

DETECTION OF THE PRESENCE OF MICROORGANISMS DURING PRODUCTION OF PLASTERBOARD

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ABSTRACT. The article introduces possibility how to use special material from plasterboard back to the production of plasterboards. The recycled material was prepared from standard plasterboards KNAUF WHITE (it means plasterboard type A according to European standard EN 520) [1]. Plasterboards were crushing, micromilled and separated from the paper on recycling line, which was developed in company Lavaris s.r.o. [2]. This material was used as an inert to the standard recipe instead of stucco. There were checked the influence on properties of final plasterboards in comparison with standard plasterboards.

KEYWORDS: Gypsum plasterboard, stucco, recycling, inert material.

1. INTRODUCTION

The massive expansion of use gypsum plasterboards in Czech Republic started in 1990s. The first years were boards imported from neighboring countries and also came first producers and built their plants there [3].

The gypsum plasterboard plant KNAUF Praha spol. s.r.o. is situated in Počeradý, direct next to power plant Počeradý, was opened in year 1994. The capacity of plant is millions square metres per year and the scrap together with customer's scrap is in thousands tons per year and this amount is sent to landfills. In the world there are sent to landfills more than 15 million tons of gypsum waste from plasterboards each year [4]. The very comprehensive and clear overview of problematic recycled gypsum in European Union is in research presented by A.J. Rivero et al. [5]. This research shows that recycling of gypsum is necessary because of hundred thousands tons of waste, which is sent to landfills, because of closing stocks of natural and also synthetic gypsum and last but not least the influence for energy consumption and emissions.

In the beginning, the FGD (flue gas desulphurization) gypsum is also kind of waste and M.A. Pedreno-Rojas et al. [6] consider use of FGD gypsum such as use of waste. In their research is presented successfully use of FGD gypsum and waste from Production from plasterboard Production in plasters.

The plasterboards only from recycled material was produced in laboratory condition. The recycling was with calcination, the material, which was produced, was stucco with binding properties – calcium sulphate hemihydrate [7].

There was also watched influence on properties of multiple recycled gypsum from plasterboards. It was

processed, that gypsum waste is feasible until the third cycle [8].

The recycled gypsum from plasterboards can be used not only back to production of plasterboards. The essential use is also in portland cement manufacture and as a soil amendment. Possibility is use this material as a compost amendment and for animal bedding [9].

The development of new sources and gypsum and recycling of gypsum products is necessary because in the near future is planned the shutdown of coal fired power plants. It means no FGD gypsum and also there is expectation that environmental impacts related to electricity consumption will decrease [10].

The target of this research is find the most safe amount of recycled material from gypsum plasterboards what is possible to use as an inert in plasterboard production.

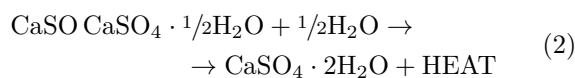
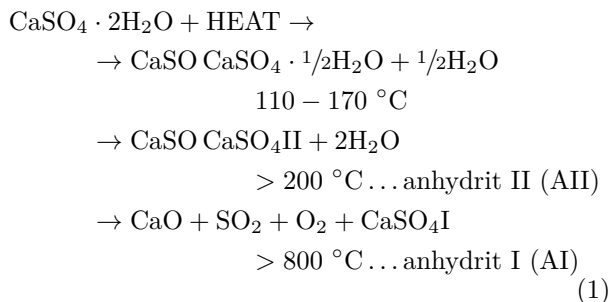
2. MATERIAL

The material, which was used for this trial, was plasterboards KNAUF WHITE and KNAUF GREEN. KNAUF WHITE is trademark for standard plasterboard type A and KNAUF GREEN is trademark for standard impregnated boards type H2 [1]. These boards are produced in KNAUF Praha spol. s r.o. in plant Počeradý. The plasterboards are produced of stucco, which is calcinated of FGD gypsum. The FGD Gypsum is produced during the desulphurization process flue gases in power plant, where is burned the brown coal. This FGD Gypsum has very high purity (96 % on average). It means there is possibility to use inert to the recipes and don't lose the binding properties of slurry.

The process of calcination (1) and hydration (2) is quite very simple and the energy, which is necessary

for production of stucco, is very low in comparison with production of cement.

The energy consumption for production 1 t of stucco from FGD in rotary kiln is 250–350 kcal depending on the moisture content. However, if we use the inert material instead of stucco, we can save corresponding quantity of heat energy for stucco production.



The inert could be also material which could be produced during recycling of gypsum plasterboards. There is a quite big amount scrap, which is formed during the production of plasterboards and also there is a lot of scrap, which is formed during construction (customer scrap). On the other hand, the recycled gypsum can be used as a retarder during rehydration of cement [11].

