ISSN: 2319-8753

International Journal of Innovative Research in Science, Engineering and Technology
Vol. 2, Issue 3, March 2013

A STUDY ON STRENGTH CHARACTERISTICS OF ORDINARY PORTLAND CEMENT DUE TO STORAGE

Lovely K M[1], Anniamma Chacko[2]

Professor, Department of Civil Engineering, M A College of Engineering, Kothamangalam, Kerala, India[1]

Professor, Department of Civil Engineering, M A College of Engineering, Kothamangalam, Kerala, India[2]

Abstract: Cement produced in factory reaches the site after some days or months. Properties of cement may change due to aging. In this paper, an attempt is made to quantify the variation in strength characteristics due to storage.

Keywords: Cement- ageing- strength- storage

I. INTRODUCTION

The twentieth century has witnessed great advances in the building industry due to the many changes in construction techniques. As in the olden days, concrete is still prepared from the same materials: cement, coarse aggregate, fine aggregate and water in varying proportions except that new methods and advances have been introduced in the application. Cement is a material having adhesive and cohesive properties enabling it to form good bond with other materials. In concrete, cement is the main constituent which is the only active binding media and the only component scientifically controlled. Cement has got the property of setting and hardening by virtue of chemical reactions with water at normal temperature. Factory fresh cement will reach the consumer only after some days. The cement thus received at the consumer's end will be consumed after some days or even after some months. Cement stored at various storage conditions and exposed to varying climatic conditions definitely might have undergone some changes in its properties. The Indian Standards for cement specifies that cement stored for more than 90 days should be used only after ascertaining its strength characteristics as per IS 4031.

II. LITERATURE REVIEW

Properties of cement include fineness, setting time, soundness, specific gravity and compressive strength[7], [8]. The fineness of cement is a measure of the particle size of cement. Finer the cement, the rate of chemical reaction or rate of hydration is faster since more surface area is available for chemical reaction. The strength development is also faster for fine cements.

When Portland cement is mixed with water to make paste, it becomes gradually less plastic and finally becomes a hard mass. When it loses plasticity, it is sufficiently rigid to withstand a definite amount of pressure. Setting is the term used to describe the stiffening of cement paste. The setting time is divided into two parts, initial setting time and final setting time. The time at which the cement paste loses its plasticity after the addition of water is known as initial setting time. The time corresponding to the paste becoming a hard mass is known as final setting time. It is essential that the initial setting time should not be too less to allow time for mixing, transporting and placing of concrete. Within this time, the cement paste, mortar or concrete should be in plastic condition.

Soundness of cement is a property which controls the volume change of hardened concrete and specific gravity is related to the density of concrete. Compressive strength of hardened cement is the most important of all the properties for structural use. Hence strength tests are prescribed by all specifications for cement. Cement should be tested for its strength in the laboratory before it is used or all major projects. The strength of mortar or concrete depends on the cohesion of the cement paste, on its adhesion to the aggregate particles and to a certain extent, on the strength of the aggregate itself [1].

ISSN: 2319-8753

International Journal of Innovative Research in Science, Engineering and Technology
Vol. 2, Issue 3, March 2013

III. OBJECTIVE

The aim of the work was
1. To study the strength characteristics of ordinary Portland cement due to aging and
2. To study the reduction in strength of cement due to various types of storage.

No definite documents are available which throws light into the experiments being done on cements at various ages of storing. Indian standard specifies that cements stored in bulk at the mill for more than six months or cement in bags in local storage in the hands of a vendor for more than three months has to be retested before use and may be rejected if it fails to conform to any of the requirements of IS 269[3]. It is quite evident that the research and development sectors of major cement manufacturing units might have done tests at different ages of storing. But published literature is very scarce in this regard. The reduction in strength given in Civil Engineer's handbook is as in Table1[2].

