International Journal of Technical Innovation in Modern Engineering & Science (IJTIMES)
Impact Factor: 5.22 (SJIF-2017), e-ISSN: 2455-2585
Volume 5, Issue 06, June-2019

STUDY ON EFFECTIVE UTILIZATION OF PAPER PULP AND CRUSHER DUST IN CONCRETE

Shahzad khan [1], Sohit Agarwal [2], Dr. Mukesh pandey [3]

[1]*Research Scholar, CE Department, ITM University, Gwalior, India*
[2]*Assistant Professor, CE Department, ITM University, Gwalior, India*
[3]*Professor, CE Department, ITM University, Gwalior, India*

ABSTRACT: ***The economy, efficiency, durability, mold-ability, and rigidity of concrete make it an attractive material for a wide range of structural applications. Paper waste and crusher dust have been utilized as a building material for a considerable length of time particularly in lightweight sustainable concrete development and thereafter researches have been carried out to build up the mechanical properties of the composite like compressive, tensile and flexural strength. Recent studies regarding the utilization of paper pulp and crusher dust can balance the ecological condition by reducing air pollution, deforestation, and cost reduction. In this paper, the literature results are reviewed and the conclusion is drawn that newly developed concrete by using the paper pulp and crusher dust is increased by 5% to 10% and is more sustainable as compared to conventional concrete.***

Keywords: Paper Pulp, Crusher dust, Structural Strength, Sustainability.

I. INTRODUCTION

In today's world, concrete consumption is more than any other man-made building material; therefore it creates a scope of incorporation of sustainable practices by using waste material instead of natural resources. When the highlight is drawn towards India's cement industry, it is observed that India itself is the second largest producer as well as consumer of cement in the world [1]. Secondly, sand from natural resources is also getting depleted on a large scale, hence becoming expensive to transport from the sources [2]. These scenarios create the potential to find alternate sustainable ingredients associated with concrete such as paper pulp and crusher dust. Recent studies have acknowledged that paper sludge shows similar properties like cement because of silica and magnesium properties and crusher dust can become an alternate economical solution for sand because of high workability and strength [3]. Since paper mill sludge is a noteworthy monetary and ecological issue for the paper board industry because the recycling of paper waste leaves the weak fibers which are taken to disposal sites and hence it creates air pollution.

a. Paper pulp

Paper pulp use in the concrete industries is becoming an alternate artificial pozzolans for conventional concrete. The predominant reason behind the utilization of paper waste is because it offers cementitious properties. Chemical analysis supported by XRF (Energy Dispersive X-ray Fluorescence Spectrometer) scan data shows paper pulp mainly contains SI (60%) and Ca (14%) which is shown in Table 1, whereas the results of proximate and ultimate analysis is shown in Table 2 and Table 3 [4]. Various investigations have supported that its Fibrous nature gives exceptionally high retaining and compressive quality, whereas dried paper waste absorbs water for 24 hours and remains to unsettle by mechanical intends to achieve consistency. To make the profitable outcome from the paper pulp waste, researchers are confronting genuine tests, and it is noted that newly developed concrete results in light weight, economical, increment in the structural strengths etc. [5] [6] [7].

Table 1 - Elemental Analysis of Paper Pulp [4]

Elements	O	Ca	Si	Al	Mg	S	Ti	K	Fe	Na	Cu	P	Cl
Paper Pulp %	15.83	14.94	60.57	2.06	3.59	1.07	0.15	0.16	0.92	0.22	0.05	0.03	0.41

Table 2 - Proximate Analysis of Paper Pulp [4]

S. No	WT. (G)	Moist %	Ash %	Volatile Materials %	Free Carbon %	GCV Kcal/kg
1	420	5.84	40.6	44.7	8.9	2372

Table 3 - Ultimate Analysis of Paper Pulp [4]

S.NO	WT. (G)	C (%)	H (%)	N (%)	S (%)	O (%)
1	420	22.7	2.5	0.3	0.4	23.6

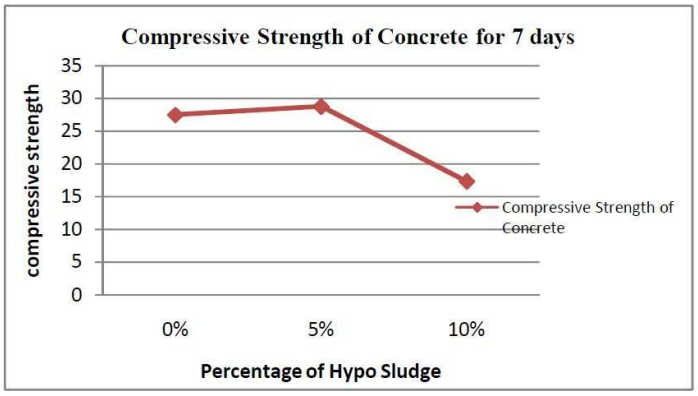

Figure 1 Comparison of Compressive strength of concretes for 7 days [8]

