A REVIEW ON USING MINERAL ADMIXTURE COATED PET FIBRES TO MAKE CONCRETE FIRE RESISTANT

Satish Rao[1], Sandeep Salhotra[2]

[1]PG Student, Chandigarh University, Punjab, India
[2]HOD, Civil Engineering, Chandigarh University, Punjab, India

---***---

ABSTRACT: *Concrete has wonderful properties with regard of fireside resistance compared with different materials and may be wont to defend different structural materials like steel reinforcement. Concrete now and then resist the results of unnaturally evoked high temperatures like high furnaces temperature or in atomic reactors, in pavements subjected to reaction engine blast, and in areas exposed to fireplace. Applications of concrete involving very high temperatures, like landing pads for missiles, are thought-about expendable, however in most instances it's desired to avoid deterioration of the concrete's physical properties the maximum amount as attainable. Cement concrete may well be an advanced mixture of varied materials. Behavior of concrete depends on its mix proportions and constituents once it's subjected to elevated temperatures. Principal effects thanks to elevated high temperatures are loss in compressive strength, loss of weight, modification in color and fragment of concrete. The experimental results of ancient concrete and high strength concrete subjected elevated temperatures at 100°C, 500°C, 700°C, and 1200°C and wholly totally different cooling regimes viz. air cooling, water extinction on totally different grade of concrete ar according during this paper. The paper represents a whole assortment of the studies applied within the field of fire resistant concrete. The literary criticism would offer an updated material for the researchers within the field of fire resistant concrete. This helps them to hold out the analysis associated with fireplace resistant of concrete, varied admixture supplemental, composites and may furnish in their studies and facilitate them to gain possible outcomes.*

Key words: Traditional concrete, Compressive Strength, Flexural Strength.

1. INTRODUCTION

As fire has been known since ancient times as one of mankind's greatest enemies we intend to draw attention to fire, as well as to its impact on structural elements. fire is one amongst the natural hazards that attack the buildings. Subjecting concrete to the next temperature (e. g., thanks to accidental fireplace etc.) ends up in severe deterioration and it undergoes variety of transformations and reactions, thereby inflicting progressive breakdown of cement gel structure, reduced sturdiness, enlarged tendency of drying shrinkage, structural cracking and associated mixture color changes. thus if one needs to reinforce concrete fireplace resistive property he or she should add some smart external agents like PETs fibers etc . PET fibers as reinforcement in appropriate shapes will facilitate up to some extent to beat this limitation .This type of concrete is thought as fiber concrete. It is outlined as a amalgamated material deep-rooted of Portland cement, aggregate, and incorporating short isolated and irregular fibers .There is big selection of applications of PET thanks to the flexibleness inculcated in them. However, the key purpose of PET includes food, alcoholic yet as hot beverages, effervescent and non-effervescent drinks etc. during this review another material that may be other beside PET fibers is silicon dioxide fume. Usually silicon dioxide fume is other to cement concrete to enhance its properties, above all its compressive strength ,bond strength, and abrasion resistance. These addition usually amendment each the mechanical and physical properties. Addition of silicon dioxide fume additionally reduces the permeableness of concrete, that protects the reinforcing steel of concrete from corrosion , particularly in chloride-rich environments like coastal regions and wet climatic conditions.

Some facts on PET bottles and plastic waste usage and employment area unit given below:

1. The plastic consumption in India has seen a hike from 61000 tons within the year 1996 to 85,00,000 tons until 2007. Globally there has been a rise of 62.0% plastic waste production since 1975.

2. The reports of Central Pollution panel of India have shown a rise from 61,000 tons in 1996 to 8,500,00 tones in plastic consumption. The report additionally clearly pictured AN alarming increase in demand of PET bottles as there has been AN enlarged demand of zero.26 Million a lot of PET from 1995 disposal technique obtainable for such a treacherous, non-perishable waste product because the majority of PET bottles directly sent to lowland. In view of all the higher than facts and knowledge, it becomes essential to resolve this environmental downside. The employment of varied waste merchandise like plastics in concrete can cause inexperienced atmosphere. The incorporation of plastics within the variety of PET fibers with totally different facet ratios in concrete so it will

modify the properties of concrete and solve the disposal downside to some extent.

In view of all the above facts and information, it becomes essential to solve this environmental problem. The utilization of various waste products like plastics in concrete will lead to green environment. The incorporation of plastics in the form of PET fibers with different aspect ratios in concrete so that it can modify the properties of concrete and solve the disposal problem to some extent.

