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A Review: Application of Granite Quarry Waste in Brick Manufacturing

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I. INTRODUCTION

Granite quarrying can generate a wide range of waste and byproducts, some of which may have environmental and economic ramifications. The wastes generated during these procedures are overburden, rock waste, granite dust and slurry. Overburden is a layer of soil, rock, vegetation, and other materials that must be removed before granite extraction can begin. To obtain access to the granite deposits, this debris is routinely scraped away. It is often unrecoverable and should be disposed of on-site or in designated areas. Its abolition could alter the terrain and damage the ecosystem.During the excavation and processing of granite, rock waste is produced. These are little granite shards and gravel-like sediments left over from quarrying. They are commonly used in road construction and as fill material. During the process of cutting and polishing fine powder or slurry is produced. It can be dangerous because, if not handled properly, it has the potential to damage water sources.

These wastes produced have adverse effects on the environment. One of the most important environmental risks associated with granite quarry waste is water contamination.If granite dust and slurry are not adequately contained and managed, they have the potential to contaminate bodies of water. Small particles in granite dust can cause siltation in streams and rivers, harming aquatic environments. Chemicals used in granite processing can contaminate groundwater and surface water, threatening aquatic life and rendering water supplies unfit for human consumption.Quarrying activities, such as overburden removal, can alter the topography and harm natural habitats. This could result in the displacement of plant and animal species, putting local biodiversity at risk.Quarry operations may also disrupt the flow of water in natural drainage systems, thereby impacting wetlands and other ecosystems. These activities also produce a significant amount of noise and dust, which can impact the environment and adjacent residents. Airborne dust can create poor air quality, respiratory problems, and soil contamination, while noise pollution can upset wildlife and adjacent residents.By removing plants and soil, quarrying increases the risk of erosion and sedimentation in local water bodies. Excess silt can suffocate aquatic habitats and reduce water quality, which can be hazardous to aquatic ecosystems.Granite quarry operators must follow environmental regulations and best practices in order to limit the environmental impact of their operations and handle waste products in a sustainable manner. The reuse of waste produced by quarry activity in construction materials offers a valuable alternative for waste disposal and pollution management. One such utilization of these wastes is in brick manufacturing.

Application of Granite Quarry Waste in Brick Manufacturing

Shilar et al., 2023 created high-quality, environmentally friendly geopolymer bricks out of granite waste powder (GWS) and iron chips (IC). GWS was added up to 40% of the total content of the mix fraction, whereas GGBS and FA (Fine aggregate) in the FGG1 and FGG2 series altered with a 5% increment or decrement. Because of the low embodied energy and carbon emissions, it was established that the GWP and IC in geopolymer bricks are sustainable. Each brick had a better compressive strength due to the alkaline agent's faster silica dissolving rate, which resulted in larger geopolymer gel formation, and the 1:3 ratio had the best value.

Ngayakamo et al., 2021 substituted granite micronized stone waste for natural clay in the manufacturing of eco-friendly bricks with distinct physical and mechanical qualities. The batches were then made with different quantities of granite powder and burned at different temperatures of

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900, 1000, and 1100°C. The final testing approach has shown that eco-friendly bricks containing up to 30% granite powder with a bulk density of 2.2 g/cm^3 and the lowest water absorption value of 9.1% when burned at 1100°C are attainable.

E.M. Abdel Hamid 2021 evaluated the feasibility of partially replacing brick clay with GSW(Granite Sludge Waste) and silica fume (SF) due to the closeness in the mineralogical composition of GSW and clay. Five different weight ratios of clay to SF to GSW were tried: (70:5:25), (70:10:20), (70:15:15), (70:20:10), and (70:25:5). These bricks were blended and moulded into 50 x 50 x 50 mm^3 dimensions before being burnt at three different temperatures (700°C, 750°C, and 800°C). The characteristics of green and burnt bricks were investigated in relation to waste percentage.Compressive strength, water absorption, saturation coefficient, apparent porosity, and bulk density were all measured and compared to ASTM standards. Water absorption and compressive strength were shown to be more responsive to temperature variations than trash addition. To meet the standard specification ASTM C216 grade for moderate weathering, it is possible to produce bricks with the highest compressive strength of 18.5 MPa at firing temperature 700°C using 70% clay, 25% SF, and 5% granite sludge waste, with water absorption of 18.2% and a saturation coefficient of 0.9.

