Comparative Study of on-going Trends of Plastering & Concluding Its Future Advancements

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Abstract — The following study review the literature and researches which have already been done on the Plastering at construction sites. It includes Sustainable and Economical methods like reuse of construction, Urban and Agricultural Waste and methods to save time and cost of construction which can be further exploited for future usage. At the end of this study we have also concluded the future developments in the field of Plastering as per on going trend.

Keywords: Plastering & Concluding

I. CURRENT RESEARCHES

A. Enhancing the Compressive Strength Property of Gypsum Used In Walls Plastering By Adding Lime [1]

Iraqi gypsum is known to have several manufacturing process defects that can negatively impact the quality of the final product. One significant issue involves the use of raw materials without proper sieving to eliminate debris and other impurities, leading to potential product defects. Additionally, the gypsum under investigation was found to have low compressive strength and workability.

However, the study also investigated the potential benefits of incorporating lime as a partial replacement for gypsum. The results showed that using lime in the production process decreased the setting time and increased the bulk density of the gypsum paste. Furthermore, the findings demonstrated that using lime as a partial replacement for gypsum enhanced compressive strength, with the *most optimal results observed at a 30% replacement ratio*.

Overall, the study suggests that the addition of lime as an additive to gypsum production processes has the potential to improve the mechanical properties of the final product. The chemical effects of lime, such as accelerated hydration and reduced setting time, can be used to enhance the production process of gypsum. Additionally, the use of lime as a partial replacement for gypsum may offer the potential to produce high-quality binders for house building, superior false ceiling products, and high-quality wall coverings. In conclusion, this study highlights the potential of using lime in developing the production process of Iraqi gypsum to produce a superior end product.

B. Design and Fabrication of Automatic Wall Plastering Machine Prototype [2]

The focus of this study is to apply mortar onto walls and pressurize it with a surface level. The model was developed and tested, proving to be successful. This development could help reduce two significant issues currently faced by the construction industry: a shortage of skilled labor and a lack of quality in the construction process, resulting in less wastage. The trials conducted showed that the machine was more productive in plastering work compared to manual labor, and the quality achieved was nearly equivalent to that of skilled labor.

The current model is semi-automatic and lacks an automatic loading system for mortar, which requires further development. It is designed specifically for straight walls, making it suitable only for large commercial buildings like apartments. It cannot be used for constructing curved walls due to the absence of a curved blade. Therefore, upgrades are necessary, requiring modifications to enable the machine to be utilized for walls of any size and to handle corners and the joining of two walls.

C. Lightweight plasters containing plastic waste for sustainable and energy-efficient building [3]

Plasters with satisfactory fresh consistency can be achieved by adjusting the plaster mixture proportions with the use of plastic waste particles. However, increasing the amount of organic waste particles resulted in a gradual decrease in both compressive and flexural strengths. Nevertheless, a minimum value of 2 MPa in compression and 1 MPa in bending can still be obtained by completely replacing both virgin raw materials with organic waste particles, and cement with a combination of lime and hydraulic lime.

In terms of plaster lightness, the addition of organic particles and a significant amount of AEA contributed to a weight reduction of up to 65%. The final value achieved was beyond 1 g/cm3, which was about 0.7 g/cm3. Furthermore, the thermal conductivity was significantly reduced to slightly lower than 0.1Wm-1 K-1 for mixtures prepared with the maximum content of organic particles, as well as with lime and hydraulic lime replacing cement.

Regarding other essential functional properties of plasters, such as water vapour permeability and water capillary absorption, the use of the maximum amount of organic waste particles and the replacement of cement with lime and hydraulic lime proved to be promising. The presence of numerous macropores, particularly produced by the addition of a vast amount of AEA, helped to reduce both the resistance to vapour passage and the rising damp, playing a crucial role in ensuring indoor comfort by decreasing humidity.

Finally, based on the results of tests on sensitivity to sulphates of the hydraulic binders used, these plasters are also suitable for restoration in ancient masonry.

Development of a plastering mortar using waste bagasse and rice husk ashes with sound mechanical and thermal properties [4]

The study showed that mixtures containing up to 30% of both BA and RHA as a replacement for cement had compressive strength within the standard recommended range while maintaining adequate water absorption and acid alkaline resistance. This suggests that BA can replace cement

up to 30% and each WBBA and WBRHA can replace 15% of cement in the manufacture of wall plaster mortar.

Moreover, increasing the proportions of BA and RHA in the mortar resulted in a decrease in thermal conductivity. Mortar with 30% BA had about 33% and 31% lower thermal conductivity compared to conventional mortar and mortar with 15% BA and 15% RHA, respectively. This implies that increasing the composition of BA and RHA improves the thermal performance of the mortar, which can be used as wall plaster to enhance thermal comfort in indoor spaces while reducing energy consumption in buildings.

