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A Review Paper on Concrete using Ferrock with M-Sand

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A B S T R A C T

Concrete is widely used in construction. Concrete, the second most used material after water around the globe which accounts for 8 to 10% of total CO2 emissions is mainly due to cement. These CO2 is responsible for global warming and pollution. Thus by the use of green concrete it is possible to reduce the CO2 emission in atmosphere towards eco-friendly construction. This proposes to evaluate the ability of Ferrock to be used as one of the best possible substitute for cement in concrete. It is an iron based binding compound which utilizes variety of waste materials to form a carbon negative building material. Iron dust (a waste from iron industries) which would otherwise end up in landfills is used along with small proportions of limestone, fly ash and metakoalin to make this novel substance. Our study compares the environmental impacts of ordinary Portland cement and Ferrock (iron dust 60%, fly ash 20%, Metakoalin 12% and limestone 8%) focusing specially on their contribution to carbon pollution, water use and energy consumption. By substituting cement with Ferrock in varying proportions in concrete we are trying to find the optimum ratio of replacement which would give desired results in both strength (compressive, split tensile & flexural tested) along with sustainability. Manufactured sand crushed from stone or gravel, also known as machine-made sand, artificial sand or crushed-stone sand, has been used as a substitute of natural sand in concrete. This is also becoming a global trend to produce concrete by using manufactured sand in the safeguarding of limited natural sand resources. Therefore, concrete with manufactured sand (MSC) has gradually become an essential and green building material. Here in this project we retrying to find optimum percentage of replacement of cement by Ferrock and river sand by M-sand

Keywords:-Compressive strength, M-Sand, Ferrock

1. Introduction

1.1 CONCRETE USING FERROCK

As the part of development, rate of construction is also high. Cement in concrete, the second most used entity after water in the world today, is responsible for the huge production of CO2 in environment. This huge production of CO2 in environment leads to environmental problems such as Global warming, climate change, pollution etc Methods to reduce greenhouse gases like CO2 in the atmosphere are an active research area today. For each one ton of cement created more or less eight ton of CO2 is released. So green concrete is the best solution .Green concrete means to protect environment by using waste material in constructive way. So this Project checks how far ferrock can be used as a substitute to cement .Ferrock is created from waste steel dust, a waste from iron mill which goes straight to the landfill as it's not recycled conventionally and the process of recovering iron from this powder is uneconomical. The iron dust reacts with carbon-di-oxide and rust, which creates an iron carbonate matrix to form Ferrock while it dries. The accepted reaction steps for this process are: Fe + 2CO2 + H2O → Fe2+ + 2HCO3 + H2 ↑Fe2+ + 2HCO3 → FeCO3 + CO2 + H2O The net reaction then is: Fe + CO2 + H2O → FeCO3 + H2 ↑ Here we use materials such as Metakoalin, limestone, fly-ash along with iron dust for proper binding and performance requirements . As per the available literature we know that the best possible proportion of ingredients are iron dust (60%), fly-ash (20%), Metakoalin (12%) and limestone (8%). Ferrock is therefore "carbon negative" unlike Portland cement, which during manufacture is a major source of CO2 and other air pollutants. It was, whereas, David Stone was doing his Ph.D. in environmental chemistry at the University of Arizona in Tucson once an unsuccessful experiment uncovered a novel material. Stone initially discarded this implausibly exhausted material, then suddenly realized it would have a helpful purpose as a lot of environmentally friendly, yet robust, alternative to cement. His aim was to search out a material that might be mixed and poured rather like cement and with a similar strength and flexibility that concrete offers. The iron among the steel mud reacts with C02 and rusts to create iron carbonate. It's this that's consolidated into the matrix of Ferrock and, like concrete, when it's dried; it can't be melted back to a liquid type, however retains It's exhausting, rock-like qualities. Ferrock in original form has 5 times more compressive strength and flexures much more before failure when compared to control mix.For carrying out the total replacement of cement the main requirement is a 100% CO2 atmosphere for curing which couldn't be satisfied for our project. As according to the scope of this paper, we have substituted cement by percentage weights of ferrock. Thus in our results we find that the strength of control mix can be achieved in substitutions itself. It has various applications similar to normal concrete in buildings, bridges and other conventional uses of concrete. Also, as our specimen gains strength in CO2 environments it will be very useful in polluted sites of industrial zones. Further, Ferrock concrete can also be used for structures in contact with sea water as this fastens the process of rusting and gives strength to ferrock.

1.2 CONCRETE USING M-SAND

With the world wide decline in the availability of construction sands along with the environmental pressures to reduce extraction of sand from rivers, the use of manufactured sand as a replacement is increasing. With the ban on sand mining implemented by different states, and with the increasing demand for river sand for construction works, many civil engineers have expressed the need to promote use of manufactured sand in the construction industry. As per reports, manufactured sand is widely used all around the world and technicians of major projects around the world insist on the compulsory use of manufactured sand because of its consistent gradation and zero impurity. There is a need for 'clean sand' in the construction from the point of view of durability of structures. Indiscriminate mining and quarrying is posing threat to the environment. As the demand for Natural River sand is surpassing the availability, has resulted in fast depletion of natural sand sources. Manufactured sand is the answer for this problem especially when some states have already banned the use of river sand for construction. This sand has been defined well in IS 383-1970, under clause 2.0. There is a need to study shape characteristics of manufactured sand, effect of micro fines on concrete characteristics such as modulus of elasticity, shrinkage, creep etc. concrete mix proportioning by resorting to particle packing approach is the need of the hour when it comes to use of manufactured sand as a replacement to natural river sand. some of the study's findings from Dr. C.S. Viswanatha, Chief Executive, Torsteel Research foundation in India has concluded that compared to concrete made from natural sand, high-fines concrete generally had higher flexural strength, improved abrasion resistance, and higher unit weight and lower permeability due to filling the pores with microfines

