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Review Article

Concrete Mix with Iron Powder and Granite Powder: A Review

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ABSTRACT

The industries involved in the milling and polishing of granite produce iron powder and granite powder as industrial byproducts. These byproducts are largely unused and harmful to human health because they are easily inhaled and airborne. The percentages of GP and IP additional to replace sand by weight. Cement concrete is the mainly extensively used construction material in the globe. The reason for its extensive use is that it provides good workability and can be turn it to any shape. Normal concrete gives a very low tensile strength, restricted ductility and small amount of resistance to cracking. Internal small cracks lead to brittle failure of concrete. In this new generation civil engineering constructions have their own structural and durability requirements. Every structure has its own design criteria and shape so meet that requirement. Concrete made of cement must be altered. Iron Powder (IP) and Granite Powder (GP) are industrial byproducts that are produced in powder form by the granite milling and polishing industries, respectively.

KEYWORDS

Granite Powder, Iron Powder, Compressive Strength,mix design, sand, cement, Flexural Strength

1. INTRODUCTION

Concrete plays a very critical role in the design and construction of the nation's infrastructure the nearly everyone widely used construction matter in the world is probably concrete with about six billion tones being produced every year. The framework needs of our nation is expanding step by step and with concrete is a fundamental constituent of development material in a huge bit of this infra-underlying framework, it is important to upgrade its qualities through strength and solidness.

Concrete is a moderately fragile material. Expansion of strands to substantial makes it a more pliable material. Plain concrete cement has a few weaknesses like low elastic, restricted pliability, little protection from breaking, high fragility helpless sturdiness. In the current work, different percentages of GI are used as a partial replacement for sand in concrete, and the resulting flexural strength, compressive strength and splitting tensile strengths of concrete have been assessed.

By doing this, the health risks posed by these industrial wastes can be reduced while protecting the natural resources of sand. Debris series from fireclay tiles combine post-industrial and post-consumer recycled wastes.The disposal of waste by-products from various industries without endangering the general public, the environment, or the eco-system is a significant challenge for scientists, engineers, and environmentalists. Since humans exploit construction materials, finding the waste materials that are being disposed of and the characteristics of these materials that resemble any component in a concrete mixture can help to some extent alleviate the issue.

The main goal of this study is to investigate the typical compressive strength of M30 grade concrete, which substitutes granite dust, a waste by-product from the construction industry, for major components like cement and fine aggregate. The replacement is carried out in different percentages, namely 5 percent, 10 percent, 15 percent, and 20 percent, and the strength is compared.

2. LITERATURE REVIEW

Pallapu Siva, Addala Satya Pavani ,Baddigam Venkateswara Reddy ,Tatineni Chenna Kesava Rao ,A Rajendra (2021)

Many industries are producing waste by-products and their disposal without creating any disturbance in the public, environment, and eco-system is a major challenging task to the researchers, engineers and environmentalists. Since construction materials are being exploited by mankind, identifying the waste materials which are being disposed off and the properties of these materials which resemble any constituent in concrete mixture can reduce the problem to some extent. The main objective of this study is to investigate the characteristic compressive strength of M30 grade concrete in which major constituents such as cement and fine aggregate are replaced with granite dust which is a waste by-product from the industry. The replacement is done in various proportions i.e., 5%, 10%, 15% and 20% and is compared with the strength of concrete prepared by nominal mix which has no replacements.

Karthik Thipparthi, Rahul B, Shoeb Uddin M K, Arun Kumar ,M Farhad Rafiq Wani,Graduate Student, (2021)

"Using metal saws, the granite industry slices the rock into

slabs according to the demands of the customer. The fine powder that is produced during cutting is regarded as solid waste and is being collected. During the sawing process, the granite mining industry produces a sizable amount of waste. The calcium and iron in granite sawdust are compatible with acids. It has been discovered that using granite waste to produce concrete for civil construction is effective. In this project's work, granite waste was used as a partial replacement for fine aggregate with cement proportions ranging from 20 to 40 percent by weight.

