Study of Concrete Deterioration Due to Coupled Action of Carbonation and Chloride Attack: A review

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A R T I C L E I N F O

Keywords:

Carbonation and Chlorination
Durability
Aggressive Environment

A B S T R A C T

This provides a wide range of reviews. The results of the demonstration of concrete under various complex processes such as high temperature and pressure, ground loading and compression, etc. The chlorination and carbonation, along with high temperature and there was condensation. Concrete structure was subjected to mechanical loads or experience the aggressive environment and surrounding gradual decline in performance. Many was analyzing have been on the durability of concrete beneath single aggressive condition, has already been described in a good way before the related research results. Solid degradation under paired action is more sever and more complex then under single aggressive environment. The properties of concrete are significantly influenced by the severity of the pairing. Aggressive action, and early age stage can be improved. Practical method also available to affects the performance of concrete due to different mechanisms, but occurs between after and under. The risk of high temperature was lower than expected. In the ends, there was laws introduced in the same section, adding air-enrichment agents such as fly ash, silica phylum or air penetration agents is effective to improving stability or durability of concrete beneath coupled aggressive environment.

1. Introduction

In order to ensure the concrete structure of the design is still ineffective in normal condition. Some has focused the life of structure is performance of concrete in various diverse environment [20]. Reinforced concrete structures are deteriorating. Due to construction all around the world. Which is mostly as a result of reinforcement corrosion. It is believed that the steel reinforcement remains indestructible passive due to thin oxide layer formed on the steel surface the increase alkalinity of the pores to concrete solutions. As one of the most aggressive environments, chloride ion enters to reaches the surface of hardened concrete cover and steel reinforcement. If chloride is added to the air, carbon dioxide (CHO2) will be released. The risk of corrosion of steel is reduced. CHO2 gas is entering into the concrete, react with pyrotechnic products, altering the internal structure of concrete and reducing the strength of concrete. The level of hydroxyl in the electrolyte is very low. After carbonization, more samples are obtained in 100% CO2. The amount of free chloride in the air can be compared to the concentration. The designated that a high effective carbonate and bicarbonate promotes the formation of passive film and ameliorate the resistance to limited corrosion while the external state of steel is week under the carbon situation. It would naturally be expected that carbonation would affect the diffusion of chloride ions, and then corrosion of steel due to chloride ion is affected. However reinforced concrete structures are usually coupled effect of chloride and carbonation in field condition. To accurately measure the life made of reinforced concrete, it is necessary to investigate the effects of the structure carbonization on chloride precipitated corrosion. Checking for corrosion of steel is a special challenge. Concrete because the concrete structures are composite system. How many authors have studied the corrosion of steel. A study was conducted to test and the effect of carbonation on chloride precipitation improvement and the affected of concrete pore solutions [3]. Due to increase the industrialization and pollution economic has changed citizen formation. Industry is one of the sectors which consumes ever larger quantities of natural resources, producing that waste which is destroyed or impact the environment. Also affects the infrastructures where some deterioration can observe in the structures. Therefore, it is challenge to determine the average value of physical, mechanical and stability properties of concrete made from aerated concrete. The possibility of using this material on a large scale is being considered. By using clay in concrete better mechanical strength and stability can be achieved. Thus, by limiting the use, more than 50% of total recycled content can be achieved. Concrete for application in medium exposure conditions [21].

