Production of ecofriendly economical blocks applying admixture and its affordable distribution to end users

Abstract

Contaminated and unused dredged sediment may turn into national wealth if it is properly utilized. The main purpose of this research is to investigate the minimum cement content required with an appropriate water-to-cement ratio (w/c) to meet given workability, strength, and durability requirements in a concrete pavement; and to reduce carbon dioxide emissions, energy consumption, and costs.

Along with a small ratio of Portland cement (17 to 20 percentage), a negligible percentage (0.1 to 0.5) of admixture has been used during the research at Housing and Building Research Institute. Stabilization or solidification method was conducted to remove toxic and organic contaminants. Having been made the raw blocks manually and automatically, blocks were cured for 28 days to check the ultimate compressive strength, water absorption. From the perspective of cost and benefit, we have calculated that it outright cost-effective and environment gets enormous benefit. This new, effective idea and solution can certainly lessen the problem of dredging sediment disposal and produce eco-friendly construction materials.

Introduction

In recent decades, huge success has been achieved by using the Chemical and Mineral admixtures for concrete construction. A proper use of admixtures offers certain beneficial effects to concrete. Admixtures are those ingredients in concrete other than Portland cement, water, and aggregates that are added to the mixture immediately before or during mixing. Air-entraining admixtures, Water-reducing admixtures, Plasticizers, accelerating admixtures, retarding admixtures, Hydration-control admixtures, Corrosion inhibitors, Shrinkage reducers, Alkali-silica reactivity inhibitors, coloring admixtures, Miscellaneous admixtures such as workability, bonding, damp proofing, permeability reducing, gas-forming, ant washout, foaming, and pumping admixtures

The major reasons for using admixtures are-

(i)To reduce the cost of concrete block.

(ii) To achieve certain properties in concrete more effectively than by other means.

(iii) To maintain the quality of concrete during the stages of mixing, transporting, placing, and curing in ad- verse weather conditions.

(iv) To overcome certain emergencies during concreting operations

Background of Chemical Admixtures

It is as old as the history of concrete. It embraces a very vast field. But a few type of admixture called water reduces or High Range Water Reduces, generally referred as plasticizers & super plasticizers, are of recent interest. They are specifically developed in Japan and Germany around 1970. Later on they were made popular in USA and Europe even in Middle East and Far East.

To better Understand the Admixtures, Review of most important admixtures is given below

1) Plasticizers: Plasticizers were commonly known as Water Reducers. These can help the difficult condition for obtaining higher workability without using excess of water. The practice of using plasticizers for almost all the reinforced concrete and even for mass concrete to reduce the water requirement for making concrete of higher workability or flowing concrete. These are used in the amount of 0.1% to 0.4% by weight of cement. At these doses, at constant workability the reduction in mixing water is expected to be of the order of 5% to 15%. This naturally increases the strength.

2) Superplasticizers or sometimes (High Range Water Reducers): These are the improved version of plasticizers and are chemically different from normal plasticizers. Use of this permit the reduction of water to the extent upto 30% without reducing workability as reduction up to 15% in case of plasticizers. These were developed for use where the amount of water reducer admixtures required to reach a desired slump or flow resulted in unacceptable reductions of other critical properties. High range water reducers are classified as: Sulphonated Malanie formaldehyde condensater (SMF), Sulphonated naphthalene formaldehyde condensates (SNF), Modified lignosulphonate (MLS) , other types which may include sulfonic acid esters or carbohydrates esters (carboxylates). Superplasticizers deflocculate the cement particles in a similar manner but much more efficient than conventional water reducer admixture.

3) Retarder: Retarder is an admixture that slows down the chemical process of hydration so that concrete remains plastic and workable for a longer time than concrete without the retarder. These are used to the accelerating effects of overtake high temperature on setting properties of concrete in hot weather concreting. The most commonly used retarder is Calcium Sulphate. In addition to gypsum there are number of other materials found to be suitable for this purpose. They are: Starches, Cellulose products, Sugar, acids or salts of acids. Other additives which has been successfully used as retarders are Ligno Sulphonic acids their salts, hydroxylated Carboxylic acids and their salts. They also increase 28 strength by 10 to 20%.