V Saravana Karthika,Mohan Anbarasu,Dinesh Kumar R,Chippymol James (2019). Due to overuse and high demand, which causes its availability and cost to rise, the infrastructure/construction industry is currently facing a serious problem with the availability of natural river sand. We require getting new applications for and alternatives to sand in order to solve this kind of issue. Health risks result from the environment's disposal of granite rock waste and iron-related particles. This waste can be partially replaced with fine aggregate by reusing it. To determine how best to use granite and iron powder as partial substitutes for fine aggregate. There has been an experimental investigation. The gaps in the concrete are filled with granite slurry waste and iron waste, which replaces the fine aggregate and improves the concrete's strength properties. In four different hypotheses, granite powder was held constant at 10% (as determined from various literatures), and iron powder was held constant at 10%, 15%, 20%, and 25%. There are tests for strength traits like compressive strength, split tensile strength, and flexural strength.

Narmatha Mahudeswaran (2018). The waste management system's primary goals are to maximize financial gains while also preserving the environment. During the sawing and polishing processes, the granite processing industry produces a lot of waste materials, mostly in the form of powder, which pollute and harm the environment. The purpose of this work is to characterize and assess the viability of using the granite sawing wastes produced by the Salem District's process industries as substitute raw materials for the production of concrete. This waste granite powder can be used in place of some of the sand in the concrete-preparation process. To test the viability of using granite powder in place of some of the sand, an experimental investigation has been conducted. The weight-based additions of granite powder to replace sand were 0, 5, 10, 15, 20, and 25.This attempt has been done due to the exorbitant hike in the price of fine aggregate and its limited availability.

Srinivasa. C. H. ,Dr. Venkatesh (2015). Investigations into the optimization of granite powder and its impact on the properties of freshly mixed concrete and hardened concrete with cement replacement were made. Using manufactured sand and granite powder, the mix design for M20 Grade was completed in accordance with Indian Standard Code IS 10262:2009. In order to determine the ideal proportion of granite powder in ready-mixed concrete for compressive strength, samples were tested. Workability was evaluated in terms of Compacting Factor and Slump. Using manufactured sand and granite powder to replace 20 percent of the cement gives the ready-mixed concrete excellent strength. Granite powder and manufactured sand are workable substitutes for natural materials when making concrete. In an effort to achieve sustainability, this paper suggests using manufactured sand and granite powder.

3. PROBLEM STATEMENT

1. The experimental research used in this study demonstrated that when iron powder and granite powder were used as partial replacements for sand in this study in specified percentages, the mechanical properties of concrete improved.
2. The flexural strength, splitting tensile strength of concrete and compressive strength have all been shown to increase when granite powder and iron powder are used in specific proportions.
3. Additionally, by using these powders to partially replace sand in the construction industry, less sand will be consumed, protecting more of these natural resources. These byproducts' environmental and health risks can be reduced by recycling them and using them in concrete.
4. The industrial byproducts of granite stone crushing and polishing and steel production, respectively, are granite powder and iron powder. These waste products can be used in concrete as a partial substitute for sand.

4. MATERIALS USED

4.1 General

A composite material called concrete is created artificially by drying a mixture of cement, sand, gravel, and water in a specific ratio. These ingredients combine to create a plastic mass that can be molded into any shape. It becomes a solid, hard mass after being hardened. One of the key components of concrete is water. This is necessary for both chemical reactions and to cure things. Cement and water in the mixture undergo a relatively slow chemical reaction that needs time and a comfortable temperature to complete. Depending on the quality and proportions of the ingredients used in the mix, to properties of concrete vary almost as widely as different kinds of stones. Concrete has enough strength in compression, but has little strength in tension.

Due to this concrete as such is weak in bending, shear and torsion. However, to use cement concrete for common structures such as beams, slabs, retaining structure etc, steel bars may be placed at tensile zones of the structure which may then be concrete.

4.2 Granite Powder

Similar to pozzolanic materials like silica fume, fly ash, slag, and others, granite powder, a byproduct of the granite polishing manufacturing, holds promise for use in concrete. These goods can be used as filler materials to lessen the amount of voids in concrete (in place of sand). Granite is a member of the igneous rock group. The granite has a compressive strength of more than 200 MPa and a density of 2.65 to 2.75 g/cm3. The properties of the granite powder were discovered after it was obtained from the polishing units. Since the granite powder was so fine, hydrometer analysis was used to determine the distribution of particle sizes in the powder. The coefficient of curvature was bring into being to be 1.95 from hydrometer analysis.