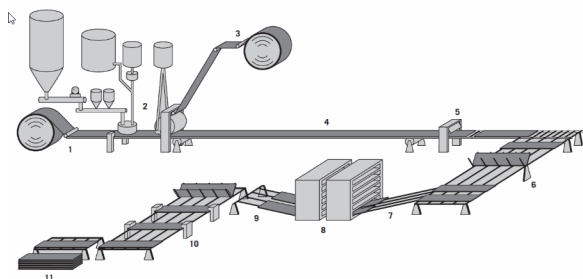


FIGURE 1. Schema of production of plasterboards.

Schema of production of plasterboards is on the Figure 1. For this topic is important point 2, where the all of components are mixed in the mixer and the gypsum slurry is put between face and back paper. The second important place is point 5. It is knife position, where the endless belt is divided to boards and where the wet scrap is formed. After dryer (point 8) are boards sawed and milled to precise dimension (point 10) and here is formed dry scrap.

In year 2019 was counted that approximately 5700 tons of scrap was sent to landfill only from plasterboards produced in Počerady plant (internal and external scrap).

There is solved only influence of recycled material from dry KNAUF WHITE boards to behavior of production and products in this paper, but there

is showed inputs and outputs of recycling process in Počerady plant on Figure 2. The photo of raw materials and outputs of recycled process is showed on Figure 3 (first line from left: FGD gypsum, stucco, recycled paper; second line from left: recycled material 2–5 mm, recycled material 0–2 mm, recycled material 0–0.05 mm).

The plasterboards KNAUF WHITE were input and output from the trial too. In the beginning was taken boards, which were not fulfill all of the requirements (European and internal standards) and they usually are throw out as a scrap. This material was delivered to company Lavaris s.r.o. and there was crushed, milled and it was separated out of the paper too. The process of crushing and milling was with cooling in order to avoid recalcination. Output is calcium sulphate dihydrate. There is process of crushing and milling on the Figure 4.

In the beginning of this project was assumed prepare granulometry of inert same as used stucco (therefore the FGD gypsum – also used as an inert). On the Figure 5 is a grain size curve of Počerady stucco (purple one) and defined milled material (green one). The maximal size of grain was 1 mm. From the input material was prepared recycled material of three fractions: 2–5 mm, 1–2 mm and 0–1 mm. Each fraction formed approximately one third of the original volume.

This material (fraction 0–1 mm) was used to the production. It was prepared for the existing equipment. Unfortunately the dosing system was not able to dose this material fluently. The very fine material made an arches and the material was very often blocked. Because of this trial production was stopped and the rest of material was thoroughly mixed with the material grain size 1–2 mm. This material was dosed without any problems. For second trial was prepared material grain size 0–2 mm. There was also milled small amount of KNAUF GREEN boards for verification assumption, that impregnated boards cannot be used as an inert to the gypsum slurry.

3. EXPERIMENTAL METHODS AND RESULTS

3.1. PRODUCTION

The milled material was used in production in 3 variants.

The first one was use recycled material with grain size 0–2 mm which was mixed from two fractions (0–1 mm and 1–2 mm). This situation was describe in capture Material. This variant has three steps

- (1.) Standard recipe with 3 % recycled material.
- (2.) Standard recipe without 3 % stucco with 4.5 % recycled material.
- (3.) Standard recipe without 4 % stucco with 6 % recycled material.

