending on the different market context, policies and competitive environments from the country under study; in the case of reincorporation all of them are considered. Table 3 shows non selected KPIs.

CATEGORY	STAGE	DECONSTRUCTION BPIs
TECH	Audit	TECH1. Existence and deviation of the audit for gypsum systems
	Deconstruction	TECH2. Effectiveness of the deconstruction process
	Traceability	TECH3. Effectiveness of the traceability
ENV	End route	ENV1. Gypsum waste sent to landfill
		ENV2. Transport emissions comparison between recyclnig and landfilling
SOC	Deconstruction	SOC4. Training of the deconstruction team
		SOC5. Follow-up of the waste management
ECO	Traceability	ECO4. Cost difference between recycling GW and landfilling route
		RECYCLING BPIs
TECH	Reception	TECH1. Quality of the gypsum waste received
		TECH2. Gypsum waste rejected
	Storage	TECH3. Warehouse storage capacity for gypsum waste
	Processing	TECH4. Output materials of the recycling process
ENV	Processing and transport	ENV1. CO_2 Emissions from the recycling process ENV2. Natural gypsum saved
SOC	Reception	SOC1. Recycler's satisfaction
		REINCORPORATIOIN BPIs
TECH	Reception	TECH1. Recycled gypsum rejected by the manufacturer
		TECH2. Recycled gypsum quality criteria
	Storage	TECH3. Recycled gypsum required space for storage
	Reincorporation	TECH4. Recycled gypsum content
		TECH5. Recycled content increase
	Production	TECH6. Production waste
ENV	Preprocessing	ENV1. CO_2 emissions: business-as-usual compared to maximized recycled content in the pre-processing
	Manufacturing	ENV2. CO_2 emissions: business-as-usual compared to maximized recycled content in the production
SOC	Manufacturing	SOC1. Manufacturer's satisfaction
ECO	Reception	ECO1. Cost difference between business-as-usual and maximized recycled content quality check
		ECO2. Cost difference between natural gypsum and recycled gypsum
		ECO3. Cost difference between FGD gypsum and recycled gypsum
	Preprocessing	ECO4. Energy cost difference between business-as-usual and maximized recycled content in the pre-processing
	Manufacturing	ECO5. Energy cost difference between business-as-usual and maximized recycled content in the production process

Table 2. Selected KPIs as BPIs

CATEGORY	STAGE	DECONSTRUCTION KPIs	NON - SELECTED KPIs CRITERIA
SOC	Decons-Demoli	SOC1. Labour time difference between dismantling and demolishing plasterboard	It doesn't impact on the implementation of best practices
	Demolition	SOC2. Productivity	Variable depending on skills of the workers and peculiarities of the country under study.
ECO	Audit	ECO1. Audit cost	Variable depending on the country under study
	Deconstruction	ECO2. Plasterboard dismantling and loading cost	Variable depending on the country under study
		ECO 3. Gypsum block dismantling and loading cost	Variable depending on the country under study
CATEGORY	STAGE	RECYCLING KPIs	NON - SELECTED KPIs CRITERIA
ECO	Processing	ECO1. Energy cost of the gypsum waste processing	Variable depending on the country under study and the equipment performance
	Transport	ECO2. Transport cost of the recycled gypsum	Variable depending on the country under study

Table 3. Non-selected KPIs as BPIs

Conclusions

- To assess the sustainable performance of the gypsum value chain the stages part of the processes have to be considered, classified into categories.
- A total of 29 BPIs have been selected out of the 37 KPIs defined, recognizing and encouraging the implementation of best practices.
- The defined analytical framework can be used as a decision-making tool helping to increase the effectiveness of the gypsum EoL recycling route, measuring the performance and progress of gypsum waste management, detecting the possibilities of improvement as well as monitoring changes over time.
- Best practices are implemented during the deconstruction process if:
  - A pre-deconstruction audit for gypsum systems exists, and a minimum deviation compared with the real amount and type of gypsum waste generated results.
  - There is no presence of impurities in the gypsum waste, and as a result there is no recyclable gypsum waste refused by the waste outlet.
  - All gypsum waste generated is tracked.
  - There is no recyclable gypsum waste sent to landfill.
  - Transport emissions are kept as low as possible.
  - Trained workers are in charge of the dismantling, sorting and storing processes.
  - At least one person is appointed to follow-up the waste management including the tracking records.
  - When comparing the cost of recycling and landfilling, which include the rental of skips, unloading and loading operations, recyclers' gate fee and tax, the cost of recycling is favourable.
- Best practices are implemented during the recycling process if:
  - Gypsum waste at the recycling plant complies with the recyclers' waste acceptance criteria thus no gypsum waste is rejected nor sent to landfill.
  - A properly dimensioned storage place is set up in order to guarantee a constant feedstock, avoiding further presence of impurities and moisture content at the same time, once received.
  - Paper is generated as an output material of the recycling process, when plasterboard is present at the waste load.
  - CO_2 emissions resulting from the recycling process are lower than those generated from the extraction of natural gypsum.
  - The use of recycled gypsum in the manufacturing of new plasterboard saves natural gypsum from extraction.
- Best practices are implemented during the reincorporation process if:
  - Recycled gypsum at the plasterboard manufacturing plant complies with the agreed quality criteria thus no recycled gypsum is rejected.
  - A properly dimensioned storage place is set up in order to guarantee a constant recycled gypsum feedstock, avoiding further presence of impurities and moisture content at the same time, once received.
  - The recycled gypsum reincorporated is kept as high as feasible.
  - The nonconforming plasterboard during the production process is below the European average.
  - Energy consumption, costs and CO_2 emissions have no significant negative impact when maximizing the recycled gypsum feedstock.
  - Plasterboard with maximized recycled content fulfil with the implementing European standards.