A REVIEW OF STUDY ON REPLACEMENT OF FINE AGGREGATE WITH STEEL SLAG AND REPLACEMENT OF CEMENT WITH PAPER SLUDGE

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Abstract: A large amount of disposal of solid waste material is harmfull to our environment because of pollution generated by it. Previous researches observed that because of increasing environmental concerns and sustainable issues, the utilization of solid waste materials is the need of the hour. Concrete is composite coalescence of material composed of cement, sand, aggregate and water. Concrete is a versatile man made material that can easily transform into special needs and can have any shape. It has various advantages like economical, durable, fire resistant, on site fabrication etc. But ordinary cement concrete also has some demerits such as very low tensile strength, little ductility i.e. it is brittle and less resistance to cracking, etc. Hence engineers needs to manipulate its ingredients with suitable materials to improve concrete properties. In order to reduce the consumption of natural and conventional resources, which by the way are limited, use of other industrial wastes are inevitable. To replace these wastes with fresh materials, one of the feasible options is to control degradation of environment.

***Index Terms*–Concrete, Replacement of fine aggregate, Steel Slag, Replacement of cement, Paper Sludge.**

I. INTRODUCTION

A very large amount of solid waste is produced by industries in India. The disposal of these solid waste materials is an environmental hazardous for the surrounding living beings. The various types of pollutions are produced by these wastes like air pollution, water pollution, land pollution, etc. These pollutions lead to the various types of infirmities to the life on globe and the waste production is increasing day by day so the disposal of these wastes is an serious issue and also the matter of concern. The productive use of solid waste materials is the best way to alleviate the problems associated with their disposal. This problem can be solved by the construction industry by using these solid wastes in the production of structural elements like concrete elements, bricks, tiles, etc.

Most common and widely used artificial material in existence of this world is cement. When mixed with water and aggregate it forms concrete, & that is used in the construction of buildings, bridges to roads, sidewalks and all kinds of infrastructure. Cement produced by India is of second largest scale in the world. Indian cement industry is an essential segment of our indian economy and it gives work to nearly above a million people. But while cement has largely shaped the modern built environment, it is also a massive source of carbon dioxide to the atmosphere. It is the second largest single industrial emitter in the world, second only to iron and steel industries.

Tackling these problems doesn't have a single solution. It will require a variety of approaches including major changes in both the material used and the manufacturing process itself. It is possible to make cement like product by the partial replacement of conventional clinker with such alternatives as fly ash, bottom ash, paper sludge and slag, all of which are by-products of other industries that would otherwise end up in landfills. Some estimates suggest the practice has the potential to lower emission by as much as 40 to 80 percent compared with Portland cement.

Hypo sludge is chemical waste and requires large space for disposal. We can use it as a partial replacement material in cement concrete and same goes for iron slag. Replacing the natural fine aggregates and cement in concrete applications with steel slag & paper sludge respectively would lead to considerable environmental benefits and would be economical.

The major problem to extent the usage of paper sludge and slag like waste product may be due to the risk of construction with technology that has not been exposed to long field testing. Construction industries will not start working with new concept even if it reduce carbon footprints until a tax is imposed. But there are many example of modern concrete mix and its enforcement. There is a Uropian based concrete industry that has started production of concrete with 95% fly ash and 5% liquid admixters. There is also a industry which has been constructing a mixture of concrete that involve different mix proportion of Portland cement, fly ash and slag depending on the structure and its properties requirement.

II. NEED AND SCOPE OF THE STUDY

It has been observed that there is scope of improving the strength parameter of concrete by using paper sludge as a partial replacement of cement and steel slag as a partial replacement of fine aggregate as both possesses good pozzolanic properties. The original scope of this research was to investigate the properties of concrete with steel slag and paer sludge. In addition to this research several tests were also included such as compressive strength, split tensile strength and the flexural strength of concrete. While producing paper the various wastes are comes out from the various processes in paper industries. From the preliminary waste named as hypo sludge, due to its low calcium is taken out for our project to replace the cement utilization in concrete.

