ARTICLE

JOURNAL`S UNIVERSITY OF BABYLON FOR ENGINEERING SCIENCES (JUBES)

مـــجلـة جـــامعة بـــــابـل للعلـــــوم الهندسية

Vol. 34, No. 2. \ 2026 ISSN: 2616 - 9916

Influence of Initial Curing on Concrete Characteristics: A Review

[a] Hawraa Najah Abass [b] Tumadhir Merawi Borhan

[a,b] *Department of Civil Engineering, University of Al-Qadisiyah, Iraq*

a) eng.civ.20.dip.6@qu.edu.iq b) tumadhir.borhan@qu.edu.iq

Received:	10/3/2026	Accepted:	9/6/2026	Published:	28/6/2026

Abstract

Concrete curing plays an important part in the production of high-quality concrete. Curing is the method of maintaining the proper temperature and moisture levels in concrete to keep the reaction between water and cement compounds continuous. It is widely acknowledged that concrete needs to be completely cured to attain its ideal properties. For different reasons, the initial curing may not be provided. A significant number of studies have found that delayed curing negatively affects the hardened concrete's properties. Controlling the moisture content of concrete can increase strength , reduce permeability, and increase durability, especially when exposed to harsh environments. It also improves compressive strength due to the reduction of the void size and ratio. This review deals with the consequences of initial curing delay time, strength grade, mix proportions, and the curing regime on the physical and mechanical properties of concrete. In addition, the variation of some properties of concrete such as strength and durability, according to the curing type and duration, is reported. This topic is very important to site engineers. The factors that affect the results of the compressive strength and durability of concrete have to be taken into consideration; thus, it is advisable to cover it more widely.

Keywords: Curing duration, Compressive strength, Delay curing, Initial curing, Durability, Mechanical properties.

1. Introduction

Concrete is considered one of the essential materials used in the construction industry. For concrete to achieve adequate properties, such as strength and durability, curing it is a significant step to be followed. It is vital in the primary phases of concrete construction, particularly to improve the cement hydration progression and optimize moisture transport into and out of the concrete as well as air temperature [1]. Curing with a sufficient quantity of water is mandatory to attain hydration of cement which ultimately contributes to concrete strength gain. Inadequate curing can lead to the depletion of 50% of its strength and appropriate curing ensures 90% attainment of concrete strength [2]. Additionally, it contributes to increasing volume stability, abrasion resistance, watertightness, and resistance to freezing and thawing [3]. With a focus on mechanical properties, durability-related behaviour, and the effects of postponing the start of curing, this paper aims to assess how initial curing conditions affect concrete attributes. This updated publication not only summarises earlier research but now incorporates the discussion in Table 1 and Figure 1, adds a clearer review methodology, and offers a more critical interpretation of contradictory findings published in the literature.

2. Review Methodology

This paper was prepared as a narrative review of published studies dealing with initial curing and delayed curing of cement-based materials. The literature was identified through keyword-based searches such as “initial curing,” “curing delay,” “curing temperature,” “curing humidity,” “air curing,” and “compressive strength of concrete.” Priority was given to peer-reviewed journal articles and conference papers that reported measurable outcomes such as compressive strength, density, permeability, shrinkage, durability indicators, or microstructural observations. Studies focused exclusively on unrelated admixture effects without a curing variable were excluded. The selected literature was then organized into four themes: temperature effects, humidity and moisture loss, curing regime and exposure condition, and delayed initiation of curing. This approach allows the review to compare experimental methods and to identify areas in which the published evidence is still limited.

Mamlouk and Zaniewski [4] claimed that the strength of concrete subjected to dry air is around 50% compared to cured concrete, 60-70% if treated for three days underwater, and 80-90% of adequately cured concrete strength for seven days.

