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RESEARCH ARTICLE

STUDY OF ORGANIC AND MINERAL ADMIXTURES ON STRENGTH OF CONCRETE IN ALKALINE/ ACIDIC ENVIRONMENTS

[1]Ramesh Reddy, R., [2]Murthy, S.G.S., [2,*]Prashanth Kumar, R. and [2]Thimmaiah Gari Aditya

[1]University College of Engineering (A), Osmania University, Hyderabad, Telangana, India
[2]Department of Civil Engineering, MVSREC, Nadergul, Telangana, India

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ABSTRACT

A blend of concrete is prepared with 20% of Ground-Granulated Blast-Furnace Slag (GGBS), 10% of Silica fumes asmineral admixtures and 5% of organic admixture (Trigonella Foenum Graecum) replacing cement. An experimental program was conducted to study the variation in compressive strength of concrete with combination of mineral and organic admixtures in alkali and acidic environment. 21 specimens each of controlled concrete and of concrete with combination of mineral and organic admixtures were cast and compressive strengths were tested after 28 days. 6 specimens of each type were exposed to alkali and acid attack for next 28 and 56 days. Investigation with respect to acid and alkali resistance was carried out on concretes with mineral and organic admixtures and their performance benchmarked against controlled concrete are presented in this paper. Their performances were measured with respect to the loss in compressive strength and weight of concrete cubes. In later stages concrete with mineral and organic admixtures showed better resistance to alkali and acid attacks when compared to controlled concrete.

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INTRODUCTION

Concrete is a construction material composed of cement as well as other cementitious materials such as fly ash and slag cement, coarse aggregate such as gravel, limestone or granite and fine aggregate such as sand, water and admixtures. Concrete is used more than any other man-made material in the world. The ability of concrete to withstand the action of water without serious deterioration makes it an ideal material for building structures to control, store and transport water. In spite of all these it has some serious deficiencies, but for its remarkable qualities of flexibility, resilience and ability to redistribute stress, would have prevented its use as building material. Efforts to improve the properties of concrete are continuously being made by researchers which led to the development of fiber reinforced concrete, ferro-cement concrete etc. In recent years, improvements in concrete properties have been achieved by the invention of high performance concrete (HPC) (Bertil Persson, 2001). Improvements involving a combination of improved compaction, improved paste characteristics an aggregate-matrix bond and reduced porosity are achieved through the use of super plasticizers. Further enhancements of some properties have been obtained through the addition of mineral admixtures such as metakaolin, silica fume and fly ash (Shriharsha *et al.,* 2016). A concrete structure is built so as to last and give maintenance free service as far as possible during the life of structure. Therefore, apart from strength, long term behavior under service conditions and environmental effects has also become important consideration in evaluating performance. To overcome various problems encountered in the field and to achieve better performance even in aggressive environments, use of high performance concrete is becoming a more popular solution (Sanjukta Sahoo *et al.,*). When offshore, sewer structures are constructed they are more varnarable to acid or alkali attack on concrete, this is due to presence of voids and excess unreacted lime in hardend concrete (Emmanuel Attiogbe and Sami Rizkalla). So blend of concrete is prepared with 20% of Ground-Granulated Blast-Furnace Slag (GGBS), 10% of silica fumeas mineral admixtures and 5% of organic admixture (Trigonella Foenum Graecum) replacing cement. An experimental program was conducted to study the variation in compressive strength of concrete with combination of mineral and organic admixtures in alkaline and acidic environment. 22 specimens each of controlled concrete and of blended were cast and compressive strengths and weights were tested after 28 days. 6 specimens of each type were immersed in tank filled with 3% of sulfuric acid solution and 3% of NaCl solution and 3 specimens of each are tested after 28 days and 62 days in specific environment and their performances are

***Corresponding author:* Prashanth Kumar, R.,**
Department of Civil Engineering, MVSREC, Nadergul, Telangana, India.

compared. Concrete is designed as M30 mix and their proportion are shown in Table 1. and Table 2.

RESULTS AND DISCUSSION

Compressive strengths test on 22 specimens of each control concrete and blendeed concrete were performed at different ages which were exposed to water, alkaline and acidic environment, and there results are compared in below graphs.

