

Optimization of Hypo Sludge Ash in Design Mix Concrete: A Review

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Abstract

Tremendous amount of waste are generated every year from paper mill industries and are being dumped at nearby places creating a big distraction. If these waste are managed and are utilized by finding some alternative uses it would be very beneficial to the society. One such waste produced from paper mill industries is Paper sludge ash technically known as Hypo Sludge Ash. This paper deals with the waste produced from the paper mill industry in terms of Hypo Sludge Ash (HSA) as a replacement to cement. This Hypo Sludge Ash can be used as a replacement to cement in varying proportions such as 0%, 5%, 10%, 15%, 20% and very convincing results can be obtained. Grade concrete is used as per the requirement and accordingly mix design is prepared. Different tests are performed for testing the efficiency of concrete. Concrete cubes of size 150*150*150mm is prepared for calculation of compressive test using compression testing machine (CTM), with curing at 7, 14, 28 days and concrete beams of size 100*100*500 mm is prepared for Flexural testing using Flexural Testing Machine (FTM) for curing at 28 days along with this water absorption and accelerated curing also yields good results. It was found that compressive strength and flexural strength increased at 5%, 10% replacement of cement with Hypo Sludge Ash.

Keywords: Hypo Sludge Ash, Compression Testing Machine, Flexural Testing Machine

I. INTRODUCTION

Industrialisation is key to success for every country. It helps in strengthening of economic sector which is hence developing the country. But to unlock this success, country should be efficient to overcome its consequences too. The main problem regarding industrialisation is disposal of waste produced from industries, which is again a challenging job. Rapid industrialization plays an important role in polluting the environment and causes severe degradation in hydrosphere and atmosphere. Water used in industries creates a waste that has potential hazard for our environment because of the introduction of various contaminants such as heavy metals into soil and water resources.

Environmental contamination with metals through industrial wastes is one of the major health concern of developing countries. Metal pollutants can easily enter the food chain if heavy metals contaminated soils are used for the production of crops. The accumulation of metals in an aquatic environment has direct consequences to man and ecosystem.

Different types of wastes are produced from different industries such as mining waste, biomedical waste, chromite industry waste, paper industries produce fly ash and paper pulp, coal ash from thermal power stations, iron manufacturing industry produce blast furnace slag, lignin which is principle constituent of wood is the waste produced from wood based industry, silica fume which is produced from ferrosilicon producing country, food industries produce different types of waste too, etc.



Fig. 1: Hypo Sludge Ash

As enlisted above, numerous kinds of wastes are produced from various sources. So now it is need of the hour to overcome effect of waste on human health and environment. As stich in time saves nine, so everyone should think of appropriate measures to overcome its effects. Disposal of waste should now be done in smarter ways. The waste instead of disposing in environment which again is hazardous, we should use them where they can be used as raw material.

Hypo-sludge is one such industrial waste obtained from paper industries, amount of waste produced is in enormous quantity and proper disposal is prime duty so the replacement of sludge with different variation of cement could be done because of the cementitious property of sludge with is obtained on incineration of this sludge ash.

A. Properties

Properties of waste paper sludge ash also called as Hypo Sludge Ash may vary depending upon the quality of paper produced in that particular paper industry. Quality of sludge finally depends upon the number of times the materials are being recycled to produce paper and different industries may have different standards to achieve the end products, but still some common properties that Hypo Sludge Ash contains in an average are as shown in table no-1.

Table - 1
Properties of Hypo Sludge Ash

Sr. No	Chemical Properties	Hyposludge Ash (% by Mass)
1	Silicon Dioxide	5.28%
2	Calcium Oxide	47.84%
3	Magnesium Oxide	6.41%
4	Sulphur Trioxide	0.19%
5	Aluminium Oxide	0.09%
6	Ferric Oxide	0.73%

B. Applications

- Hypo Sludge Ash can be used as a alternative material for production of concrete of different grades.
- Waste Paper Sludge ash can also be used for making of bricks.
- Hypo Sludge Ash can be used as a alternative material for plastering work and other minor repair works.
- It can also be used for temporary construction work where strength is not the major parameter.