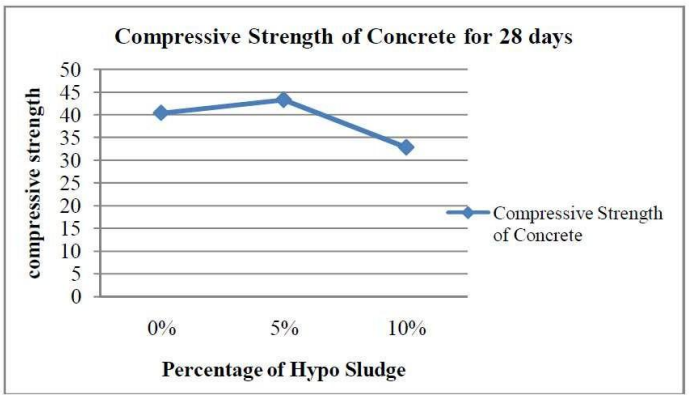

Figure 2 Comparison of Compressive strength of concretes for 28 days [8]

b. Crusher dust

Stone dust is such an elective material which can be adequately utilized in construction as partial replacement of natural sand [9]. This is a waste material obtained from the aggregate crushing plant. Stone dust is well suitable for its quality and economy over ordinary sand for mid-range review concrete.

Aggregate can be adequately replaced with stone dust approximately by 40%, and in addition to that, the compressive strength of the concrete mix increases by 22% [10]. The present study aimed to use stone dust as fine aggregate in concrete instead of natural fine aggregate and it improves the pozzolanic reaction, micro-aggregate filling, and concrete durability. To support this, an experimental program on conventional concrete (red) versus partial replacement of crusher dust (blue) is performed by researcher, and the results are shown in Figure 3.

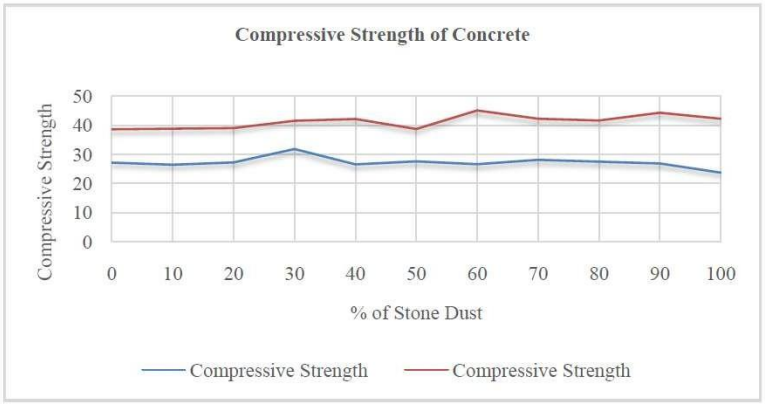

Figure 3 Compressive Strength of Concrete Cubes with Varying Percentage of Stone Dust [10]

II. LITERATURE SURVEY

Santosh et al. (2018) [3]. They performed an experimental analysis in which specimen of concrete is prepared with the composition of 7.5%, 10%, 12.5% and 15% of hypo sludge which is used in order to reduce the weight of concrete cement mechanical property also known as compressive strength. It is evaluated on cubes with dimension 150 x 150 x 150 mm and their analysis results are obtained on the basis of strength after storing it for 28 days.

Sumit et al. (2013) [4]. They used the paper-mill pulp in the concrete formulation. The cement is replaced by waste paper sludge in the range of 5% to 20% by weight for M-20 &M-30 mix. The concrete mixture produced is compared in terms of slump & strength with the conventional cement. As a result, they get an increase of 10% strength in compressive, splitting tensile and flexibility.

R. Srinivasan et al. (2010) [5]. Their examinations were undertaken to deliver minimal effort concrete by mixing different proportions of cement with hypo sludge. This project is worried about test examination on quality of concrete and ideal level of the partial replacement by replacing cement via. 10%, 20%, 30%, 40%, 50%, 60% and 70% of hypo sludge.