Ngayakamo et al., 2020look into the successful reuse of granite powder (GP) and eggshell powder (ESP) wastes for the production of clay bricks as an alternative waste disposal approach while also improving the quality of the burnt clay bricks (FCBs). Four batches of bricks were constructed with varying clay, GP, and ESP compositions and burned at ramp rates of 10°C/min to three different temperatures of 900, 1000, and 1100°C. FCBs mixed with 20% GP and 10% ESP had the greatest compressive strength of 3.12 MPa, bulk density of 1.76 g/cm3, and water absorption of 12.2% at 900°C, which is deemed an energy-saving 28 method for FCB manufacturing.The compressive strength of 3.12 MPa exceeded the minimum compressive strength of 1.65 MPa recommended by the Nigerian Building and Road Research Institute (NBRRI), Nigerian Building Code, and Nigerian Industrial Standards for building purposes. Reusing waste granite and eggshell powder to manufacture FCBs was determined to be a realistic and successful alternative waste disposal strategy for long-term growth while reducing pollution and environmental deterioration.

The goal of the experiment by Iswarya E was to measure and evaluate the strength of blocks made from various percentages of clay and granite sawing powder waste. The inquiry was carried out using various mix ratios and laboratory tests such as compression and water absorption tests. When comparing the compressive strength features of bocks, the results showed that a progressive increase in compressive strength, and water absorption values in blocks was good.

Kumar et al., 2020. They sought to make bricks from industrial trash utilizing fly ash (FA), granite waste (GW), and black cotton soil (BS) during their experiment. In the block cotton soil (BS) brick mixture, the FA and GW proportions were adjusted by adding 0%, 10%, 20%, 30%, 40%, 50%, 60%, 70%, 80%, 90%, and 100%. BS60:A20:W20 was the greatest compressive strength value. Water absorption was less than the standard amount of 22% in all cases. Furthermore, the weight of these bricks was around 30% to 50% less than that of standard bricks. The efflorescence test results were uniformly negative in all studies.

Shilar et al., 2019. The study comprised an experimental assessment of the effects of various concentrations of granite waste powder and lime in the fly ash while building a fly ash-based interlocking brick to examine interlocking brick features such as compressive strength and water absorption. The compressive strength for 72% fly ash, 18% granite powder, and 10% lime mix was 3.96 N/mm² for 7 days and 8.59 N/mm² for 21 days; for 72% fly ash, 16% granite powder, and 6% lime mix, it was 3.98 N/mm² for 7 days and 8.96 N/mm² for 21 days; and for 72% fly ash, 18% granite waste powder, and 10% lime mix, it was 3.78 N/mm² for 7 days and 8.32 N/mm² for 21 days.The percentages of water absorption for all three mix proportions were 15.20%, 16.10%, and 16.50%, respectively.

Geetha et al., 2019 incorporatedwaste productslike granite wastes, sawdust and fly ashintobricks.The brick samples with granite and fly ash had water absorption for all percentages of waste was less than 20%. For brick samples with sawdust, water absorption was 15% for 3% sawdust added in the specimen brick (class 1 brick). For 6%, it rises to 20.5% (class 2 brick).When 12% granite was added, the compressive strength reached its maximum value of 8.06 N/mm². When 3% fly ash was added, the compressive strength was 8.25 N/mm². Lastly, when 3% sawdust was added, the compressive strength was 3.19 N/mm², which was less than the compressive strength of normal brick (5.64 N/mm²).

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Hamza et al., 2011aimed to replace traditional coarse and fine aggregates in the manufacture of concrete bricks with scraps of marble waste and slurry powder comprising up to 40% marble and granite waste. All cement brick samples tested in this study met the Egyptian code requirement for structural bricks, proving that recycled goods have physical and mechanical properties that make them suitable for use in the building sector. Granite slurry enhanced cement brick samples, with a maximum slurry incorporation of 10%.

II. CONCLUSION

The above observation shows that granite waste can be effectively used in the form of powder waste as well as slurry waste in brick manufacturing. In clay bricks granite sludge waste is used as a replacement for natural clay and tested for temperature endurance. When burned at 1100°C, bricks containing up to 30% granite powder with a bulk density of 2.2 g/cm³ and the lowest water absorption value of 9.1% are obtained.In cement brick, granite powder is used in different proportions with fly ash. These samples were tested for compressive strength and water absorption showed better results when compared to standard bricks.

It can be concluded that the incorporation of granite waste in brick manufacturing can be considered an effective approach towards the utilization of these wastes to minimize environmental effects.Finally, because waste materials are employed in manufacturing, higher quality brick is generated through sustainable and eco-friendly techniques, lowering the overall cost of brick.

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