The surface layer, between 30 and 50 mm thick, is most affected by improper concrete curing as water may evaporate from the surface of the concrete [5]. This is particularly important as it constitutes the cover zone for most reinforced concrete construction (RCC) [6]. This means that controlling the moisture can increase strength and decrease surface permeability as well. For this reason, the durability of the structure can be increased, especially when exposed to harsh environments while enhancing its compressive strength. In general, concrete properties recover with time by maintaining the cement internal moisture content at or above 80%. The improvement of concrete strength stops when the internal humidity of the concrete drops below 80%. Once the moisture percentage rises again, the improvement of the concrete strength is reactivated [7].

For a country like Iraq, where the climate is very hot in summer and temperature variation is very high in various places, it is essential to explore the effect of curing on the characteristics of concrete buildings. The importance of the primary curing humidity of concrete for the first three days after casting is reviewed and discussed in this research.

3.Factors Affecting Curing

3.1 Temperature

Temperature directly affects the rate of cement hydration and the type of hydration products that form within the paste [8,9]. Moderate temperature elevation can accelerate early-age strength gain; however, excessively high curing temperatures may produce a coarser and less homogeneous microstructure, which weakens later-age performance. For example, curing at about 20 °C generally supports better hydration products than very high-temperature exposure, while temperatures above 60 °C may improve early strength but reduce long-term strength if they are not properly controlled [10].

Curing conditions were investigated by Aghabaglou et al. [11] strength gain of steam-cured mortar specimens at various temperatures was investigated. The specimens were cured in a steam-curing cabin for the first 24 hours after being placed in the mould at 95% relative humidity (RH) at five temperature levels: 20, 35, 50, 65, and 80 C. Then, after demoulding, the samples wre immersed in water until the test. The findings showed that using steam-curing at high temperatures, for the first 24 hours, had a good influence on the first-day compressive strength which was 60% higher than that of the reference mix. However, the rise in the curing temperature up to 80°C had a detrimental consequence on the specimens' 28-day compressive strength performance. This adverse impact is thought to be caused by the early creation of C-S-H gel with bigger voids and a non-homogeneous structure throughout the first 24 hours after casting.

The hydration process that happens during the hardened phase of concrete, may be affected by the surrounding environment. Low humidity, high temperature, wind, and other conditions are just some of the limitations that must be taken into account throughout the concrete setting process [12]. Two phenomena influence concrete curing; water evaporation and self-desiccation. They are accelerated by high temperature, dry atmosphere, and strong wind due to the speed of cement hydration [13] . It is not recommended to cast concrete at high temperatures, especially as they exceed 35 degrees Celsius [14]. Therefore, regulating the concrete's temperature is essential to the curing process. In the initial hours following placement, cold structures or slabs may hydrate very slowly or not at all. It could be necessary to use safeguards against plastic shrinkage cracking or to keep forms in place longer [15]. Conversely, the temperature differential between the inside and exterior of the concrete is more likely to result in cracking if it is allowed to get too hot during the first few hours [16].

3.2 Humidity and Moisture Loss

Humidity is equally important because hydration cannot continue without sufficient internal water. Low relative humidity, high wind velocity, and high ambient temperature accelerate evaporation and self-desiccation, increasing the risk of plastic shrinkage cracking and early interruption of hydration [17].

Das et al.[18] showed that the relative humidity applied during the first 24 h after casting had a significant effect on compressive strength, especially for concretes containing pozzolanic cement. Different relative humidity (RH) levels of 50%, 60%, 70%, 80%, and 95% were applied on the first day after casting. Portland Pozzolan cement (PPC) and ordinary Portland cement (OPC) with a 0.45 water-to-cement ratio were utilized. Additionally, the study investigated five different underwater curing durations of 3, 7, 28, 56, and 90 days. The outcomes indicated that the initial twenty-four-hour curing period following the placement of concrete under varying relative humidity conditions is an essential factor that considerably influences the properties of the concrete. The compressive strength values of PPC concrete exhibited minimal variation during extended curing times, with only 6.65% and 0.95% reductions observed at 28 and 90 days, respectively. The delayed formation of hydration products in PPC concrete might be ascribed to the slower pozzolanic reactions that occur during the early stages. As the age of the material increases, it undergoes a process of microstructural densification, leading to an observed enhancement in compressive strength values.