TABLE 1

. REDUCTION IN COMPRESSIVE STRENGTH DUE TO AGING

Sl.No	Period	Reduction in strength
1	3 months	20 %
2	6 months	30 %
3	12 months	40 %
4	24 months	50 %

IV. MATERIALS AND METHODS

The test programme was planned to fulfil the stipulated aim. Cements manufactured by different companies vary slightly in their chemical composition and the materials used which directly reflects on the physical properties even though all of them satisfy Indian standards. One popular brand of cement conforming to IS 269 was used for allthe studies.

Tests were conducted with cement stored in two types of storage. Four cement bags were stored in normal storage conditions as is done practically. Another set of four cement bags were kept in airtight containers. All the tests were conducted as per Indian standards. Cement mortar cubes of 50 cm^2face area were cast, cured and tested as per IS 4031[6] for determining the compressive strength at 3, 7 and 28 days of curing. Specimens cast with cement samples from normal storage and bin storage were tested at zero date and monthly intervals from first day of storage. Concrete cubes of 15 cm size were cast with M15 and M20 mixes as per IS 456[4], cured and tested as per IS 516[5] for determining the compressive strength at 7 and 28 days of curing. Concrete cubes were also made from cement samples of the two types of storage and tested at monthly intervals up to 4 months.

V. EXPERIMENTAL RESULTS AND DISCUSSIONS

Quantification of the change in strength characteristics due to storage at different conditions was the main objective of the study. The compressive strength of cement was tested as per IS 4031. Fig. 1 shows the effect of storage on 3 day compressive strength of cement mortar cubes. It can be seen that compressive strength of cement reduces with aging. The behaviour on strength of cement with the two types of cement was similar. The percentage reduction in the case of normal storage is more compared to that of air tight storage.

The effect of storage on 7-day compressive strength of mortar cubes are given in Fig.2. It may be observed that the behaviour is almost the same for both types of storage due to aging of cement.

Fig.3 presents the reduction in 28 day compressive strength with different types of storage. After 4 months of storage, the reduction is 46 percent for cement with normal storage only 25 percent for air tight stored cement. Concrete cubes were made with M 15 and M 20 mixes of cements with different types of storage to study the effect on ageing. Tests were carried out conforming to IS 516. The cubes were tested after 7 days and 28 days. The results of 7 day compressive strength of M15 mix are presented in Fig. 4. As in the case of cement mortar cubes, the compressive

ISSN: 2319-8753

International Journal of Innovative Research in Science, Engineering and Technology
Vol. 2, Issue 3, March 2013

strength reduces with storage period. It is evident from the figure that concrete mix made with air tight stored cement is superior in strength compared to concrete mix made with normally stored cement.