Furthermore, the study showed a significant reduction in embodied GHGE with increasing replacement of BA and RHA in mortar. When 30% of cement in conventional mortar was substituted with BA and 15% BA and 15% RHA, both cases reduced CO emissions by about 28% compared to the control mix. The production cost of mortar containing 30% BA and mortar containing 15% BA and 15% RHA is only 16.6% of conventional mortar mix. However, the energy required to produce BA mortar is less than that of BA and RHA mortar. Thus, BA has more potential as a cost-effective, energy-efficient, and environmentally friendly construction material.

However, for developing a more reliable mortar mix, a more comparative analysis should be conducted to investigate the content of SiO and Ca(OH) as well as the formation of hydration products in the cement mortar phase. These findings can be considered for further optimization involving microstructural investigation of the cement mortar.

D. Gypsum plaster waste recycling: a potential environmental and industrial solution [5]

The potential for recycling Brazilian gypsum plaster waste is high and has practical applications in both environmental and industrial settings. The recovered gypsum plaster powders have smaller particle sizes and higher fineness compared to commercial plaster, which can decrease setting time, but this issue can be resolved by adding retardants. The mechanical properties of the recovered gypsum plaster hydrated products are superior to those of the original commercial plaster and their compositions are similar. The main phases of the recycled gypsum plaster do not change during the recycling process, indicating that this process can be used for manufacturing building components. With the same recovery process used by small recyclers, the new recovered hemihydrated plaster can be recycled indefinitely, produced without significant changes in composition and with low energy consumption. GPW recycling can reduce the consumption of natural gypsum resources and the amount of CDW sent to landfills, thus optimizing the environmental benefits of gypsum plaster.

E. Thermal and environmental impact analysis of rice husk ash-based mortar as insulating wall plaster [6]

The objective of this research was to create a thermally enhanced plaster for walls using RHA-based mortar. RHA was utilized to replace some of the sand in the conventional mortar, allowing for a cost-effective and environmentally sustainable plaster. Eight different mortar mixes were subjected to compressive and thermal conductivity tests to determine the optimal RHA content. Two prototype houses were built and plastered with both conventional and RHA-based mortars to investigate the heat transfer mechanisms. Environmental impact assessments were conducted to evaluate the sustainability of using RHA-based mortars. Based on the experimental tests and environmental impact assessments, the following conclusions were drawn:

Mortar with 10% RHA replacement had a thermal conductivity of 0.58 W/m K, which was a decrease of about 28% compared to the conventional mortar. The thermal conductivity decreased even more to 59% when sand was replaced by 30% with RHA.

A cost-effective and sustainable thermally enhanced plaster suitable for wall application could be produced by replacing 30% of sand in the conventional mortar with RHA. This plaster provided satisfactory compressive strength (~5 MPa), reduced thermal conductivity (~0.33 W/m K), and lesser GHG emissions (~1.15 kg CO2-eq).

The thermally enhanced RHA-based wall plaster improved thermal control, providing better thermal comfort for occupants, as it produced constant indoor air temperature and wall surface temperatures. Heat transfer analysis showed that plaster with 30% RHA reduced peak heat flux by an average of 10% and average daily heat transfer by 26%.

Environmental impact assessment revealed that increased RHA replacement for sand reduced the impact of climate change, ozone depletion, human toxicity, terrestrial acidification, freshwater ecotoxicity, and fossil depletion.

This study concluded that 30% RHA replacement for sand in the conventional mortar significantly reduced thermal conductivity, peak heat flux, and GHG emissions, making it the sustainable option to reduce the operational energy and carbon-intensive materials in the building.

However, more research is needed to determine the durability characteristics (acid and alkaline resistance, thermal diffusivity, sunlight resistance, corrosion, etc.) of RHA-based mortars, as well as the long-term thermal performance of RHA-based mortars on actual walls with different climatic conditions.

F. Improvement of gypsum plaster strain capacity by the addition of rubber particles from recycled tyres [7]

This research aimed to determine the feasibility of incorporating ELT (end-of-life tire) rubber particles into gypsum plaster used in construction. Based on the results of the study, it was concluded that there is compatibility between rubber particles and gypsum plaster, and the valorization of ELTs residuals is feasible by incorporating them into the construction material.

The addition of rubber particles resulted in a decrease in the mechanical properties of the gypsum plaster, but the impact of small variations in w/p ratio on mechanical properties was found to be more significant than the presence of rubber particles in the studied percentages. The study found an average decrease of 16% in bending strength and 18.3% in compressive strength, but the values obtained in the tests were sufficient to meet the conditions specified for this gypsum plaster type in the UNE-EN 13279-1 standard.

The addition of rubber in gypsum plaster caused a decrease in surface hardness of renders (1.7% and 7.8% for additions between 1% and 3% of rubber, respectively), and it could also affect the color of the finish surfaces. However,

improvements in resistance to cracking could not be verified due to the absence of cracking in gypsum plaster in the modified Kraai slab tests, regardless of the w/p ratios used (0.6-0.7-0.8). The study suggests that the increase of the elastic modulus could lead to a decrease in toughness with the percentages of rubber addition studied (between 1% and 3%), which could negatively affect crack resistance.

