

COMPRESSIVE STRENGTH COMPARISON OF OPC AND PPC ARGHAKHANCHI CEMENT

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Abstract— This paper reports the compressive strength of OPC (Ordinary Portland Cement) and PPC (Portland Pozzolana Cement) manufacture by the Arghakhanchi Cement Pvt Ltd. OPC is produced with 95 % clinker and 5 % gypsum. PPC is produced by 70 % clinker, 20 % fly ash, and 5 % gypsum. The quality of cement depends upon the quality of the clinker. Physical properties are compared concerning NS (Nepal Standard). Compressive strength in 3 Days, 7 Days, and 28 Days is compared. In 28 days, the compressive strength of OPC is more than that of PPC. OPC is highly used in reinforced concrete (RCC) work, whereas PPC is widely used in plaster and finishing works. These results were compared with NS. PPC is an environmentally friendly cement because it uses a lesser amount of clinker and byproduct –fly ash.

Keywords— Cement, OPC, PPC, Clinker

I. INTRODUCTION

Cement is a fine-grained powder that, when it is mixed with water, turns into a solid. Because of its strength, cement is widely used for construction works. It is simply a binder, which sets after it dries and reacts with carbon dioxide in the open air and hence binds other materials together. The basis of cement is lime; it has been used as a binding material in construction for thousands of years. In the past, lime was simply heated by itself to drive out the carbon dioxide and leave calcium oxide, which is what was used to make cement. These days they use what is called Portland cement. They then crush it and add gypsum to the mixture. The gypsum will slow down the rate at which the cement hardens, making it easier to use. Clinker is the main material for producing any kind of cement. The type of cement depends upon the quantity of clinker added to produce cement. Clinker is produced by mixing limestone, bauxite, and clay, and Iron ore. Worldwide more than ten types of cement are used. In Nepal, OPC and PPC are widely used. OPC is manufacture with 95 % clinker with the addition of 5 % of gypsum. PPC is made with 70 % of clinker, 25 % fly ash with the addition of 5 % gypsum. It is also important to note that Portland cement characteristics are relatively unchanged over the last 10 years [1]. The physical

properties of OPC and PPC compare and found OPC with higher strength.

Gypsum is used to delay the setting time of the cement. Suppose the proportion of gypsum is higher or less, which will directly affect the setting time of cement. The physical properties are fineness, setting time, soundness, and compressive strength of the cement. Five samples of both OPC and PPC are taken for comparing compressive strength. If cement is stored in airtight conditions, it gives the expected strength up to 3 months [2]. The cement should not be in contact with moisture. Curing age increases the strength of cement. A similar comparative study on cement in Nigeria found that the density value of concrete cubes did not show variation but, in turn, dependent on the age of curing while the strength increases with the age of curing [3]. Curing should be done a minimum of 7 days to gain high strength.

II. MATERIAL AND STANDARD SIZE

A. OPC

OPC is manufacture with 95 % of clinker with the addition of 5 % of gypsum. The setting time is less, and the strength gain is quick. It is widely used in the mega project where the strength requires getting high as early. In RCC, OPC is highly used. During hydration of the ordinary Portland cement, calcium silicate hydrate (C-S-H) gel and calcium hydroxide, $\text{Ca}(\text{OH})_2$, are formed from silicates phases, and ettringite (AFt), mono sulphate (AFM) are formed from aluminate phases [4].

B. PPC

PPC is the blended cement. It is manufacture with 70 % of clinker, 5 % of gypsum, and the remaining 25 % of fly ash. The setting time is more, and the strength gain is slow. It is used in Plastering and finishing work. Pozzolana is a natural or artificial material containing silica in a reactive form [5]. PPC is considering environmentally friendly cement. It consumes less amount of clinker and utilization of byproducts- fly ash.

C. Clinker

Clinker is the raw material that is produced with a combination of limestone, bauxite, red clay, and iron ore. The raw mix has to pass the different stages. One stage is pre-heater, where the raw mix has to pass, and chemical reactions take place. The next important stage to pass is the rotary kiln. In a rotary Kiln, the heat temperature is 1450 degrees Celsius to melt the raw mix. Finally, after quick cooling, the clinker is produced. The cement depends upon the quality of the clinker. The clinker is cooled, mixed with setting regulators (e.g. gypsum) grounded to a fine powder to obtain the cement [6].

D. Gypsum

Gypsum is a mineral that is added to the cement. It is added to control the setting time of cement. If gypsum is not added, the cement will set quickly after adding water. It makes it difficult for workability. Around 5 % of gypsum is added during the manufacture of cement upon the cooling of clinker at the grinding process. In both types of cement, gypsum is added.

E. Fly ash

Fly ash is fine in powder which is blended with clinker and gypsum to produce PPC. Fly ash is the byproduct of thermal plants. It has cement properties, so it is widely used as blended material. 25 % is added during the manufacture of PPC. It was also observed that finer particles resulted in increasing the rate of reaction needing less heating time to achieve a given strength [7].