Carbonation occurring to the concrete

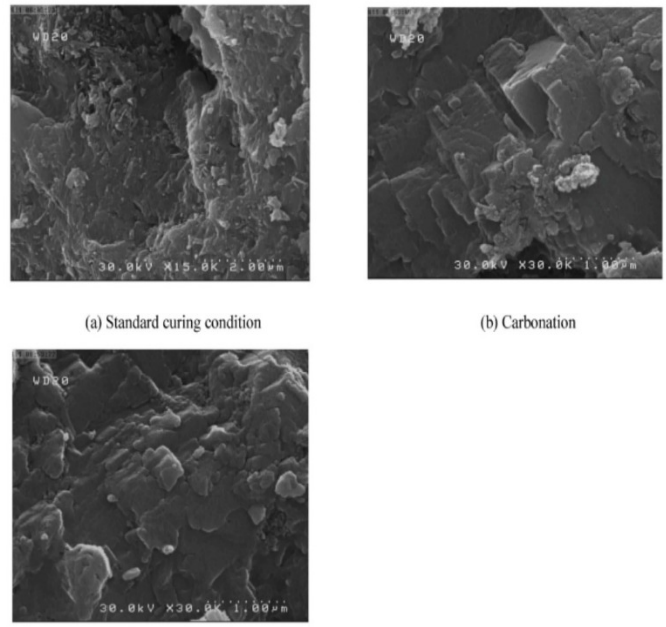
The student can check the results of his combination of two looks from the effect of aggressive environment on concrete. After this, chlorine should be added by the carbonation (Cl^- CO_2), carbonation before this chloride penetration (CO_2, Cl^-) or two components alternately [1,2,3,4]. Another carbonate ion can react to produce calcium hydroxide, calcium carbonate, filling holes in concrete [5,6].

Effects of carbonation to the concrete

Before carbonation, only one quantity was more. Lime hydroxide in excess of cement paste, later post carbonation, portlandite diffraction peaks disappeared and where displace by high calcite diffraction peaks. The percentage of calcium carbonate increases structure, which reduces the entry of outside chloride ions. On other side, carbon dioxide diminished pH value in concrete by anticipated with alkaline hydration consequences [7]. This can be seen from the XRD graph in fig No.19 Friedel's name peak is shown at 2th=11.21 degree and 11.24 degree after adding chloride solution, but after carbonization, the transition peak becomes visible. The presence of Friedel's salt in concrete is high decomposed in acidic environment, and release large amount of free chloride ions, causing corrosion of steel [7,8,9].

Carbonation and Chlorination (briefly described)

Regarding the effect of carbonation on chloride resistance of concrete, different carbonation stages conflict test result may show [10,11]. Approximately 60-70% of chloride in our concrete has been destroyed (ratio of bond Cl^- to complimentary Cl^-) post carbonation of 28 to 90 days. In this process, the products of the fire are consumed. Free chlorine appears in concrete. The concrete surface thin layer of 5-5mm will be less than that, as the same time liberated large amount of free chloride ions to deeper thin layer, therefore likely to cause corrosion of steel [13,14,15]. Carbonization of concrete to the three levels, before carbonation level, late carbonation level and complete carbonation level. The concrete at before carbonation level has compact surface structure and heavy chloride ion binding stability, grant to block the diffusion of chloride ions [10,11]. Concrete can be separated into carbon dioxide in the poor carbonized sector, soon carbonized ion and noncarbonized ion from inside to outside [10]. Aggregate has more pores and cracks, carbonation area from the carbonation shrinkage [3,10,16]. Released external chloride ions and free chloride ions can pass through this layer easily but will stop initially carbonated area [10]. The used 5% CO_2 and 2.8 mol/L sodium liquid as liability surrounding to examine the effect of 3 moths of carbonation (3CO_2) and 3 months of chloride reaction (3Cl^-). The test results are shown in Fig [19]. Eliminated the effect of name on carbonation, before and after dipping in chloride solution to make it, the dried concrete in the oven to make the indicated dampness is constant [16]. The specimen is carbonation for 3 months and chloride penetration for 3 moths (3CO_2+3Cl^-), the chloride ion specimen at surface level was very decreased and the specimen in inner was increased. It is prepared as follows chloride was used for samples are carbonation for 3 months and chloride penetration for 3 months (3Cl^- +3CO_2), the chloride ion solution in the surface level is decreased suddenly. The discrepancy is that there is a peak plateau at 5-10mm near about the surface level. This is because carbonization makes concrete a week, prevent the entry of free chloride ions from waking till outside. In increase, spread chloride ions move entering to balance cation and anion [16]. Carbonation depth of concrete normally less after existing attacked by chloride solution [13,14,19]. The main reason for this is that it will not cause chloride anion and on cement paste. The chloride solution can fill the pores of the concrete, prohibiting the carbon dioxide from involved in concrete and reacting with the hydration products [3,17,18]. The microscopic structure of concrete daily treatment status, carbonation, and the combination with chloride ions. How much calcium carbonate crawling in concrete under the carbon stone, concrete internal structure is heavy. When concrete was a compound to carbonate view of carbonation and chloride penetration [3]. Apart from this, a small amount of chloride ion also affect. Effectively reduce the total concentration of concrete, for the quantity of 100-300nm coarse capillary pores also to the formed of origination of various dispersible chloride salts, which can also avoid carbonation [19]. Fig. 1. Shows the structure for concrete due to standard curing situation, carbonation, and coupled environment of carbonation with chlorination. Under carbonation, many aggregate in concrete form calcium carbonate, which forms the internal concrete structure is highly compact [3]. When the coupled environment of carbonation and chloride penetration then the decrease cubic calcium carbonate [3].



