ENVIRONMENTAL GUIDELINES FOR READY MIXED CONCRETE PLANTS

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Abstract- Cement and steel production accounts for almost 19-20 % of CO_2 emissions in India. Due to exponential growing in urbanization and industrialization, by products from the steel industries such as GGBS are becoming an increasing concern for recycling and waste management. At same time, studies have revealed usage of GGBS in concrete as a partial replacement for OPC have increased the compressive strength, tensile strength, durability and decreases the permeability, embodied energy and cost per cubic meter. By knowing the numerous advantages of industrial by products, Ready-mixed concrete (RMC) industries have partially replaced the cement with Fly Ash, GGBS, ultrafine GGBS or Silica Fume, which are by-products of other industries.

Keywords- GGBS, OPC, RMC, fly ash, silica fume.

1.1 Introduction

Concrete is a versatile & most widely used material in civil engineering constructions. Based on Method of production concrete can be classified as Site Mixed Concrete & Ready Mixed Concrete (RMC).

The first commercial delivery of RMC was made in Baltimore, USA in 1913 and the first revolving drum type transit mixer, of a much smaller capacity than those available today, was born in 19263. By the late 1920s and 1930s, RMC was introduced in some of the European countries In many other countries of the world, including some of the developing countries like Taiwan, Malaysia, Indonesia, as well as certain countries in the Gulf region, the RMC industry is well-developed today6.

The growth pattern of RMC world over can be divided into three phases. The phase 1 or the introduction phase is considered upto 10% cement consumption by the RMC industry. The phase II or the growth phase is assumed upto 50% cement consumption and phase III or consolidation phase is considered thereafter .

1.2 HISTORICAL DEVELOPMENT OF RMC PLANT

Ready-mixed concrete was first patented in Germany in 1903, but the means of transporting it had not been developed sufficiently by then to enable the concept to be commercially exploited. The first commercial delivery of RMC was made in Baltimore, USA in 1913 and the first revolving drum type transit mixer, of a much smaller capacity than those available today, was born in 19263. By the late 1920s and 1930s, RMC was introduced in some of the European countries.

The early plants were of a very small capacity. In 1931, a ready-mixed concrete plant was set up at what is now the site of Heathrow airport, London, had a 1.52 m3 (2-yd3) capacity central mixer, supplying through six 1.33 m3 (1 ¾ -yd3) capacity agitators with an output of 30.58 m3/hr (40 yd3/hr). Aggregates were stored in a four-compartment bin of about 76.45 m3 (100 yd3) capacity. The cement was handled manually in bags. Till the beginning of World War II, there were only six firms producing RMC in the UK. After the war, there was a boost to the RMC industry in whole of Europe, including the UK. In the mid-nineties, there were as many as 1,100 RMC plants in UK, consuming about 45 percent of the cement produced in that country.

In Europe, the European Ready Mixed Concrete Organization (ERMCO) was formed in 1967 and is a federation of the national associations of the 22 countries. As of in 2013 there are 5,850 companies represented by it having a turnover of 13.11 billion Euros and producing a total of 349.4 million m3 of RMC4. Cement consumption averaged 60.8 percent of total cement sales, and RMC consumption of 1.2 m3/capita/annum (3.0 ton) 4.

2. CONCRETE BATCHING PLANT

A **concrete plant**, also known as a **batching plant** or a **concrete batching plant**, is equipment that combines various ingredients form **concrete**. Some of these inputs include water, air, admixtures, sand, aggregates (rocks, gravel etc.), fly ash, silica fume, slag, **cement.**

Fig. 1. Concrete Batching Plant

AGGREGATES :- Inert particles (i.e. gravel, sand and stone) added to cement and water to form concrete.

CEMENT :- Dry powder that reacts chemically with water to bind the particles of aggregates, forming concrete. Portland cement is typically used in concrete production.

FLY ASH :- Ash produced in small dark flecks by the burning of powdered coal or other materials and carried into air.

GGBS:- Ground-granulated blast-furnace slag is obtained by quenching molten iron slag (by product of iron and steel-making) from a blast furnace in water or steam, to produce a glassy, granular product that is then dried and ground into a fine powder.

2.1 READY-MIXED CONCRETE (RMC)

RMC is concrete that is manufactured in factory or batching plant, according to a set amount, and then delivered to a work site by truck mounted in transit mixture .

2.2 MATERIAL REQUIRED FOR RMC PLANT

a) Admixtures
b) Aggregates
c) Cement
d) Fly Ash
e) GGBS
f) Water

ADVANTAGES

i. Production by weigh batching in a Mechanized Batch mixing plant with computer/Numerical controls.

ii. Quality of concrete – The concrete is produced in controlled condition with excellent control on w/c ratio and consistent quality of raw materials begets quality control.

iii. Speedy construction – Due to mechanization the production of concrete is fast with minimum wastage.

iv. Eliminates the problems and inconvenience associated with stacking of construction material on construction sites, public pathways etc. Also the pilferage of material gets eliminated.

v. Lowers the labor and supervisory cost also lowers inventory and overheads.

vi. Reduced pollution – creates a clean environment with reduced noise and air/dust pollution.

vii. RMC is not only a “Material” but also a “Service”.