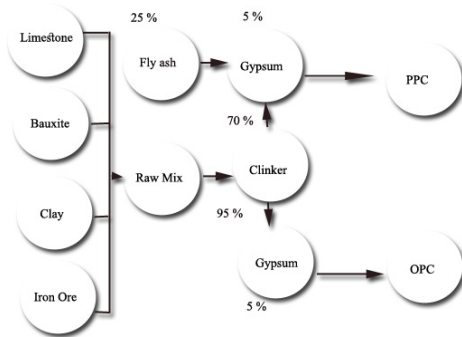


Fig.1. Flow chart of OPC and PPC

In Fig.1. Its shows the production of OPC and PPC. Limestone, bauxite, clay, and iron ore are mixed to form a raw mix. The clinker is produced after several processes. In clinker, with the addition of gypsum, OPC is produced, and with the addition of fly ash and gypsum, PPC is produced. OPC is a pure form of cement. PPC is a blended form of cement.

III. STANDARD TEST

TABLE I. NS STANDARD OF OPC AND PPC

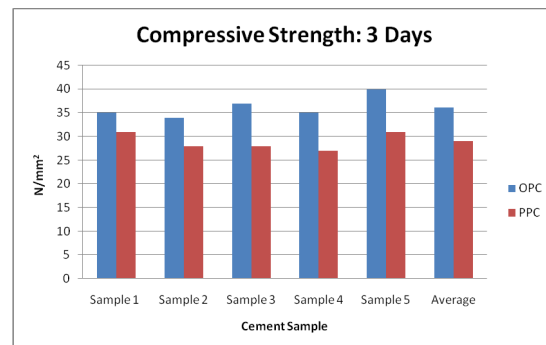
Particulars (Unit: MPa / N/mm ²)	OPC Requirements of NS: 49 (Min = Minimum)	PPC Requirements of NS: 385 (Min = Minimum)
Compressive Strength		
3 Days	16 Min.	16 Min.
7 Days	22 Min.	22 Min.
28 Days	33 Min.	33 Min.

IV. LAB TEST



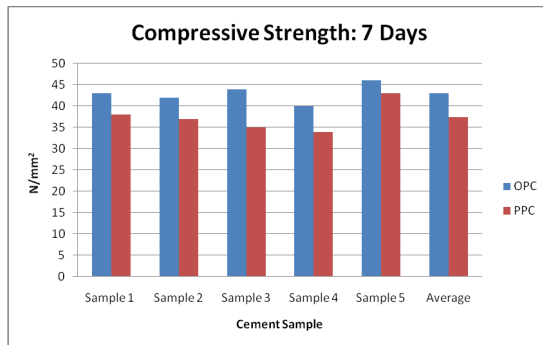
V. RESULT AND DISCUSSION

TABLE I. COMPRESSIVE STRENGTH - 3 DAYS



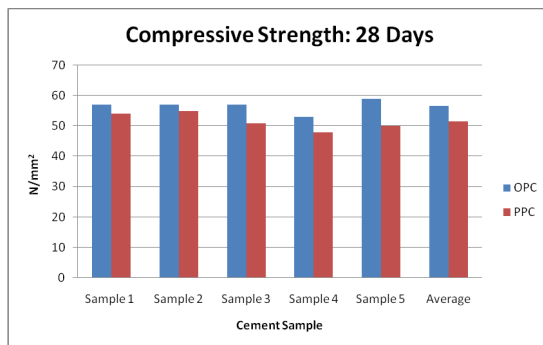
The strength (MPa) gain in 3 days is 35,34,37,35 and 40 of five different samples of OPC whereas 31,28,28,27 and 31 by PPC. The average strength gained by OPC in 3 days is 36.2 and by PPC is 29.

TABLE II. COMPRESSIVE STRENGTH - 7 DAYS



In 7 days, the strength (MPa) gain by OPC is 43,42,44,40 and 46. Similarly, 38,37,35,34, and 43 strength is gain by PPC in 7 days. Hence, the average strength of OPC is 43 and PPC is 37.4.

TABLE III. COMPRESSIVE STRENGTH - 28 DAYS



Finally, in 28 days, the strength is tested to finalize the Grade of cement. In 28 days, the strength (MPa) gained by OPC are 57,57,57,53 and 59 and by PPC is 54,55,51,48 and 50. The average strength of OPC is 56.6, whereas, for PPC, the average strength is 51.6. The final strength gain in 28 days is considered the Grade of Cement.

9 cubes of 7.06 cm are made with a ratio of 200 gm of cement and 600 gm of soli of Grade I, II, and III. It is the ratio of 1:3 (Cement: Soil). No, any admixture is mixed in this test.

VI. CONCLUSION

The strength of OPC is more than that of PPC. Finally, strength gain in 28 days by OPC is 56.6, whereas by PPC is 51.6. In construction where the high strength is required than OPC should be used instead of PPC. It is because OPC is the pure form of cement without the addition of Fly ash. The strength is gained during the period. The curing process also helps to gain strength over time and should be done in at least 7 days. The amount of clinker is less used,

and utilization of byproduct – fly ash makes PPC environmentally friendly cement.

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