(a) Standard curing condition

(b) Carbonation

(c) Coupled carbonation and chloride penetration

Fig. 1. Microstructure of concrete under single carbonation or coupled carbonation and chloride penetration [3].

Coupled chloride penetration and carbonation

Under the combination of concrete situations, SCMs due to fly ash adequately decrease free chloride ions something in concrete by compacting the pores and increase the chloride binding capacity of concrete by ability of fly ash is appropriate to the water cement ratio [13,10]. As shown in Fig. 2. When water cement ratio 0.47 and generally agree with the content of fly ash is 15% or 30%, the chloride binding quantity was increase by 5% and 79% [13]. Water cement ratio was more than 0.5. Which use the law is similar to that of carbon dioxide. That the minimum fly ash exchange ratio was 15% [10]. When proportion of votes to the water-cement ratio was reduced it was difficult to maintain it, improvement in the carbonization process of concrete, whenever the water-cement ratio increased, then opposite effects was observed [10]. Regarding resistance to chloride entry, there is fly ash and silica fume under concrete is coupled position [19]. The cement is indicated the ternary mixture, the mixture of spreading silica fume dust was the best, which was followed cement and silica cleaning method and the mixture of cement and fly ash. Additionally, there is chloride penetration resistance affected by carbonation [19].

To improve the efficiency of experiments, to concentration of carbon dioxide is generally hotter than that is atmosphere when the some are require the carbonation test. When the carbonated product the different formation the product in the natural state [13]. Concrete can be separated into carbon dioxide. Poor carbonized zone and outward carbonized zone. The release of residual chloride and free chloride can cause water loss. It will pass through this layer easily but will be blocked in the initial carbonized area [10].

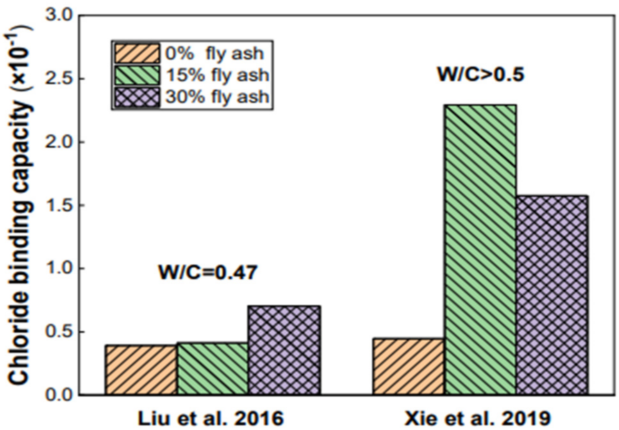

Chloride binding capacity (×10⁻¹)
0% fly ash
15% fly ash
30% fly ash
W/C=0.47
W/C>0.5
Liu et al. 2016
Xie et al. 2019
0.0
0.5
1.0
1.5
2.0
2.5
3.0

Fig.2. Chloride binding capacity of concrete with fly ash under coupled
Chloride penetration and carbonation [13,10].

2. Conclusion

After application of chloride the carbonation of concrete reduces at low temperature. SCMs can reduce the impact of free chlorides on the concrete by thickening the chloride and improving the chloride binding properties of the concrete. The effectively of fly ash is appropriate to water cement ratio. Fly ash can improve the carbonation resistance of concrete when the water cement ratio was low. Whenever the higher preparation is done the effect is found. Chloride entry is affected by carbonation. The performance of concrete under combined load and environmental action is generally lower than that under single action.

3. References

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