G.L. Abhishek. (2017) [6]. They performed an experimental analysis which is focused on the examination of the concrete quality and optimum percentage by the partial replacement of cement with hypo sludge for around 10%, 20%, 30%, and 40%. Therefore, different test compressive strength, tensile strength, and flexural strength are carried out after the addition of hypo sludge in it.

Lodhi et al. (2015) [7]. They investigated the utilization of paper waste as extra material in concrete mixes to be utilized for a housing project for which it must be guaranteed that the resulting concrete has the best possible mechanical quality. Concrete mixes containing the different substance of the waste are prepared and basic characteristics, for example, compressive strength and water absorption are determined and compared with a control mix. Four concrete mixes with 0%, 10%, 15% and 20% of paper waste as extra material to the concrete were set up for M-25 concrete.

Katru Sai Teja. (2017) [8]. They performed the experimental analysis by investigating the partial replacement of cement in concrete by using Hypo sludge. They prepared three different samples by replacing 5%, 10%, and 15% cement by hypo sludge and afterwards the main objectives were to check the compressive strength and split tensile strength. The outcomes of the investigation showed that at 5% replacement they have noticed that the strength of concrete has increased by 6% to the nominal mix of M- 30, whereas on further increment in percentage of Hypo sludge the strength of concrete decreases.

Lohani T.K. et al. (2012) [9]. In search of better alternative sand quarry dust can be an economic alternative. In the experiment, M-20 grade concrete replaced of 0%, 20%, 30% and 40% of quarry dust and gave through different tests like slum test, compressive strength, modulus of elasticity, water absorption, etc.

Brajesh et al. (2015) [10]. This study shows that the suitability and potential use of stone dust in the concrete mix as fine aggregate in place of natural sand. The result shows that stone dust is one of the alternatives of natural sand which increases the strength of the material.

Cherian et al. (2016) [11]. They performed an experimental analysis in which cement is replaced partially with paper sludge which was 5% by weight. They found that by using paper sludge reduced the disposal and environmental problems in comparison with other cement. They partially replaced paper sludge in place of cement in concrete by 2.5%,

5%, and 7.5% for M-25 grade. They performed compressive strength test after storing for 28 days and further the results obtained from analysis are compared with the conventional concrete.

Tarun et al. (2004) [12]. They proportioned concrete mixtures which contained residuals which showed higher compressive and splitting tensile strength as compared to concrete without residuals, they observed a high correlation between the density and strength of concrete containing residuals.

S. Selvarani. (2016) [13]. They performed an experimental analysis in which hypo sludge mechanical properties such as compressive and split tensile strength were tested and evaluated after storing it for 28 days. They found the expansion of hypo sludge of about 20% and increment in the mechanical properties of hypo sludge and decrement in the quality of hypo sludge. They performed a trial examination in which cement is replaced partially with hypo sludge with around 5%, 10%, 15% and 20% and their mixed design is carried out for concrete with M-25 grade.

Seyyedeh et al. (2014) [14] They investigated the usage of pulp and paper industry wastage in the concrete mix. They prepared concrete mix with wastes, cement, aggregate, and water which is compared in terms of strength with the conventional concrete. The results at the end are formulated in order to suggest an alternative.

V.V.S. Sarma et al. (2016) [15] They performed research work on the properties of hypo sludge when used as a partial replacement for ordinary Portland cement (OPC) in concrete. They replaced OPC with hypo sludge by weight at 0%, 5%, 10%, 15%, 20% and 25%. They carried out compacting factor test on concrete while compressive strength test on hardened 150 mm concrete cubes after 7, 14 and 28 days cured in water. It resulted in decreased compacting factor and compressing strength also decreased as the percentage replacement of OPC with hypo sludge increased.

Radhikesh et al. (2010) [16]. They performed a parametric experimental study for producing paving blocks using crusher dust. They replaced physical and mechanical properties of paving blocks with fine aggregate (sand) by various percentages of crusher dust and is investigated their results showed them that the replacement up to 50% by weight has a negligible effect, while there is a saving of 56% of the money.

Lalit Kumar et al. (2015) [17]. In their experiment, they crushed stone dust which was effectively used to replace natural sand or we can say fine aggregate in concrete. It is found that there is an increase in compressive strength, flexural strength and tensile strength of concrete.