4) Accelerators: Accelerating admixtures are added to concrete to increases the rate of early strength development of concrete. In past decades commonly used material as accelerator was Calcium Chloride but it is not in use. Inspite, of some soluble carbonates, silicates flurosilicates and some of the organic compounds such as triethenolamine are used. In the recent studies done by our chemists, researchers, engineers and designers. Calcium Chloride is harmful for reinforced concrete. It may be used for plain cement concrete in comparatively high dose. The accelerating materials added to plasticizers or superplasticizers are triethenolamine chlorides, Calcium nutrite, nitrates and flousilicates etc.

5) Air- Entraining Admixtures: Since 1930 there has been an ever-increasing use of air entrained concrete all over the world especially in the United States and Canada. These are made by mixing a small quantity of air entraining agent or by using air entraining cement. These air entraining agents incorporate millions of non-coalescing air bubbles, which will act as flexible bull bearing and will modifies the properties of hardened concrete regarding its resistance to frost action and permeability. Natural wood resins, Animal and vegetable fats and oils, and such as tallow, olive oil and their fatty acids such as steric and obic acids, various wetting agents such as alkali silica or sulphated and animal and vegetable fatty acids, Miscellaneous materials such as the Sodium salts of petroleum Sulphonic acids, hydrogen peroxide and aluminium powder are the types of air entraining agents used for making air entrained concrete.

HBRI Research Work

HBRI has worked on developing the quality sand cement blocks that are ecofriendly and cheap at the same time. To make the block cheap and affordable, the main concern is the cost of raw materials. Common practice is to use stone dust and Sylhet sand as aggregate, which are costly. If sand-cement block is made without these raw materials, blocks loose the required compressive strength for construction purpose. So HBRI has taken the challenge to find out the most suitable chemical admixture which will enable us to use the cheaper alternatives to the costly raw materials but at the same time to gain required strength.

Keeping in mind these goals we started working for the production of the following Non-fired bricks from dredged Sand.

A. Non-Fired Sand Cement Solid Block
B. Non-Fired Sand Cement Hollow Block

Raw Materials

Raw materials used for Non-Fired Sand Cement Solid Block & Non-Fired Sand Cement Hollow Block:

I. Dredged Sand (FM:0.97-1)
II. Cement(OPC/PCC)
III. Admixture X-710/ Admixture H-234
IV. Tap Water

Fig-1: Dredged Sand

Fig-2: Cement

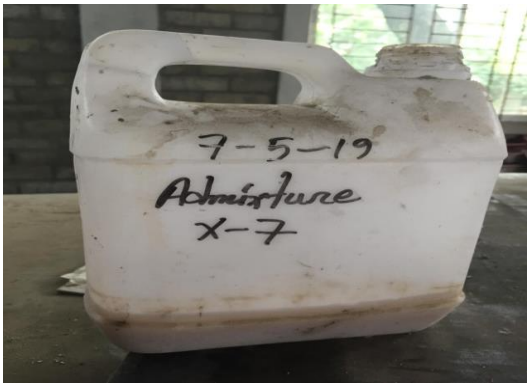

Fig-3: Admixture X-710

Fig-4: Tap Water

Manufacturing process of Sand cement blocks

The blocks are made in a Hydraulic press machine. Compaction pressure of Hydraulic Hollow machine is about 2000 psi. The usual size of blocks was cast (400×200×100mm). Composition of block is dredged sand, Cement (PCC) admixture and water. Where the water reducing agent is added while mixing of materials. Average Twenty block mould sample were casted. The manufacturing process of blocks usually consists of three operations i.e mixing the ingredients in pan mixture placing of mixed materials in moulds, then the mould has get hydrolic compaction pressure about 2000 psi by hydrolic compaction pressure machine and finally molded mixture material can transported to drying / to give covered internal curing into polyethylene. After 24 hours later block is test. Then the other block was placed ground water for 28 days for proper curing.