- To find the optimum strength of the partial replacement of cement with hypo sludge.
- Minimize the max degradation in environment due to cement and safeguard ozone layer.

- Using the wastes in useful manner.
- To reduce the cost of the construction.
- It should be easily adopted in construction field.
- To provide a most economical concrete.
- Minimize the maximum demand for cement.

III. PREVIOUS RESEARCH

Gaurav Desai et al (2018), In this project, mix design is done as per the bureau of Indian standards, IS 10262- 1982 for M20 and M40 grade concrete with good degree of quality control .For the mix designed, specimens are cast and investigated experimentally. Preliminary attempt is made to study the effect of partial replacement of fine aggregate by steel slag in the properties of concrete. The properties involve of compressive strength, split tensile strength and flexural strengths of M20 conventional concrete by replacing the 0%, 10%, 20% and 30% of steel slag was added, tests were conducted on concrete cubes, cylinders and Beam to study compressive strength, split tensile strength, and flexural strengths. The results are compared with the normal conventional concrete. The strength properties of concrete are determined with the various replacement level of steel slag with fine aggregate. The use of steel slag aggregates in concrete by replacing natural aggregates is a most promising concept. Steel slag aggregates are already being used as aggregates in asphalt paving road mixes due to their mechanical strength, stiffness, porosity, wear resistance.

Santosh Ahirwar & prof. Rajeev chandak (2018), In this study series of the experiments have been conducted on concrete with the addition of Hypo Sludge as partial replacement of OPC. In the Hypo Sludge was used as partial replacement of OPC in different percentage that is 7.5%, 10%, 12.5% and 15% of the dry weight of the cement. The experiments were conducted on M-40 grade of concrete as per relevant IS-code practice based on the test results obtained from this study it is found that the higher strength is observed for the conventional concrete. However the strength attained with the mix of Hypo Sludge complies with the target strength up to a replacement of 10%.

Aravind B.Patil et al (2017), This research concludes that hypo sludge can be innovative supplementary Cementitious Construction Material. This project is concerned with experimental investigation on strength of concrete and optimum percentage of the partial replacement. By replacing the cement by 0%, 10%, 20%, 30%, 40%, 50%, 60%, and 70% of Hypo-sludge. And testing compression and split tensile strength of the cubes and cylinder's. And also the cost analysis indicates that percentage of cement reduction decreases the cost of concrete, but at the same time the strength also decreases beyond optimum addition of 30% hypo sludge.

E. Devakumar & A. Prof. C. Krishnaveni (2016), In this Experimental study we are replacing various quantity of Hypo sludge and M-Sand (10%, 15%, and 20%) individually in plain cement concrete of the grade M20, M25 and M30. And comparing the compressive strength of the concrete cubes with the conventional concrete cubes. Hyposludge was done individually by 10, 20 and 30 at each replacements strength of concrete came highest at 10% replacement.

S.T.Borole et al (2016), The present work is to use steel Slag as replacement for fine aggregate. The M30 concrete with high volume steel slag replacement for fine aggregate are examined in the present study. According to material properties compressive strength, flexural strength and split tensile strength were found experimentally. The results were compared with conventional concrete property. The results showed that replacing about 0%, 25 % and 50% of steel slag aggregates by volume for natural aggregates will not do any harm to concrete and also it will not have any adverse effects on the strength and durability.

Michael Nirmal.X. (2015), Characteristic Study of Concrete by Replacing Conventional Natural Agreegrates with Recycled Coarse Aggregate and Manufactured sand (M-Sand). In this experiment results that strength about 50-50% replacements of RCA and M-sand reaches the maximum strength about 23.96 % than compared to the conventional concrete. Hence the usage of RCA and M-sand are recommended as an alternate material to achieve the Optimum strength with optimum percentages of quantity.

Ravikumar H et al (2015), In this study concrete of M20, M30, M40, M50 grades were considered for a W/C ratio of 0.55, 0.45 ,0.37, 0.32 respectively for the replacement of coarse aggregate 30% 60% and 100% by steel slag. This study revealed that there is a improvement in compressive strength 5 to 10% for all the grades of concrete. There is 4 to 8% increase in split tensile strength in all grades of concrete. The Flexural strength of concrete is increase about 2 to 6% for all the grades .steel slag can be use upto 60% replacement in all grades of concrete. Full replacement by steel slag decreases the strength considerably.