The study also found that achieving a homogeneous distribution of rubber in the gypsum plaster mass is difficult, especially with small percentages of addition and high w/p ratios due to rubber floatability. Additionally, the rubber particles tend to cause black coloration of the surfaces. The addition of rubber in gypsum plaster also led to greater water retention, which increased as the percentage of added rubber increased.

Finally, it was found that there was no significant difference in the addition of different rubber particle sizes, which could be due to the small difference between the studied granulometric fractions or the lumping of small particles that are not separated when sieving.

II. Conclusion and Scope for Future Work

Research Title	Conclusions
Enhancing the compressive strength property of gypsum used in walls plastering by adding lime	Gypsum is known to have several manufacturing process defects that can negatively impact the quality of the final product. Significant issue involves the use of raw materials without proper sieving to eliminate debris and other impurities causing other issues & gypsum under investigation was found to have low compressive strength and workability. results showed that using lime in the production process decreased the setting time and increased the bulk density of the gypsum paste. The *most optimal results observed at a 30% replacement ratio*. the study suggests that the addition of lime as an additive to gypsum production processes has the potential to improve the mechanical properties of the final product.
Design and Fabrication of Automatic Wall Plastering Machine Prototype	This development could help reduce two significant issues currently faced by the construction industry: a shortage of skilled labor and a lack of quality in the construction process, resulting in less wastage. The trials conducted showed that the machine was more productive in plastering work compared to manual labor, and the quality achieved was nearly equivalent to that of skilled labor.
Lightweight plasters containing plastic waste for sustainable and energy-efficient building	Adjusting plaster mixture proportions with the use of plastic waste particles can lead to satisfactory fresh consistency. However, an excess of organic waste particles can reduce compressive and flexural strengths. Nevertheless, it is possible to achieve a minimum strength value by replacing virgin raw materials with organic waste particles and using lime and hydraulic lime in place of cement. The addition of organic particles and a significant amount of air entraining admixture (AEA) can also significantly reduce plaster weight and thermal conductivity. using the maximum amount of organic waste particles and lime and hydraulic lime can reduce resistance to vapor passage and rising damp, leading to increased indoor comfort by decreasing humidity.
Development of a plastering mortar using waste bagasse (BA) and rice husk ashes (RHA) with sound mechanical and thermal properties	Using up to 30% BA and RHA as a replacement for cement in wall plaster mortar can maintain compressive strength, water absorption, and acid alkaline resistance within recommended standards. Increasing the proportions of BA and RHA can also improve the thermal performance of the mortar, reducing energy consumption in buildings and embodied GHGE (greenhouse gas emissions). The production cost of mortar containing 30% BA and mortar containing 15% BA and 15% RHA is only 16.6% of conventional mortar mix, with BA showing more potential as a cost-effective, energy-efficient, and environmentally friendly construction material.
Gypsum plaster waste recycling: a potential environmental and industrial solution	The recovered gypsum plaster powders have smaller particle sizes and higher fineness, leading to superior mechanical properties compared to the original commercial plaster. The recycling process can be used to manufacture building components, with low energy consumption and without significant changes in composition. This process can also reduce the consumption of natural gypsum resources and the amount of CDW sent to landfills, thus

	optimizing the environmental benefits of gypsum plaster.
Thermal and environmental impact analysis of (RHA) rice husk ash-based mortar as insulating wall plaster	Mortar with 30% RHA replacement for sand in the conventional mortar reduced thermal conductivity, peak heat flux, and GHG emissions, making it a sustainable option to reduce the operational energy and carbon-intensive materials in the building. More research is needed to determine the durability characteristics and long-term thermal performance of RHA-based mortars.
Improvement of gypsum plaster strain capacity by the addition of rubber particles from recycled tyres	The study aimed to investigate the feasibility of using ELT (end-of-life tire) rubber particles in gypsum plaster for construction. The results showed that incorporating rubber particles into gypsum plaster is feasible, but it can decrease mechanical properties, surface hardness, and crack resistance. The decrease in properties was found to be more affected by variations in water-to-plaster ratio than the presence of rubber particles. Achieving a homogeneous distribution of rubber in the gypsum plaster mass was difficult, and rubber particles tended to cause black coloration of surfaces. There was no significant difference in adding different rubber particle sizes.

From the above papers it can be concluded that combination of various methods depending upon location, climatic conditions, availability of resources etc can be utilized for plastering work which can be sustainable, environment friendly and economical as compared to traditional method that is being used in present construction work which not only improves the quality but also saves time.

III. FUTURE SCOPE

By observing and concluding things from above research papers and development in field of science & technology it can be predicted and theorized that AI and Robotics can be utilized in plastering work and other construction works, making it economical and time efficient process, and with the use of different waste products environmental problems like in Urban centers of Plastic waste like of Polythene Bags, Plastic Bottles, Waste Tyres etc can be solved and in Places around Agricultural Area where Agricultural waste is available, it can be used which can solve major problems like of "Parali" Stubble Burning.

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