3.3 Curing Environment .Duration and Curing Method

The curing of concrete depends on many factors. The environment in which the concrete was placed, plays an important part in whether the concrete was placed into moulds, spread on the ground, or submerged in water. In addition, environmental and storage conditions, with or without wetting, during curing process, have a major effect on the final product's strength. The influence of variations in the curing procedures can be clearly observed in concrete samples stored inside. The strength of concrete stored outdoors is lower than that stored indoors, regardless of the curing method adopted [19].

Other curing arrangements can also alter performance. Bakir [20] found that wet coverings and polyethylene sheets reduced water loss in hot conditions, while Amadi and Amadi-Oparaeli [21] showed that the sensitivity to curing depends partly on the admixture system. Abdulla [22] further demonstrated that protective plastic forms could reduce heat and moisture exchange, thereby altering the early curing environment. Taken together, these studies show that initial curing is not determined by one variable alone; instead, the final outcome depends on the combined effects of temperature, humidity, exposure condition, mixture composition, and curing duration.

The laboratory study conducted by Abalaka and Okoli [23], was performed in two stages. First, two sets of concrete specimens, having similar mix proportions, were poured and demoulded after 24 hours**;** one set was constantly immersed in water. The second set was kept uncured on the laboratory floor until their compressive strength was measured at 3, 7, 14, 28, and 90 days. The second stage started after 24 hours when the cubes and cylinders were de-moulded and immersed in water for intervals of 1, 2, 3, 4, 5, 6, 7, 14, and 28 days. Then, the cubes were kept on the lab floor and strength was examined at the ages of 28 and 90 days. The outcomes revealed that specimens cured underwater had better mechanical properties than uncured specimens. The findings also demonstrated that after 90 days, the compressive strength of air-cured cubes was 9.53% lower than that of water-cured cubes. The strength increased in water-cured specimens due to the formation of CSH gel stimulated by continuous cement hydration.

Arslan et al. [24] analysed the effect of the different curing regimes on concrete compressive strength. Fifty-four specimens were cast and tested at the ages of 3, 7, 10, 14, 21, and 28 days for this purpose. These specimens were positioned in diverse curing environments for each age day of 3, 7, 10, 14, 21, and 28 days. Three of the specimens were subjected to the same open environment as the actual building without curing. Another three were placed in water, and three specimens were cured with a curing compound. The cement was ordinary Portland cement with a w/c of 0.45. Concrete samples cured with water always had higher strengths than uncured samples and those cured using compound agents, Whereas its compressive strength is equal to **32.4** MPa. While the compressive strength of uncured specimens is equal to 29.6 MPa at 28 days.

The study conducted by Amadi and Amadi-Oparaeli [21] examined the impact of curing conditions on concrete compressive strength that incorporates chemical admixtures. A total of five mixtures were formulated in the study, consisting of a control mix (WP) and mixtures with four different admixtures; waterproof (WP), chloride-free accelerator (ACC), and two superplasticizers- Polycarboxylate Ether (PCE) (SP1) and Sulphonated Naphthalene Formaldehyde condensates (SNF) (SP2). The control mix was M30 concrete with a w/c of 0.55 and a slump range of 150-180mm. To achieve the desired slump, appropriate water reduction was implemented for mixes comprising admixtures. The concrete samples were separated into two groups. The first one was cured in water and the second one was cured in air. The compressive strength was evaluated at three distinctive time intervals of 3, 7, and 28 days. The SP2 mixture had the lowest strength difference between cured and uncured samples at 28 days, with a strength loss of 4.73% while the ACC mixture had the greatest reduction in strength, with a loss of 15.21%. The presence of a catalysed hydration reaction could explain the observed considerable difference. Accelerators speed up the hydration of cement tricalcium silicate (C3S) and tricalcium aluminate (C3A) phases, resulting in higher temperatures**.**