Flow Chart Diagram for Block Manufacturing Process:

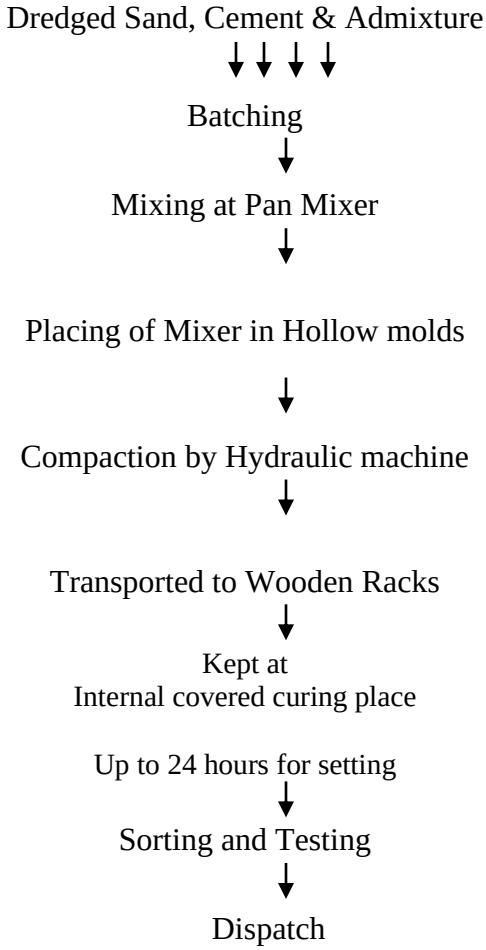

Fig-5: Mixing of raw materials

Fig-6: Mixing of Admixture with water

Fig-7: Admixture adding with raw materials

Fig-8: Processing of block

Fig-9: Non-Fired Sand Cement Solid Block

Fig-10: Non-Fired Sand Cement Hollow Block

Laboratory Tests

To ensure the quality of Non-fired sand cement blocks the following tests have been carried out both at HBRI Physical Test Research Laboratory (PTRL) and Chemical Test Research Laboratory (CTRL):

- Size and Weight
- Compressive Strength
- Water Absorption
- Efflorescence

Results and Discussions

Size and Weight

For Non-Fired Sand Cement Solid Block:

Size: 9.5×4.5×2.75 inch

Weight: 3.5 kg

For Non-Fired Sand Cement Hollow Block:

Size: 400×200×100 mm

Weight: 10.21 kg

Compressive Strength

The results of Compressive Strength of Non-Fired Sand Cement Solid Block and Non-Fired Sand Cement Hollow Block have shown in the following Table-1 and Table-2 respectively:

Table-1: For Non-Fired Sand Cement Solid Block

Name of Admixtures	Ratio of Cement and Dredged Sand	Compressive Strength at (psi)		
		7 days	14 days	28 days
X-710	1:4	1800	2000	2300
	1:5	1600	1900	2100
	1:6	1100	1300	1600
H-234	1:4	2400	2600	3100
	1:5	2200	2300	2500
	1:6	1200	1400	1700

Table-2: For Non-Fired Sand Cement Hollow Block

Name of Admixtures	Ratio of Cement and Dredged Sand	Compressive Strength at (psi)		
		7 days	14 days	28 days
X-710	1:4	560	1150	1650
	1:5	450	980	1450
	1:6	400	850	1250
H-234	1:4	842	1340	1700
	1:5	682	1280	1650
	1:6	560	870	1240

Water Absorption

For Non-Fired Sand Cement Solid Block: 4-6%

For Non-Fired Sand Cement Hollow Block: 4-5%

Efflorescence

For Non-Fired Sand Cement Solid Block: Nil

For Non-Fired Sand Cement Hollow Block: Nil

Conclusion

HBRI has successfully completed the project “Production of ecofriendly economical blocks applying admixture and its affordable distribution to end users’’. To make the block cheap and affordable, the main concern is the cost of raw materials. Common practice is to use stone dust and Sylhet sand as aggregate, which are costly. HBRI has developed various chemical admixtures. Due to use of this chemical admixture in sand cement block, it is not necessary to use stone dust and Sylhet sand as an aggregate which are costly. We can get desired compressive strength only by using chemical admixtures (0.1% total mass of cement), cement and cost-effective dredged sand. On the other hand, this research has resulted in less use of cement. So HBRI is successful on developing sand cement blocks that are ecofriendly and cheap at the same time.