Edit: percent means % wt. of amount of stucco in standard recipe

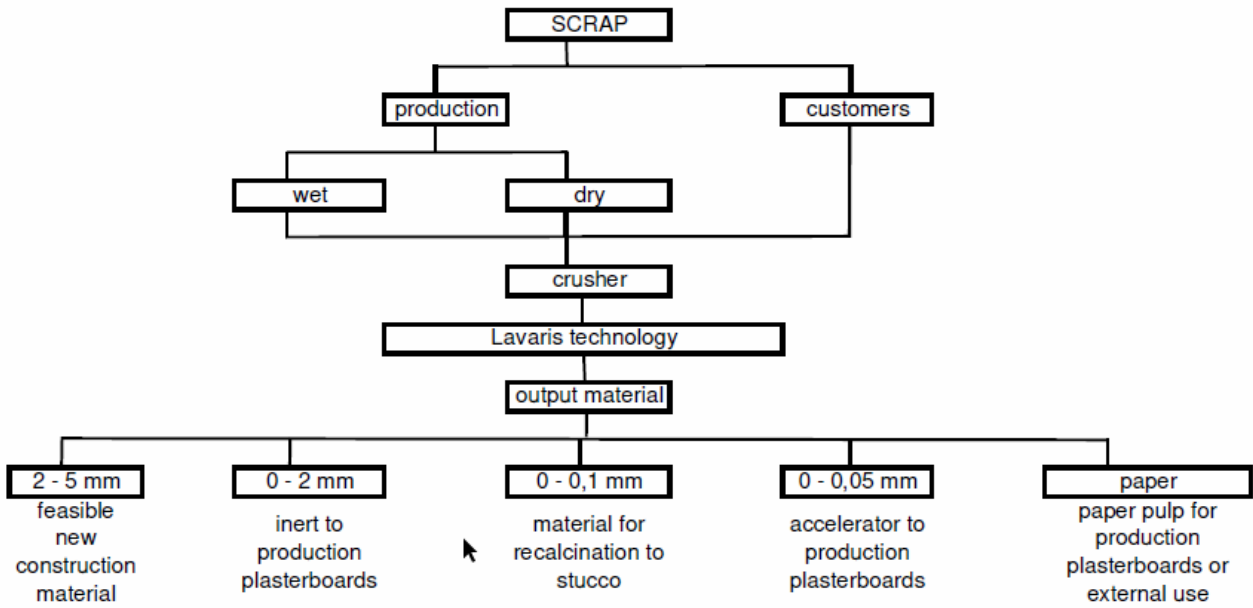


FIGURE 2. Diagram of recycled process in Počerady plant.



FIGURE 3. Raw materials and outputs from the recycled process.

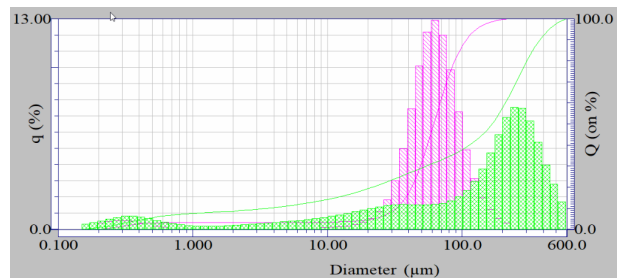


FIGURE 5. Diagram of granulometry – stucco and recycled material.



FIGURE 4. Lavaris recycling babyline.

Each step took about 5 minutes. There was watched

only small changes on gypsum slurry. Any other check didn't notice any abnormalities. The second variant was long term trial with material with fraction 0–2 mm.

During second trial was standard recipe included inert (raw FGD), because of that was only FGD gypsum replaced with recycled material 1:1. The amount was 3 % wt. of stucco. This trial took 55 minutes and there was consumed almost 500 kg of recycled material. During the change material and trial production was not noticed any abnormalities on production line.

The third one was verification assumption, that impregnated boards cannot be used as an inert to the gypsum slurry. There was used fine milled material 0–1 mm with median under 0.5 mm. There was dosed only 6 g/m² of this material it means less than 0.002 % wt. of stucco. Immediately afterwards there was a massive decline of gypsum slurry on the forming table due to degradation of foam, which is integral part of gypsum slurry. The first assumption was hereby confirmed.

3.2. OUTPUT QUALITY CONTROL

Output quality control consists of the visual, mechanical, and chemical tests.

The set of visual controls consists of checking defects and abnormalities on the surface of boards. The boards produced during trials had no defects like bubbles or blisters under the paper. The porosity of gypsum core was without changes.

Mechanical properties are tested according to European Standard EN 520 [1]. The breaking loads was in the same range of values like boards produced with standard recipe. There was not any increase but also any decrease of values. It means all of values were between 610 and 620 N in lengthwise and between 210 and 230 N in crosswise.

The most exposed and watched test is paper bonding. There is three tests of paper bonding. The first one is paper bonding direct after drying process, next one is paper bonding after 24 hours of storage and third one is paper bonding after 24 hours storage in moist box (or climatic chamber). All of the test use cross cut method, which is showed on Figure 6. There is also the results of paper bonding of trial boards. There was watched no decrease of bonding between paper and gypsum core.



FIGURE 6. Results of paper bonding cross test.

4. CONCLUSIONS

All of the trials were successful and they fulfill all of the expectation. The safe amount of recycled material is 6 % wt. of stucco. This amount of recycled material had no influence to behavior of production process and quality of product. The benefit of use inert is safe energy for production of stucco. On the other hand the recycled material is more expensive that raw FGD gypsum which is also used as an inert. Important is that raw FGD gypsum is better use for production of stucco and from an ecological point of view is better use the recycled material as an inert instead of send it

to the landfill. Definitely this trial open the possibility to increase the amount of inert in recipes in the future.

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