Sun et al. [25] explored the influence of various curing temperatures and relative humidity on the compressive strength of cement mortars. The mix proportion adopted in their study was 1:2.75 (cement: sand) with a 0.5 w/c. An automatic curing chamber provided a consistent relative humidity and temperature while curing the specimens. This investigation incorporated four levels of relative humidity: 70, 80, 90, and 100%. As well as, three levels of temperature were examined: 10, 18, and 40oC. The results demonstrated that the relative humidity substantially influences the compressive strength of the cement mortar. The compressive strength of the mortars declines with a decrease in curing relative humidity. This reduction becomes more pronounced as curing progresses. During curing time at the same relative humidity (RH), specimens subjected to elevated temperatures can attain greater early-age strength.

Anwar et al. [26] investigated the effect of different curing regimes on the compressive strength of concrete. Four curing regimes were employed : air curing, polythene curing, water-submerged curing, and boiling curing. Mixtures with a 1:1.5:3 mixing ratio and a w/c of 0.5 were prepared. The specimens were tested at 3, 7, 14, 21, and 28 days. The results indicated that specimens of concrete cured by water immersion attained a maximum compressive strength of 41.42MPa after 28 days. Additionally, the results implied that uncured concrete may be utilized in hilly areas where the humidity is higher and the temperature is lower. In barren regions, the performance of uncured concrete would be substandard. Uncured concrete has a lower density and greater porosity. A positive correlation has been established between the curing duration, specimen curing, and compressive strength of concrete.

3.4 Comparative Synthesis of Previous Studies

Figure 1 and Table 1 show a comparison between the results obtained by many researchers who demonstrated the outcomes of air-curing (un-curing conditions) on the compressive strength of concrete. NSC has a compressive strength range from 30 to 40 MPa. All authors determined the compressive strengths for air-dry curing procedures at ages of 3, 7, and 28 days.

Table 1: Reported compressive strength of air-cured concrete from previous studies.

Study	Age (days)	Compressive strength (MPa)
Akinwumi and Gbadamosi[27]	3,7,28	3.62,9.5,16.5
Osei et al [28]	3,7,28	7,12.9,18.8
Raheem et al.[1]	3,7,28	11.9,16,17.8
Jasmine et al [29]	3,7,28	13.5,19.56,28
Arslan et al [24]	3,7,28	15,20,29

