

# Processing of brick building materials with special mechanical properties using recycled materials

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## ABSTRACT

The purpose of this paper is to study some properties of building materials made with plaster (commercial - CGP and recycled - RGP) and waste (red - RC, and porcelain - PW ceramics) using Press pressure. The brick is made with a solid mass composition containing 50 wt% of cohesive material and 50 wt% of waste material and is proportional to the amount of dry water / dry powder (0.22). According to these findings, there are various industrial waste materials such as plaster recycling, as well as materials from red (RC) and porcelain waste (PW) waste. In this study, specimens were cast before using a single - core inquiry (10 kN) before obtaining a uniaxial compressive strength (10 kN). After treatment and characterization of specimens, the stress and flexural strength, porosity and microstructure of samples were investigated. The results of the compressive strength were in the range of 12MPa to 35MPa. The ratio of solid water / mass and the applied force applied to the uniaxial compressive stress before getting caught in reducing the porosity of specimens had a significant effect on their mechanical properties. The results show that this increase of waste material will cause a better quality of brick building materials

## KEYWORDS

Recycled gypsum, Red body ceramic waste, Porcelain waste, Compressive strength.

## 1. Introduction

Gypsum plaster can be considered as environmentally friendly materials and low energy consumption for production. The slaughter temperature for gypsum plaster is in the temperature range of 125 to 180 degrees Celsius. At this temperature, water vapor disappears and carbon dioxide is released from the material due to the heat of the furnace [11]. During the production and use of gypsum plaster in urban construction, a large amount of gypsum plaster waste (GPW) is produced. GPW is an inactive substance that has the potential to contaminate groundwater. Under anaerobic conditions, the sulfate in the landfill, which causes a bad odor for staff and residents around these neighborhoods and also rusts the pipes, can be converted to hydrogen sulfide (H<sub>2</sub>S) [12-15]. GPW can be reused or recycled. Because it has the same function compared to the original gypsum plaster [16-17]. Killing GPW requires little energy. Suarez et al. Showed that the energy used for the gypsum recycling process is 65% less than that used to obtain natural gypsum [18].

## 2. Methodology

In this research, commercial gypsum plaster (CGP), recycled gypsum plaster (RGP), RC, PW and water from municipal water supply system were used. RC used in this research is a combination of red body ceramic tile waste. This substance was used without any changes. PW was supplied from the waste of porcelain factories. This material was crushed and ground to obtain a soft powder, then sieved until 95% of it passed through a 45  $\mu$ m sieve, and finally a homogeneous powder was obtained. CGP was used without any changes. RGP, produced by local construction companies, was collected and dried in the sun to remove moisture, then crushed by hand with a mortar. The material was then milled by a hammer mill and formed into particles less than 3 microns in size. The resulting powder was calcined (killed) in a dryer at constant temperature (150 °C) for 1 hour.

## 3. Results and Discussion

### 3.1. Setting time

The results show that RC and PW delayed setting time. These results are consistent with the results obtained by Khalil et al. Longer setting times occur in samples with RC or PW because these mixtures have a small amount of viscous substance that can react with water, resulting in slower reaction progress. The results show that the effect of increasing lesions on CGP uptake is greater

than RGP. In both types of gypsum, RC increases the setting time at a higher rate than PW. In all mixtures, the sensitivity of this effect to the initial setting time was higher than the final setting time. The final setting time of mixtures with recycled gypsum plaster and waste (RGP RC and RGP PW) was very close to the final setting time of mixtures made with only recycled gypsum plaster (RGP).

### 3.2. Mechanical properties

Compressive strength results show that CGP had the highest results in terms of compressive and flexural strength at all times. The mechanical coordinates of CGP were higher than RGP, which Bardella and Camarini observed in molds without any loading pressure. Addition of compressive strength lesions reduces CGP samples [17]. At 28 days, CGP RC and CGP PW compressive strength decreased by 52.2% and 58.3% compared to CGP, respectively. The results were consistent with the results of Ayres et al. And San Antonio Gonzalez et al., Who reported that the strength of gypsum plaster composition decreases with the addition of waste [5]. The results showed that adding lesions to RGP did not cause a significant change in compressive strength. The 28-day compressive strength was between 12 MPa and 35 MPa. The compressive strength results of RGP RC in 28 days were slightly higher than the results obtained by San Antonio Gonzalez et al. [5] from gypsum composites containing RC and also higher than commercial gypsum plaster (CGP).

### 3.3. Absorption of total water and its disposal

The results of total water uptake and desorption at 28 days showed that CGP samples molded by pressing pressure had lower water uptake and desorption before initial setting compared to CGP, which was made without any pressing pressure.

## 4. Conclusion

In this research, gypsum mixtures (commercial and recycled) using industrial waste (RC red ceramic and PW porcelain waste) to produce building components were investigated. Mixtures with 50% by weight of adhesive and 50% by weight of waste with water / solid mass ratio were considered 0.22. Prior to setting, uniaxial loading pressure was used to mold the components. Compacted mixtures had better mechanical performance and less porosity compared to conventional gypsum. Microstructural analysis showed high correlation of gypsum crystals. Addition of waste

resulted in longer clotting time. In commercial gypsum plaster samples, the addition of waste resulted in less compressive strength, although when recycled gypsum plaster was used, the reference samples showed similar results to the samples made from the waste. The 28-day compressive strength was between 12 MPa and 35 MPa, which provides a favorable outlook for waste recycling. The results show that it is technically possible to produce an environmentally friendly material with good mechanical performance in which recycled gypsum plaster and waste are used. The production of gypsum-based construction components using uniaxial molding loading pressure prior to initial setting can be an environmentally friendly option for large amounts of gypsum plaster, RC and PW waste.

## 5. References

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