DISADVANTAGE OF RMC

i. Delay in setting of concrete- Generally the admixtures / Retarders are used to delay the setting time due to transit time involved is more. Excess dosage of set retarding admixture may cause the delay in setting time substantially. Hence, it is necessary to arrive at optimum dosage of set retarding admixture such that there is no undue delaying than required. This will also establish the compatibility between cement and admixture.

ii. Requirement of good formwork- Since the placement speed of concrete is more the formwork required shall be strong enough to sustain the load of fresh concrete.

2.3 EQUIPMENT REQUIRED IN RMC PLANT

Following are the equipments required in RMC Plant.

A) Batching plant
B) Mixing Process

MANUAL BATCHING PLANT

Manual batching plant is charged by device that are actuated manually, with the accuracy of the weighing operation being depend upon the operator visual observation of scale.

Fig 2. Manual Batching Plant

SEMI-AUTOMATIC BATCHING PLANT :-

Batching equipment’s is charged by devices , which are separately actuated manually for each material to allow weighing of the material. They are actuated automatically when reaching the designated mass (weight) of each material.

Fig. 3. Semi- Automatic Batching Plant

FULLY- AUTOMATIC BATCHING PLANT :-

Batching equipment is charged by devices which when actuated by a single starter switch, will automatically start the weighing operation of all materials consecutively and stop automatically when reaching the designated mass (weight) of each material.

2.4 TRANSIT MIXED (TRUCK MIXED) CONCRETE :

In transit mix concrete, all of the raw ingredients are loaded directly into the truck mixer. No plant mixer is involved. Some or all of the mixing water is usually introduced at the plant. The mixer drum is rotated at charging speed during loading.

There are three methods for mixing concrete in a truck mixer.

1. Concrete can be mixed at the jobsite. The materials are batched into the truck mixer and hauled to the job site with the drum rotating at slow, agitating speed. After arrival at the site, the concrete is then completely mixed by the mixing truck. This method has been used traditionally on longer delivery times, but with the recent advent of new set control admixture systems, this method is gradually falling out of favour.
2. Concrete can be mixed in the yard. This is the most common way to mixed the concrete produced at a transit mix plant. The drum is turned at high speed for about 70 revolutions, at 12-18 revolutions per minute, before driving to the constructions site. By completing the mixing in the yard, this procedure allows the batch team to check and adjust the slump and air of the batch, if required, before leaving the plant. The concrete is agitated slowly while driving to the job site.

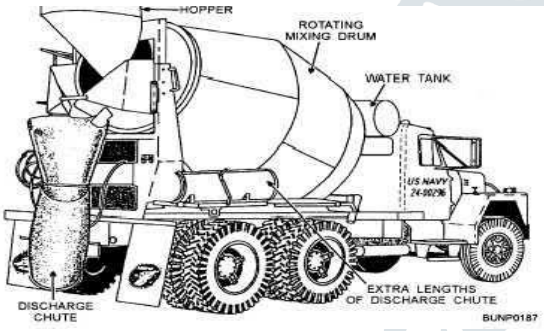

Fig. 4. TRANSIT MIXED

3. SHRINK MIXED CONCRETE :-

Shrink mixed concrete is partially mixed in a central mixer and then charged into a truck mixer, where the mixing is completed. The truck mixer is turned at high speed while charging the concrete. Mixing can be completed at the plant or at the job site. The number of revolutions needed to complete the mixing of shrink mixed concrete in the truck mixer varies depending on the size of the central mixer vessel and the duration of mixing or co-mingling of all of the ingredients (often less than 90 seconds), but generally about 30 turns of the mixer truck drum produces mix uniformity throughout the load

4. SCOPE

This paper covers the requirements for the production and supply of Mechanized batched mixed concrete produced in captive batching plants and/or concrete produced in and procured from commercial ready-mixed concrete plants. It does not cover the placing, compaction, curing or protection of concrete after delivery.

5. Conclusion

Ready Mix Concrete is a modern technique of production of concrete in massive quantities away from the actual site of placing. It is very useful where demand of concrete is very high and construction sites are in congested areas, where mixing on site is not possible due to lake of storage place. RMC is ready to use material. It is widely adopted throughout the world. It gives higher strength to the structure and it also provides higher Durability to the structure. It reduces noise pollution as well as air pollution. The Supervisory and labour costs associated with the production of RMC is less, and the quality of concrete is high. It is suitable for huge industrial and residential projects where time plays a vital role. So ultimately it provides economy in the construction and better finish to the structure. Hence the advantages of RMC are realized by engineers and contractors in the construction industry.

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