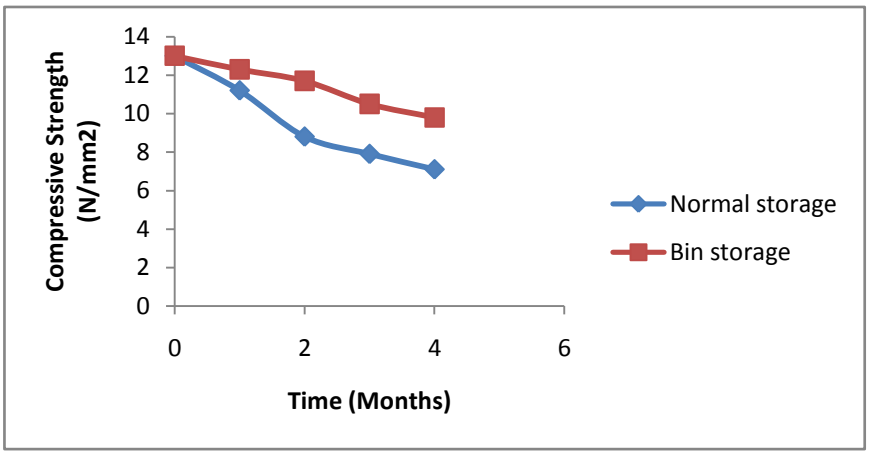

Fig. 1. 3- day compressive strength of mortar cubes

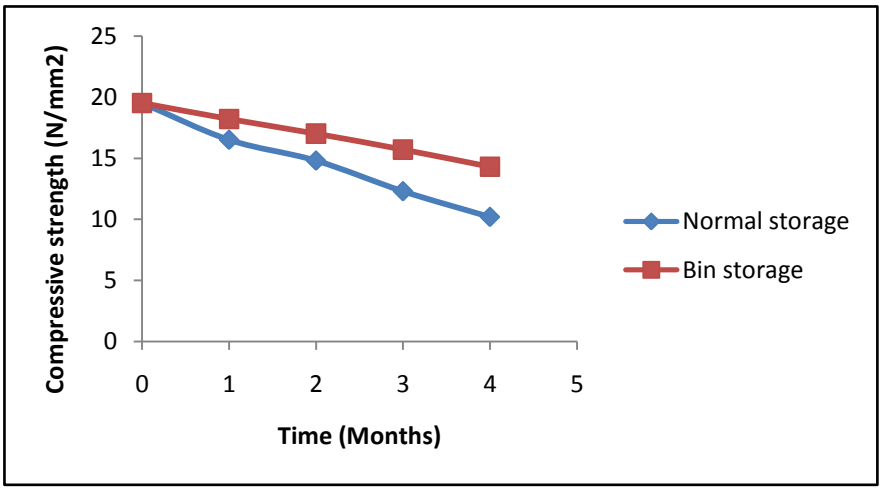

Fig. 2. 7-Day compressive strength of mortar cubes

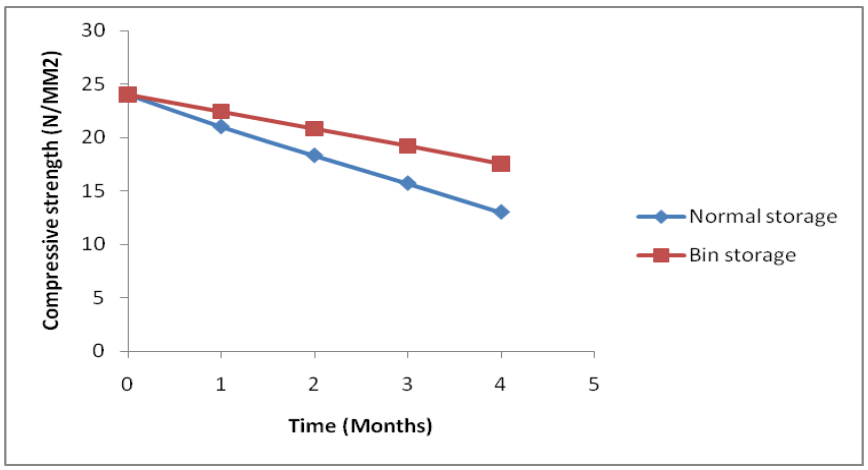

Fig.3. 28- day compressive strength of mortar cubes

ISSN: 2319-8753

International Journal of Innovative Research in Science, Engineering and Technology
Vol. 2, Issue 3, March 2013