G.Balamurugan and Dr.P.Perumal (2014), Study the Use of Quarry Dust to Replace Sand in Concrete – An Experimental Study his experimental study presents the variation in the strength of concrete when replacing sand by quarry dust from 0% to 100% in steps of 10%. M20 and M25 grades of concrete were taken for study keeping a constant slump of 60mm. The compressive strength of concrete cubes at the age of 7 and 28 days were obtained at room temperature. Also the temperature effect on concrete cubes at 100oC on 28th day of casting was carried out to check the loss of strength.

Ritesh Patil and M.Jamnu (2014), Study the various mechanical properties of concrete containing hypo sludge. Hypo sludge was used as a replacement to cement. Replacement percentages used during the present study were 10%, 15%, 20%, 25%. Compressive strength of cubes were found on 3days, 7days, and 28days. The 28th day flexural strength and split tensile strength of the specimens was found on the respectively beams and cylinders. It is found that replacement of hypo sludge have beneficial effects on the mechanical properties of concrete.

Jayraj et al (2013), Has done experimental investigation on strength of concrete and optimum percentage of the partial replacement by preparing a mix M20 grade was designed as per Indian Standard method and the same was used to prepare the test samples. In the test performed, the optimum compressive stress obtained by utilizing paper waste was at 30% replacement. The compared values of cost show gradual decrement in total cost of per cubic meter concrete. When government implement the projects for temporary shelters for who those affected by natural disaster, this material can be used for economic feasibility.

Jayesh kumar Pitroda et al (2013), They focused on investigation of strength of concrete and optimum percentage of the partial replacement by replacing cement via 10%, 20%, 30%, and 40% of Hypo Sludge. Keeping all this view, the aim of investigation is the behaviour of concrete while adding of waste with different proportions of Hypo sludge in concrete by using tests like compression strength and split strength.

Rushabh A Shah & Prof. Jayeshkumar Pitroda (2013), This paper presents the results of the cement mortar of mix proportion 1:3 in which cement is partially replaced with Hypo Sludge as 0%, 10%, 30% and 50% by weight of cement. Four sets of mixture proportions were made. First were control mix (without Hypo Sludge) with regional fine aggregate (sand)) and the other mixes contained Hypo Sludge obtained from J. K. Papers mill Pvt. Ltd, plant near Songadh, Tapi District in Gujarat State. The compressive strength has been obtained with partial replacement of Hypo Sludge with cement. Test results indicate the decreases in the strength properties of mortar with Hypo Sludge for strength at 7 &28 days as partial replacement with the cement in the cement mortar 1:3. So it can be used in non-structural elements in the low range compressive strength where strength is not required and low cost temporary structure is prepared.

Khalid Raza et al (2012), In this study the coarse aggregate (CA) were partially replaced with iron slag aggregate (ISA) at different proportions of 0%, 10%, 20%, 30% 40% and 50%. Compressive strength and Flexural strength on M40 grade of concrete with 0.45 water/cement ratio were investigated. In which to determine and check out the compressive strength, Flexural strength, and split tensile strength of concrete with various percentages of iron Slag Aggregate. The result has been found from the various tests which were compared with conventional concrete. Thus the use of iron slag in concrete could enhance the strength in concrete.

IV. FINDINGS FROM LITERATURE REVIEW

The research works carried out by different researchers are studied and evaluated, hence following gaps has been identified:-

- None of the investigators have studied the development of mix having both steel slag and paper sludge on any grade of concrete.
- Combine effect of waste materials on concrete has not seen till now . The effect was seen only indivisually.
- M25 concrete is most commonly used in India. But studies shows so little work on M25 concrete with paper sludge and iron slag.