II. LITERATURE REVIEW

Sajad Ahmad, M. Iqbal Malik, Muzaffar Bashir Wani, and Rafiq Ahmad in “Study of Concrete Involving Use of Waste Paper Sludge Ash as Partial Replacement of Cement” presented that, waste produced from cement manufacturing industries are growing day by day so we have come to the peak period to find out such a sources that help to produce greener concrete. It is found that cement industries are the major sources that produce greenhouse gases leading to its emissions into environment. So they found out one such material called Waste paper sludge ash which is used as replacement to cement to produce concrete. Mix Design for M-25 grade concrete is used in project work. Concrete cubes were prepared and compression tests was carried out and concrete beams were prepared for testing flexural test along with that water absorption and dry density tests were also carried for checking out the weight reduction and water absorption. It was found that concrete strength increased at 5% replacement of cement with waste paper sludge ash and along with this water absorption was also found to be increased.

Saveria Monosi, Daniela Sani and Maria Letizia Ruello in “Reuse of Paper Mill Ash in Plaster Blends” presented that as paper mill ash is a waste and is light weight, it can be used in manufacturing of plaster bends. This waste if used with Portland cement, limestone powder, natural sand with a maximum diameter of 2mm, and a silane-based hydrophobic powder can be used in manufacturing of cement mortar which can be used in the production of dry-cast concrete products such as masonry blocks and paving stones, wet-cast precast products, structural-grade concrete. As different paper mills produce different quality of paper there properties may vary in nature. Paper ash used were provided by Burgo Group" paper mills (Mantova, Italy). Mechanical strength found ranged from 4 to 10MPa with specific gravity between 1150 and 1350 Kg/m³. Paper ash being light weight in nature can be used in various field applications such as filling of temporary joints and other minor repair work.

Sumit A Balwaik and S. P. Raut in “Utilization of Waste Paper Pulp by Partial Replacement of Cement in Concrete” presented that waste produced out of paper mill industries are in large amount and can be used in production of concrete production. Two types of design mix were used for concrete production M-20 and M-30. Tests like compression test, splitting tensile strength, flexural strength were carried for curing of 14 and 28 days and it was found that the end results showed convincing results. Increase in strength by 10 % was found for replacement upto 5%. However after 5% replacement there was continues decrease in strength. The waste that were utilized were first tested for Elemental, Proximate and Ultimate analysis for finding the constituents of Paper mill ash and actual detailing was made to match with the properties of cement and finding out better replacement alternatives. Different sets of tests were performed on fresh and hardened concrete and finding out slump values for different replacement ranging from 5% to 20%. Slump found to be decreased beyond 5 % replacement Also by using waste paper ash disposal cost and land which is used for disposal can well managed if they are used in various building construction techniques.

Apurva Kulkarni, Samruddha Raje, Juned Peerzada and Mamata Rajgor in “A Miniscule Endeavour for Accomplishing Hypo Sludge Fly Ash Brick in Indian Context” presented that as the waste produced out of paper industries can be recycled only a limited number of times so these low quality fibres which are treated as a waste can be used for construction work. This waste contains a large amount of lime so they used these Hypo sludge ash for production of Fly Ash Bricks. They replaced lime with

different proportions such as 5, 10, 15, 20% with HSA. They found good results at 5 % replacement for production of Fly Ash Bricks.

Dr. L.B. Zala and Dr. F. S. Umrigar in “Utilization of Hypo Sludge by Eco-Efficient Development of Rigid Pavement in Rural Roads” presented that Hypo Sludge Ash can be used for rigid pavement construction in rural areas. By using this waste road construction may become cost efficient and at the same time best utilization of waste could also be made. They found good results for the replacement.

Gabriele Fava, Maria Letizia Ruello and Valeria Corinaldesi in “Paper Mill Sludge Ash as Supplementary Cementitious Material” presented that, as the waste produced out of paper industries are on large scale now-a-days so gainful utilization should be made, so they targeted to use this waste material as a supplementary cementitious material. Material properties of this paper mill ash were tested and they used it for preparation of mortars and other concrete manufacturing. They found excellent results at 10% replacement of cement with paper mill sludge ash.

III. CONCLUSIONS

- Strength found to be increased for initial replacement of cement with Hypo sludge Ash for instance up to 10% replacement.
- By using Hypo sludge Ash greener concrete can be produced.
- Utilization of waste and disposal cost are reduced.
- Low cost houses can be constructed using waste paper ash by reducing the cement content.
- By using suitable admixture such as superplasticizers, the problem of water absorption can be reduced.
- Weight of concrete member can be reduced by using paper mill sludge ash which ultimately helps in reducing the dead load of the structure.

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