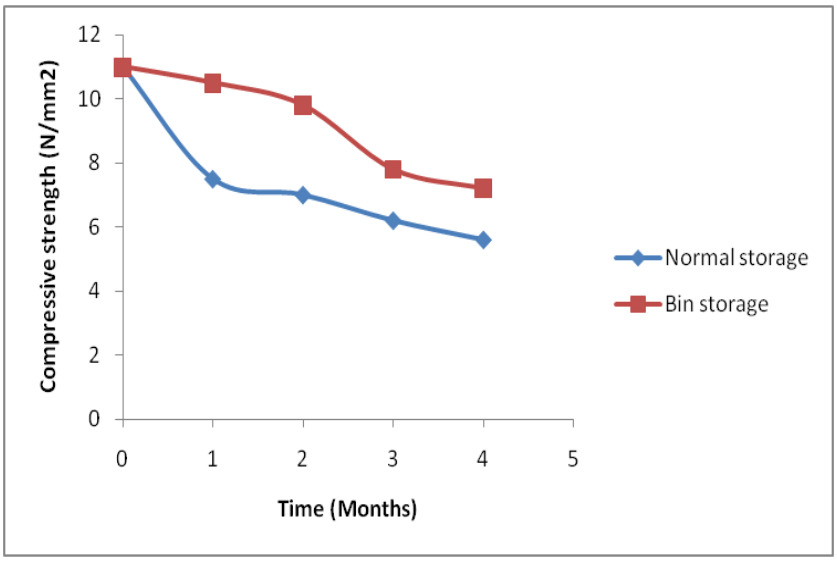

Fig.4. 7-day compressive strength of M15 concrete

Concrete cubes made of M 20 mix were also tested on similar lines. The results are presented in Fig. 5. It can be observed that the nature of variation is the same.

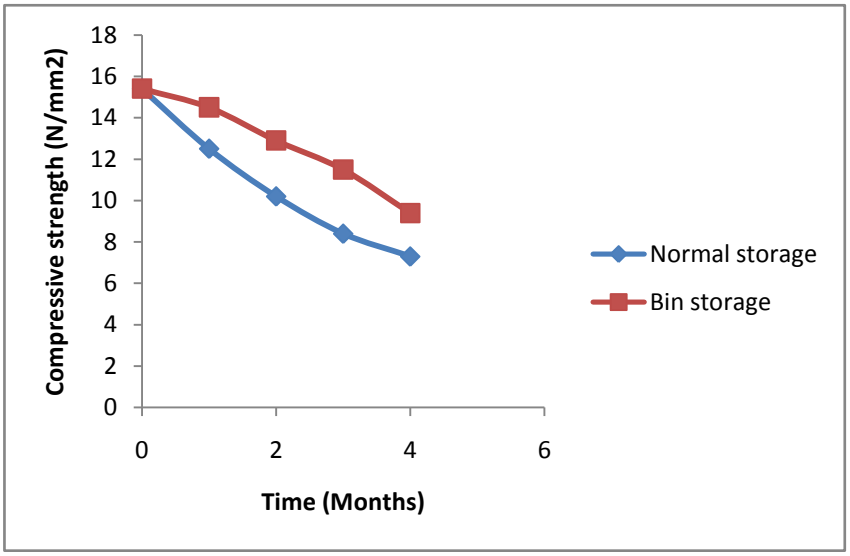

Fig.5. 7-day compressive strength of M 20 concrete

The compressive strength of concrete cubes of M15 mix is given in Fig. 6. The behaviour is similar to that of 7 day strength. The percentage reduction in 28 day strength is more compared to 7 day strength.

ISSN: 2319-8753

International Journal of Innovative Research in Science, Engineering and Technology
Vol. 2, Issue 3, March 2013