Fig 1Granite Powder

Table 1 Chemical composition of Granite Powder

Chemical Compound	Weight (%)
SiO2	64.5
TiO2	0.67
Al2O3	12.01
Fe2O3	5.77
MgO	0.57
MnO	0.39
CaO	4.8
Na2O	5.92
K2O	5.26
P2O5	0.07

4.3 Iron Powder

When iron powder makes up 2.5 percent of the cement, the porosity decreases by 9.38 and 19.16 percent, respectively. When 3.5 and 5 percent of iron powder were added to the concrete, the increase began. It has been established that the iron powder is only slightly more effective than other compounds at changing the pore structures and reducing concrete's porosity. 20 to 200 m is the range of particle sizes. Depending on its characteristics, each type is employed in a variety of applications. The visual appearance of reduced iron powder and atomized iron powder hardly differs from one another.

Fig. 2 Iron Powder

Iron powder is also used for the following:

- Bearings and filter parts.
- Machine parts.
- Hand Warmers.
- High strength/wear-resistant parts.
- Magnetic materials.
- Friction parts (mainly automobile parts).
- As a fuel.

Table 2 Chemical composition of Iron Powder

Chemical compound	Weight (%)
SiO2	2.41
TiO2	0.72
Al2O3	1.81
Fe2O3	89
MgO	0.23
MnO	2.16
CaO	0.45
Na2O	0.66
K2O	1.64
P2O5	0.34
Ni	0.002
Cu	0.003

5. PROPOSED METHODOLOGY

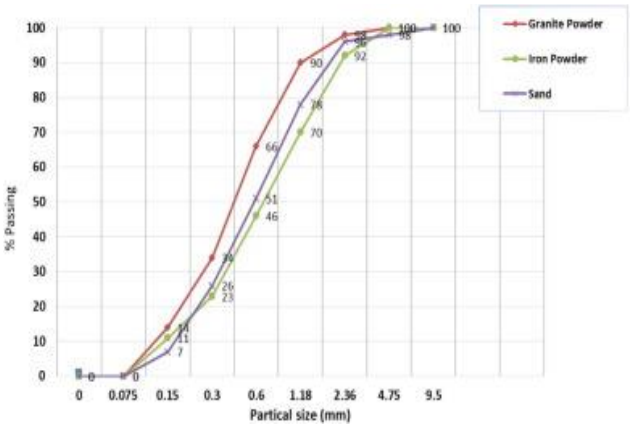
5.1 Preparation of granite powder test specimens

Preparation of granite powder test specimens Prior to use, the granite powder was dried after being collected from granite crushing and polishing locations. Cement and granite powder were thoroughly combined first. Following thorough mixing of all the components, water containing super plasticizer was added to the dry mix in a conventional concrete mixer. The specimens were then taken out of the moulds and allowed to cure for 28 days. The effect of granite powder (GP) on curing time was not compared because curing time was not a study parameter. A number of mixtures were created using various amounts of granite powder in place of some of the sand. The remaining

ingredients remained unchanged. Plasticizing admixtures are added to a concrete mixture to make the mix workable without additional water especially for use in ready mixed concrete.

5.2 Preparation of iron powder test specimens

With a small amount of other chemicals, iron oxide fines are used to make the iron powder. It was used to prepare concrete specimens in a manner akin to granite powder. The mix designs for concrete with various iron powder ratios are shown in Table 4. 0 percent, 5 percent, 10 percent, 15 percent, and 20 percent of sand were substituted for the iron powder, respectively. There were five different mixes tested: M10, M15, MI10, MI15, and MI20, which, respectively, contained 0%, 5%, 10%, 15%, and 20% IP by weight. When compared to GP mixes, the slump values of this concrete with iron powder were comparable.



Graph 1 Grain size distribution of granite powder, iron powder, and sand.

6. COCLUSION

Based on the results of this study, the following conclusions can be drawn:

1. The concrete mix made using iron powder (IP) and granite powder (GP) as partial replacement of sand showed good workability and fluidity similar to normal concrete mixes.
2. The compressive strength of concrete increased with the addition of granite powder (GP) as partial replacement of sand.
3. For mixes with iron powder (IP), the compressive, flexural, and tensile strengths all increased with the increase in the (IP) ratio. Unlike the granite powder (GP), the increase in strengths continued to concrete with the increase in the (IP) ratio. The increase was more pronounced in flexural strength compared compressive and tensile strengths.
4. This study was limited to the evaluation of the mechanical properties of concrete with granite powder and iron powder as well its workability and fluidity.

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