Table 1. Mix proportion of m30 grade control concrete

materials	kg/m^3	
Cement	414	
water	186	
Fine aggregate	711	
Coarse aggregate	1162	
W/C		0.45

Table 2. Mix proportion of blended concrete

Materials	kg/m^3
Cement	269
GGBS	82.8
Silica fumes	41.4
Organic admixture	20.7
Water	186
Fine aggregate	711
Coarse aggregate	1162
W/C	0.45

Table 3. Showing weights of water cured concrete specimens

Mix Designation	28 days weight (Kg)	28+62 days weight (Kg)
Control concrete	8	8.1
Blended concrete	7.8	7.7

Table 4. showing weights of concrete specimens exposed to alkaline environment after 28 days of water curing

Mix Designation	28 days weight (Kg)	28+62 days weight (Kg)
Control concrete	8	7.9
Blended concrete	7.8	7.8

Table 5. showing weights of concrete specimens exposed to acidic environment after 28 days of water curing

Mix Designation	28 days weight (Kg)	28+62 days weight (Kg)
Control concrete	8	6.8
Blended concrete	7.8	7.17

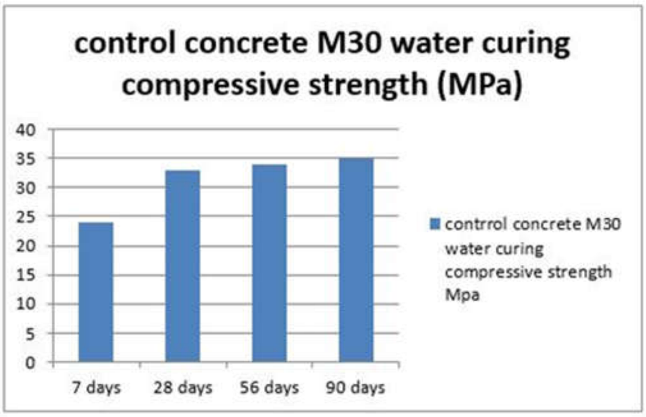

Figure 1. Compressive strength of m30 grade control concrete water cured for 90 days

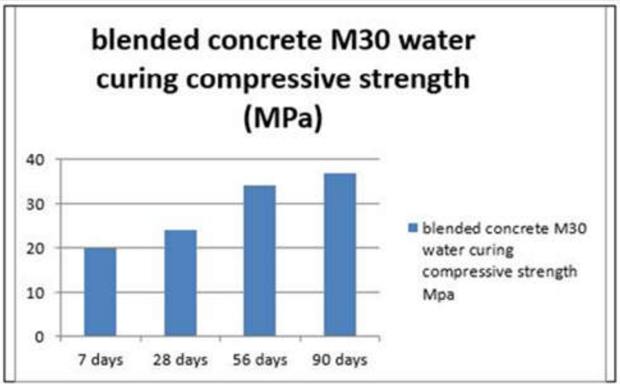

Figure 2. compressive strength of blended concrete water cured for 90 days

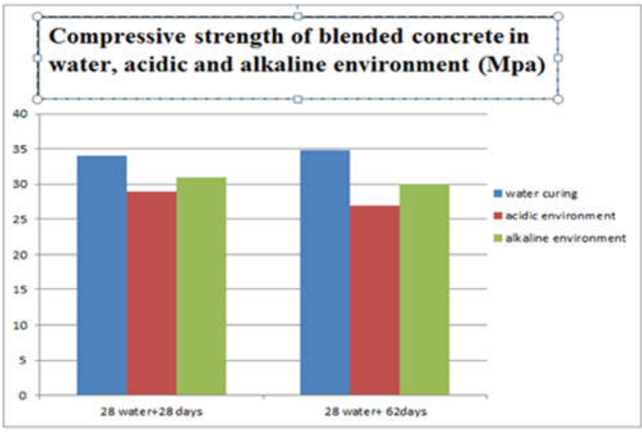

Figure 3. compressive strength of blended concrete exposed to acidic and alkaline environments after 28 days of water curing

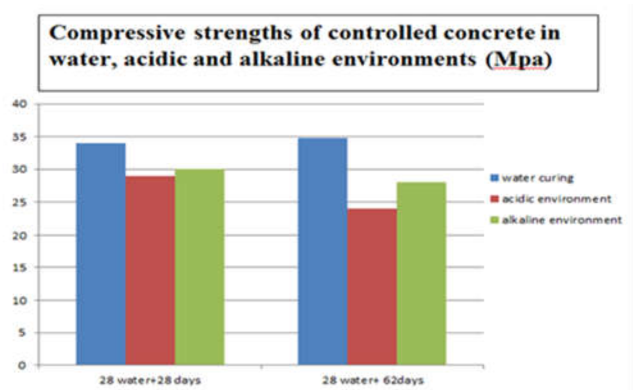

Figure 4. compressive strength of m30 grade control concrete exposed to acidic and alkaline environments after 28 days of water curing