2. Experimental Studies On Effect Of Fire On Building Materials:

Dwaikat And Kodur: Studied that reinforcement that has been exposed by the spalling is ignored in the analysis. The accuracy of this model is questionable due to the disputes and questions surrounding accurate modeling of spalling Although equations are given to calculate the different strain components. Final experimental values shows that reinforced concrete shear walls exposed to fire suffer a loss in lateral load capacity, energy dissipation, and stiffness. It is also noted that an increase in reinforcement ratios can offset these effects due to the ability of steel to recover some of its strength after exposure to high temperatures

Abdulaziz. A & Bubshait: Studied that the advantages of using micro silica can be considerable as it reduces thermal cracking caused by the heat of cement hydration and can improve durability to attack by sulphate and acidic water, giving increase in performance of concrete. The optimum replacement of cement by silica fume gave high durability, permeability, high compressive strength. The final alterations produced by high temperatures are more evident when the temperature surpasses 500^0C, which is the strength giving compound of cement paste, decomposes further above 600 – 800C. At 400°C gel-like hydration products are decomposed, and at 800°C cracks starts to take place.

Gales Etal : Present detailed reviews of available test data and case studies of real fires in unbounded post tensioned (UPT) concrete buildings. They show that multiple case studies and much of the available furnace test data show that the response of real UPT buildings in fire is more complicated than suggested by the available prescriptive guidance, particularly with respect cover spalling and prestressed tendon rupture.

King Des et al.: Studied the impact of silica fume in concrete under various properties such as workability, permeability, durability, bleeding, heat of hydration, sensitivity to curing, acid resistance, tensile strength, flexural strength etc. He concluded that the 28th days strength of concrete with silica fume gives a higher strength of compressive strength as compared to any other material such as fly ash, GGBS etc.

The figure 1 shows that the strength of concrete containing siliceous combination begins to drop off at regarding 800°F and is reduced to regarding fifty fifth at 1200F. Concrete containing light- weight aggregates and carbonate aggregates retain most of their compressive strength up to regarding 1200F. Light-weight concrete has insulating properties, and transmits heat at a slower rate than traditional concrete.

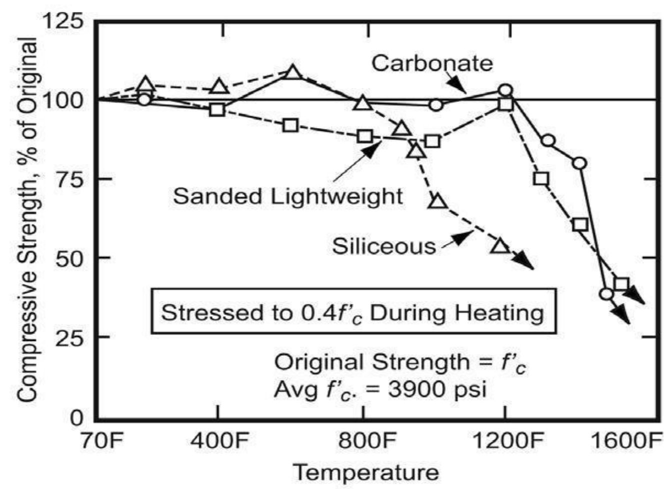

Figure 1 shows effect of high temperature on the compressive strength of concrete.

Figure 2 shows the effect of high temperature on the modulus of elasticity of concrete. The figure shows that the modulus of elasticity for concretes manufactured of all three types of aggregates is reduced with the increase in temperature. Also, at high temperatures, creep and relaxation for concrete increase significantly.

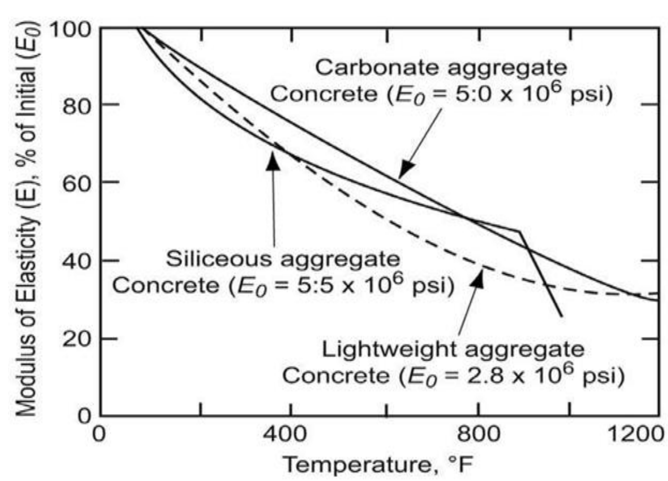

Figure 2 shows Effect of high temperature on the modulus of elasticity of concrete.

3. Advanced Analytical Models

Recently some engineers have suggested using 3D finite element software to calculate the change in spatial temperatures over time in structural components using as input the time, temperature, and pore pressure data from the fire analysis described in previous sections. The software has to be able to model the non-linear non-isotropic behavior of reinforcement steel and concrete including crack development and crushing of the concrete. In addition to the external service loads, the model has to be able to include the following: internal forces due to restraints that prevent free expansion, internal forces due to pore pressure changes, internal forces due to redistribution due to degradation of the mechanical properties of the steel reinforcement and concrete, internal forces due to second order effects from the interaction of external loads and the deformations due to the three types of internal forces mentioned above.