III. CONCLUSION

According to the research performed by partial usage of paper pulp and crusher dust in place of cement and sand respectively, several outstanding results are drawn related to structural strength, density, sustainability, etc. The results obtained with the help of literature study and the experimental work performed by the researchers are enumerated as the replacement of 5% cement by waste paper results in 10% and 15% increment in compressive strength at 7^{th} day and 28^{th} day respectively [18]. Splitting tensile and flexural strength increases up to 10% at the age of 28 days [4]. As waste paper sludge quantity increases, there is an increment observed in the percentage of water absorption [18]. Re-use of the waste paper pulp makes concrete more sustainable [5]. Compressive strength of cubes with stone dust as fine aggregate accomplishes maximum value at 60 % replacement level of natural sand with stone dust [10].

REFERENCES

[1] M. R. Sharma, "Cement Industry Trends Report," in *The Energy and Resources Institute*, New Delhi, 2017.

[2] S. R. Q. Dr. A.D. Pofale, "Effective utilization of crusher dust in concrete using portland pozzolana cement," *International Journal of Scientific and Research Publications,* vol. 3, no. 8, 2013.

[3] D. R. c. Santosh Ahirwar, "Effective use of paper sludge (Hypo Sludge)," *International journal of engineering development and research (IJEDR),* 2018.

[4] S. R. Sumit A Balwaik, "Utilization of waste paper pulp by partial replacement of cement in concrete," *International Journal of engineering research and applications (IJERA),* vol. 1, no. 2, pp. 300-309, 2013.

[5] K. S. M. R. Srinivasan, "Experimental investigation in developing low-cost concrete from paper industry waste," *Gheorghe Asahi din IASI,* 2010.

[6] G. Abhishek, "Experimental study on the behaviour of paper sludge concrete," *Institute of integrative omics and applied biotechnology journal (IIOAB),* vol. 8, no. 3, pp. 73-78, 2017.

[7] A. B. Lodhiravindrasingh, "Application of paper waste in cement concrete," *International journal of engineering research and applications (IJERA),* 2015.

[8] K. U. K. P. V. S. Katru Sai Teja, "HYPO SLUDGE AS A PARTIAL REPLACEMENT," *International Journal of Civil Engineering and Technology,* vol. 8, no. 4, p. 1645–1651, 2017.

[9] J. S. Lohani T.K. Padhi M, "Optimum Utilization of quarry dust as partial replacement of sand in concrete," *International Journal of applied science and engineering research (IJASER),* vol. 1, no. 2, 2012.

[10] A. K. S. V. S. Brajesh Kumar Suman, "Stone dust as fine aggregate replacement in concrete and its effect on compressive strength," *International journal of advances in engineering and emerging technology (JANET),* vol. 7, no. 4, pp. 220-224, 2015.

[11] J. P. J. N. V. N. Cherianvarkey, "Study on the utilization of waste paper sludge by partial replacement of cement in concrete," *International research journal of engineering and technology (JET),* vol. 03, no. 05, May 2016.

[12] T. S. F. Y.-m. c. Tarun R. Naik, "Use of pulp and paper mill residual solid on the production of cellulite," *Cement and concrete research,* 2004.

[13] M. S. Selvarani, "Structural Performance of concrete by partial replacement of cement with hypo sludge," *International Journal of advanced research trend in engineering and technology (IJARTET),* vol. 3, no. 2, March 2016.

[14] D. Y. K. N. R. M. G. N. Seyyedeh Fatemeh Seyyadalipour, "Study of the utilization of pulp and paper industry wastes in the production of concrete," *International Journal of engineering research and applications (IJERA),* 2014.

[15] P. R. D. N. A. V.V.S. Sarma, "Durability studies on concrete with hypo sludge as partial replacement of cement," *International journal of engineering research and application (IJERA),* 2016.

[16] A. K. D. M. N. Radhika P. Nanda, "Stone crusher dust as a fine aggregate in concrete for paving blocks," *International Journal of civil and structural engineering (IJSCER),* vol. 1, no. 3, 2010.

[17] E. A. S. Er. Lalit Kumar, "A study on the strength of concrete using crushed stone dust as a fine aggregate," *International Journal for research in applied science and engineering technology (IJRASET),* vol. 3, no. 1, pp. 308-316, 2015.

[18] M. I. M. M. B. W. R. A. Sajad Ahmad, "Study of Concrete Involving Use of Waste Paper Sludge Ash as Partial Replacement of Cement," *IOSR Journal of Engineering,* vol. 3, no. 11, pp. 06-15, 2013.