V. EXPECTED OUTCOME

a) The addition of paper sludge and steel slag in concrete may lead in increase of compressive strength and will make concrete more economical.
b) The use of steel slag as replacement of fine aggregate in concrete is beneficial for the better workability and strength.
c) Previous studies shows that higher strength achieved with paper sludge replacement with cement is in percentage is relatively small (10-15%).
d) Hence fine aggregate replacement with steel stag will make concrete more economical and environmentally safe.The disposal and pollution problems which ultimately affects environment can be reduced through this concrete.
e) Hypo sludge reduces degradation and bleeding and Hypo sludge improves the setting of concrete due to presence of silica and magnesium thus improves the durability of concrete.
f) Light weight concrete will be achieved compare to conventional concrete.

REFERENCES

[1] Rushabh a. Shah & Prof. Jayeshkumar Pitroda "Effect of Hypo Sludge as partial replacement with cement in mortar" Journal of International Academic Research for Multidisciplinary , Volume 1, Issue 3, April 2013, (APRIL 2013)

[2] E. Devakumar , C. Krishnaveni "Experimental Studies on Cement Concrete by Partially Replacing Individually Cement by Hypo Sludge and Sand by M-Sand" International Journal of Innovative Research in Science, Engineering and Technology, Vol. 5, Issue 4, April 2016

[3] Sajad Ahmad, M. Iqbal Malik, Muzaffar Bashir Wani, Rafiq Ahmad "Study of Concrete Involving Use of Waste Paper Sludge Ash as Partial Replacement of Cement" IOSR Journal of Engineering (IOSRJEN), Vol. 3, Issue 11 (November. 2013)

[4] Ravikumar H, Dr. J.K. Dattatreya, Dr. K.P Shivananda "Experimental Investigation on Replacement of Steel Slag as Coarse Aggregate in Concrete" Journal of Civil Engineering and Environmental Technology, Volume 2, Number 11; April – June, 2015 pp 58 – 63.

[5] Santosh Ahirwar, Dr. Rajeev Chandak "Effective use of Paper Sludge (Hypo Sludge) in Concrete" IJEDR 2018 | Volume 6, Issue 2 | ISSN: 2321-9939.

[6] Chetan Khajuria, Rafat Siddique "Use of Iron Slag as Partial Replacement of Sand to Concrete" International Journal of Science, Engineering and Technology Research (IJSETR), Volume 3, Issue 6, June 2014.

[7] Divya Patel1 Namish Mehta "A Review: To Enhance the Selected Properties of Concrete as a Partial Replacement of Cement by Hypo Sludge" IJSRD - International Journal for Scientific Research & Development| Vol. 5, Issue 08, 2017 | ISSN (online): 2321-0613.

[8] Y.D. Shermale, M.B .Varma "Effective use of Paper Sludge (Hypo Sludge) in Concrete" IJSRD - International Journal for Scientific Research & Development| Vol. 3, Issue 08, 2015 | ISSN (online): 2321-0613

[9] Cherian Varkey, Jefin P John, Neema V N, Namitha Joshy "study on utilization of waste paper sludge by partial replacement of cement in concrete" International Research Journal of Engineering and Technology (IRJET), Volume: 03 Issue: 05 | May-2016.

[10] Harsh K. Mistry, Kaushal D. Patel, kunj B. Patel, Kahan P. Ramani "A review on the study of behaviour wastepaper sludge ash as a partial replacement of cement" International Journal of Civil Engineering and Technology (IJCIET), Volume 8, Issue 4, April 2017.

[11] Mamta B. Rajgor, Jayeshkumar Pitroda "A Study on Paper Industry Waste: Opportunities for Development of Low Cost Concrete in Indian Context" International Journal for Scientific Research & Development, Volume : 2 | Issue : 2 | Feb 2013 • ISSN No 2277 – 817

[12] Jayeshkumar Pitroda, L.B.Zala, F S Umrigar "Durability of concrete with Partial Replacement of Cement by Paper Industry Waste (Hypo Sludge)" International Journal of Innovative Technology and Exploring Engineering (IJITEE) ISSN: 2278-3075, Volume-2, Issue-3, February 2013