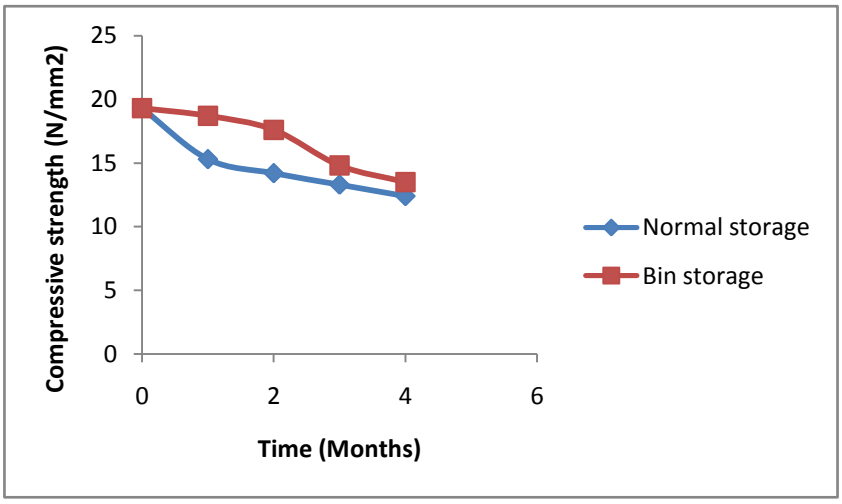

Fig. 6. 28-day compressive strength of M 15 concrete

Fig. 7 shows the effect of ageing on 28 day compressive strength of M 20 mix. It may be noted that for richer mix, the reduction in strength is less. To ascertain this, further studies are required.

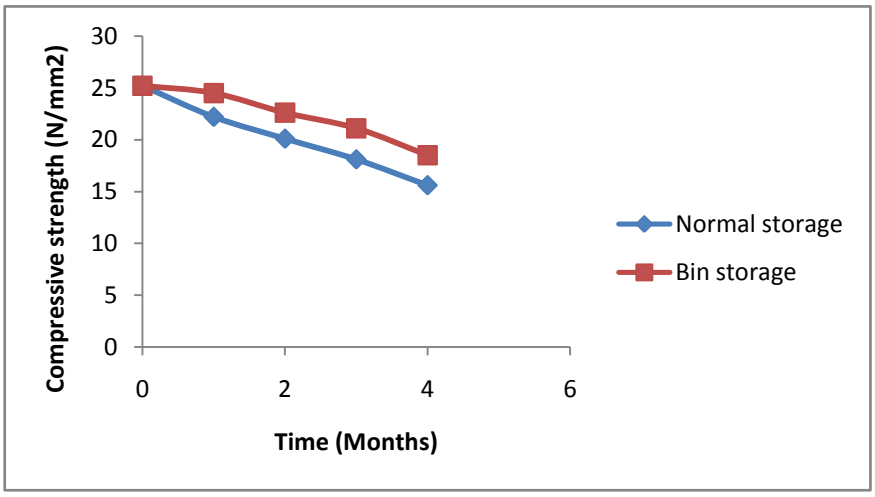

Fig. 7. 28-day compressive strength of M 20 concrete

VI. Conclusions

The effect of ageing on strength characteristics of cement were investigated by conducting a systematic study. Based on the experimental results, the following conclusions were made. There is considerable reduction in strength due to ageing. If cement is stored in air tight condition, it gives the expected strength up to 3 months. For rich mix, the reduction in strength is much less.

Acknowledgment

1. Mallia R. V., Deputy Chief Engineer (Rtd), FACT, Kochi, Kerala, India.
2. Babu T. Jose, Director (Rtd) Cochin University of Science and Technology, Kochi, Kerala, India.

References

[1] Neville, A. M., *Properties of Concrete*, ELBS, Singapore, 1963.
[2] Association of Engineers, Kerala Public Works Department, *Reduction of Strength of cement*, Civil Engineer's Hand Book,1981
[3] *IS269:1989 "Specification for ordinary and low heat Portland cement" Bureau of Indian Standards.*
[4] *IS 456:2000 "Code of practice for plain and reinforced concrete", Bureau of Indian Standards.*
[5] *IS 516:1959 : Methods of tests for strength of concrete", Bureau of Indian standards*
[6] IS 4031:1988 "Methods for physical tests for hydraulic cement", Bureau of Indian standards.
[7] Krishnaswamy, K. T., Kamasundara, R., and Khandekar, A. A., *Concrete Technology*, DhanapathRai & Sons, Delhi 1978.
[8] Shetty, M.S., *Concrete Technology*, S. Chand & Co., New Delhi, 1982.