CTL Group performed a 3D analysis using the software DIANA for the Portland Cement Association and was able to obtain a fair correlation to actual ASTM E119 tests on high strength concrete columns. Needless to say, this type of analysis is very complex and expensive and therefore is not suitable for general structural design. Although testing according to ASTME 119 is probably the most reliable method, the time and expense required to build and test the assemblies makes this method impractical and is actually unnecessary for most situations.

The fire resistance (based on the heat transmission end point) of a concrete member or assembly is found by calculating the equivalent thickness for the assembly and then finding the corresponding rating in the charts and tables provided. The equivalent thickness of solid walls and slabs with flat surfaces is the actual thickness. The equivalent thickness of walls and slabs that have voids, undulations, ribs, or multiple layers of various materials (for example, a sandwich of concrete, insulation, and concrete) must be calculated using equations found in ACI 216.

State and municipal building codes throughout the country regulate the fire resistance of the assorted parts and assemblies comprising a building structure. Structural frames (columns and beams), floor and roof systems, and cargo bearing walls should be ready to face up to the stresses and strains obligatory by totally developed fires and carry their own dead hundreds and superimposed hundreds while not collapse for the desired period. The 2006 International code (IBC) contains prescriptive needs for building parts in Section 720. This section contains tables describing varied assemblies of building materials and finishes that meet specific fireplace endurance ratings. The tables within the 2006 IBC are compatible with the tables in ACI 216 aside from the provisions for the employment of high strength concrete columns found in ACI 216.

4. Thickness Requirements

Test results show that fire resistance in concrete structures will vary in relation to the type of aggregate used. Table 1 shows a summary of the minimum thickness requirements for floor slabs and cast in place walls for different concrete types and for different fire resistance ratings.

Concrete type	1 hr	1.5 hr	2hr	3hr	4hr
Siliceous aggregate	3.5	4.3	5.0	6.2	7.0
Carbonate aggregate	3.2	4.0	4.6	5.7	6.6
Sand-lightweight	2.7	3.3	3.8	4.6	5.4

Table 1 Minimum thickness for cast in place floor and roof slabs.

Table 2 shows the minimum column dimensions for different concrete types and different fire resistance ratings. Tables 1 and 2, show that there may be economic benefits to be gained from the selection of the type of concrete to be used in construction. The designer is encouraged to evaluate use of the different type of material as well.

Concrete type	1 hr	1.5 hr	2 hr	3 hr	4 hr
Siliceous aggregate	8	9	10	12	14
Carbonate aggregate	8	9	10	11	12
Sand-lightweight	8	8.5	9	5	12

Table 2 shows minimum column dimensions for different concrete types.

5. ADVANTAGES OF FIBERS

Addition of carbon fibers improves the following properties of Concrete;

1. Fire resistance.
2. Compressive strength.
3. Split tensile strength.
4. Flexural strength.
5. Durability.
6. Erosion strength.
7. Serviceability of concrete.
8. Fracture characteristics.
9. Reduce cracking.

CONCLUSION:

The current review paper shows the studies dispensed on fire resistance properties once appropriate fibers and admixture being supplemental in it. The American Concrete Institute and various building codes have developed prescriptive and analytical strategies supported the fire tests on concrete elements of structures. Test results show that fire resistance in concrete structures can vary in respect to the kind of combination used. Table 1 shows a outline of the minimum thickness necessities for floor slabs and forged in situ walls. Totally different concrete varieties and for various fire resistance ratings summarizes the minimum column dimensions for various concrete varieties and different fire resistance ratings. It absolutely was discovered that the compressive strength of M40 grade of concrete was enhanced from 16.15% to 19.24% once mineral admixture were added. Hence from in particular calculated results it appears that concrete shows higher strength towards elevated temperature once it's casted with some admixtures and fibres like PET.

References:

1) 2006 International Building Code, International Code Council, Inc., Falls Church, VA, 2006, pp. 109-155. Joint ACI-TMS Committee 216, "Standard Method for Determining Fire Resistance of Concrete and Masonry Construction Assemblies (ACI 216.1-07/TMS 0216.1-07)," American Concrete Institute, Farmington Hills, MI, 2007, 28 pp.

2) ASTM E 119-00a, "Standard Test Methods for Fire Tests of Building Construction and Materials," ASTM International, West Conshohocken, PA, 2000, 21 pp.

3) Andrew Abdulaziz And Bubshait, "Use of Microsilica in Concrete Construction", Article 4, Volume 2, Issue 5, August 1996.

4) Dwaikat and Kodur, "Stress and deformation characteristics of concrete at high temperatures". Division of Structural Mechanics and Concrete Construction, Lanad Institute of Technology, Bulletin 5, Vol. 4, Issue 5, 1 - April-2008.

5) Gales Etal J.W, "Modes of failure of concrete panels exposed to high temperatures". Magazine of Concrete Research 24, Vol. 9, Issue 4, 1 -April-2009.

6) King Des, "Effect of Silica Fume on Mechanical Properties of Concrete" Vol.1 September 2012, J. Acad. Indus Res. Vol. 4 September 2012.