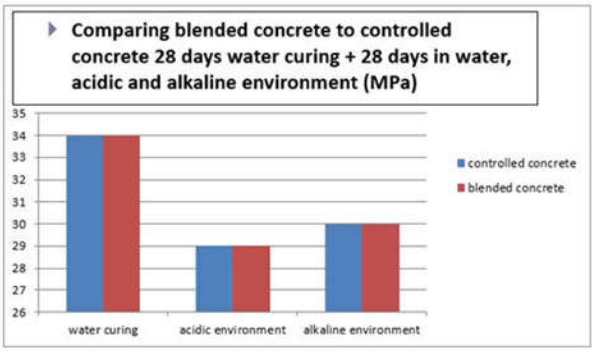

Figure 5. Comparing compressive strengths of blended concrete to control concrete after 28 days of water curing + 28 days in water curing, acidic and alkaline environments.

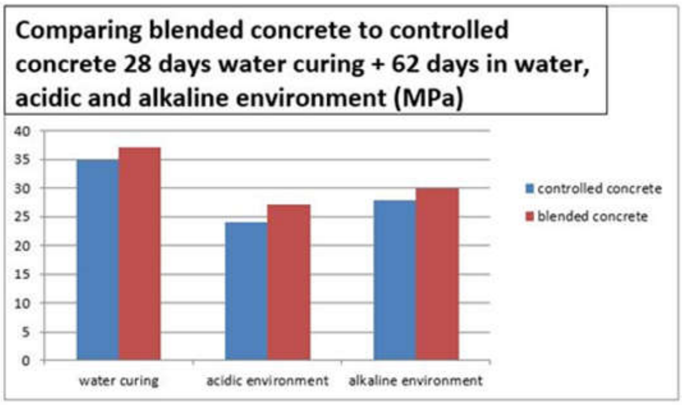

Figure 6. comparing compressive strengths of blended concrete to control concrete after 28 days of water curing + 62 days in water curing, acidic and alkalyne environments

- Compressive strength of control concrete specimens from 7 days to 90 is shown in Figure 1. at 28 days of curing compressive strength of control concrete were 33 MPa and at 90 days of curing they were 34.8 MPa.
- Compressive strength of blended concrete specimens from 7 days to 90 is shown in figure 2. at 28 days of curing compressive strength of blended concrete were 24 MPa and at 90 days of curing they were 37 MPa.
- In Figure 3. compressive strengths of blended concrete exposed to acidic and alkaline environments after 28 days of water curing are shown, compared to water cured blended concrete specimens there is reduction of strength when blended concrete specimens were exposed to alkaline and acidic environment.
- In Figure 4. compressive strengths of control concrete exposed to acidic and alkaline environments after 28 days of water curing are shown, compared to water cured control concrete specimens there is reduction of strength when blended concrete specimens were exposed to alkaline and acidic environment.
- After 28 days of water curing specimens of blended concrete and control concrete are exposed to alkaline and acidic environments and these specimens tested for their compressive strength after 28 more days and their results are shown in Figure 5.
- After 28 days of water curing specimens of blended concrete and control concrete are exposed to alkaline and acidic environments and these specimens tested for their compressive strength after 62 more days and their results are shown in Figure 5
- Weights of specimens exposed to different environments are been tabulated in Table 3-5

Conclusion

- Compared to controlled concrete blended concrete showed better performance in later age its compressive strength was 6.3% higher than control concrete after 90 days of curing.
- Compressive strengths of both control concrete and blended concrete were comparative less in acidic and alkaline environment.
- In later ages blended concrete showed better strengths compared to controlled concrete in acidic and alkaline environment.
- There is not much variation in weight when specimens were exposed to alkaline environment.
- When specimens were exposed to acidic environment there were 15 % loss in weight of control concrete specimens whereas there was 8% loss in weight of blended concrete specimens.
- By above observation it is clear that mineral admixtures are helping to improve later age strength of concrete and organic admixture is filling the voids and improving its durability.

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