2. LITERATURE REVIEW

D.S. Vijayan et al, In this research paper substituting cement with Ferrock in varying proportions as 4%, 8%, and 12% in concrete we are trying to find the optimum ratio of replacement which would give desired results in both strength (compressive, split tensile & flexural tested) along with sustainability. In all the test result which is compares 8% which shows the good result in strength.[1]

Kavita Singh et al, In this project there is replacement of cement with the percentage of ferrock. Ferrock is a waste material of steel and having a tensile property. In this M20 Grade concrete is used and for that the mix design was done having the different composition of cement, Fine Aggregate, Coarse Aggregate, Ferrock and Water. The cubes are tested after the curing duration of 7 days, 28 days, and 56 days. In this research work, there was replacement of the cement with the ferrock having a percentage variation 5%, 10 %, 15%, 20%. With the replacement of cement with ferrock it was found that compressive strength of the green concrete was increased, and durability of the concrete was also increased. Also, it was economical as ferrock is a waste material which is available free of cost, so it reduced the overall cost of the work. Also, the Ferrock has a property to absorb the Carbon dioxide from the environment so it is also reducing the air pollution.[2]

Sakshi Agrawal et al, In this review paper she conclude that Green concrete having reduced environmental impact with reduction of the concrete industries CO2 emission by 30%. Green concrete is having good thermal and fire resistant. In this concrete recycling use of waste material such as ceramic wastes, aggregates, so increased, so increased concrete industry's use of waste products by 30%. Hence green concrete consumes less energy and becomes economical. So definitely use of concrete products like green concrete in future will not only reduce the emission of CO2 in environment and environmental impact but also economical to produce.[3]

S.Karthika et al, This research focuses unexpectedly on their commitment to carbon dioxide contamination energy use, water use, the ecologic impact of ordinary Portland cement and ferrock (Limestone 8%, Metakaolin 12%,,Fly ash 20%,Iron residue 60%) by sustaining concrete with ferrock in fluctuating proportions of 5%,10%,5% and 20% in solid ,They attempt to find the ideal proportion of substitution which long with sustainability would boost wanted outcomes for both compressive and divided tensile ,In this proportion the test result shows 10% is more efficient than others [4]

Shaik Feroz et al, In this paper, ferrock mortar is prepared with various solids such as iron powder, iron dust, cement and fly ash to establish the optimum combinations of solids for preparing the high strength ferrock systems. Iron dust in the form of powder (size less than 90 microns) and fine aggregate (size between 150 microns to 2.36 mm) is used in the study to develop the iron carbonate matrix which is major binding material in ferrock. For the process of iron carbonation, carbon dioxide is prepared from the chemical reaction of sodium bicarbonate and acetic acid. Iron dust cubes are carbonated to form iron carbonation matrix upon fusion. This material has very high strength than the references cement mortar samples.[5]

Alejandro Lanuza Garcia et al ,In this paper, Life Cycle Analysis (LCA) is used from a cradle-to-gate perspective to compare the environmental impacts of Ferrock and Ordinary Portland Cement (OPC), focusing specifically on their contribution to carbon pollution, water use and energy consumption. This process-based LCA includes a comprehensive literature review, and an in-depth environmental assessment of Ferrock production, from the point of its raw materials extraction, to its curing and hardening phase, and all processing steps in between. The results have been compared to a previous life-cycle analysis of OPC. This preliminary analysis finds that Ferrock has both the intriguing potential to replace OPC, and contribute significantly to the promotion of an environmentally sustainable future.[6]

Niveditha M et al,Told about the, in this fast growing globe, public are focusing on the infrastructural growth, place building sector plays a main act. Cement is ultimate famous material being used in building that emits nearly 6-8% of the total colorless odorless gas in the world all the while allure result which is the important constituent of worldwide warming up. Thus, focusing on the element issuance decline and again utilization of the waste output for a better atmosphere, a produce named Ferrock was formed.[7]

Shunbo Zhao et al, Concrete with manufactured sand (MSC) is a potential environmental friendly building material. As the limited study on tensile strength development of MSC, the findings of research work are presented in this paper. The MSC cubes were tested by the splitting tensile method, the influences that the water-cement ratio and the stone powder content have on the tensile strength development of MSC were analyzed. Test results showed that manufactured sand with no more than 13% stone powder content was beneficial to the long-term tensile strength of MSC. Forecast models are suggested for the prediction of long-term tensile strength of MSC.[8]

T.Shanmugapriya et al, Addition of up to 50% of manufactured sand as sand replacement yielded comparable strength with that of the control mix. However, further additions of manufactured sand caused reduction in the strength. The optimum percentage of replacement of natural sand by M-sand is 50%. [9]

Dr. S .Elavenil et al, In this project concrete is made using M-Sand and compared to concrete made from river sand. Research findings concluded that, compared to concrete made from river sand, high fines concrete generally had higher flexural strength, improved abrasion resistance, and higher unit weight & lower permeability due to fillings the pores with micro fines [10]

3 CONCLUSION

- Use of ferrock in concrete not only reduce the emission of CO2 in environment and environmental impact but also economical to produce.
- As per the available literature the best possible proportion of ingredients for ferrock are iron dust (60%), fly-ash (20%), Metakoalin (12%) and limestone (8%).
- From researchers it is conclude that the best proportion of replacement of cement by Ferrock is 8-10% which gives best result
- The optimum percentage of replacement of natural sand by M-sand is 50%.

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