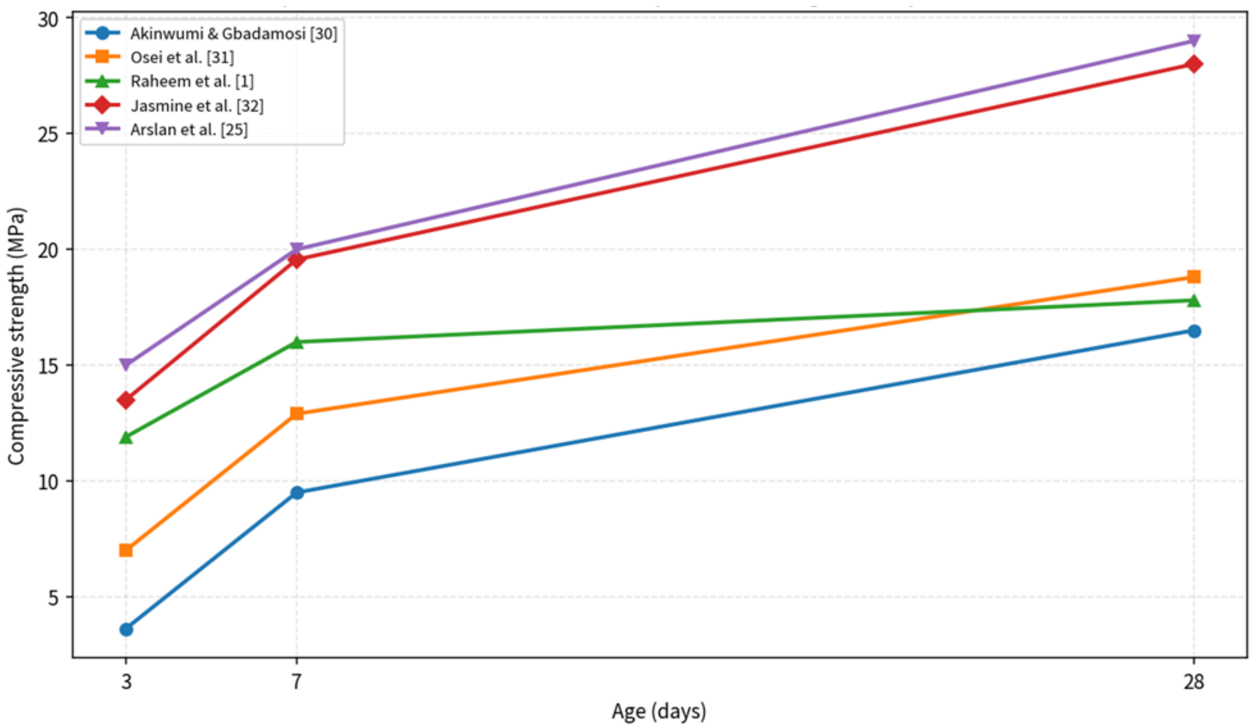

Figure 1: comparison of air-cured concrete compressive strength from previous studies.

The results of Akinwumi and Gbadamosi [27] show a reduction in strength compared to that of the results obtained by Osei et al[28] . The difference in the results could be related to the concrete's exposure to external environments. Gayarre et al. [30] discovered that concrete cured outside had a lower compressive strength than concrete cured indoors. The result attained by Raheem et al.[1] is better than that of Akinwumi and Gbadamosi [27] and Osei et al.[28] , although the mix proportions are the same and the ratio of w/c is higher, which is 0.65. This is because of the exposure conditions of the specimens which were subjected to ambient air in the laboratory with a high relative humidity of 75%.

Figure 1 also demonstrates that despite using the same 0.45 w/c ratio, similar materials and proportions, and the same air curing method, the results obtained by Arslan et al [24] are better in compressive strength than Jasmine et al. [29] .This is explained by the inclusion of the superplasticizer, which disperses the cement particles and allows water that has been trapped by cement clusters to be released. Thus, the higher the class of concrete, the lower the drop in compressive strength and the higher the water/cement ratio, the higher the loss in compressive strength as a result of curing delays.

A second point of comparison concerns early-age versus later-age performance. High curing temperature and rapid moisture loss can increase short-term strength in some cases, yet the same conditions may reduce 28-day strength because the resulting microstructure is more porous and less stable [12,18]. This explains why studies that focus only on one-day or three-day strength may reach a different practical conclusion from studies that evaluate 28-day or 90-day strength.

4. Effect of Curing Delay on Concrete Properties

Delaying the start of curing is one of the most harmful forms of inadequate curing because it exposes fresh concrete to evaporation before a stable hydration structure has formed. The first day after casting is especially critical.

Al-Ani & Al-Zaiwary [31] focused on showing that the delay in curing harms concrete. The largest effect of the delay is on the first day. Ordinary Portland cement was used to prepare four different cement contents. Each mix was subjected to 15 different curing conditions. The first group of specimens was cured immediately outside the lab by covering it with wet burlap twice throughout the day for ages 1, 3, 7, 14, and 28 days and then cured in air until testing. When curing was delayed or interrupted, significant fluctuations in the length of the concrete (expansion, and shrinkage) were observed. This is undesirable since the cracking tendency develops, particularly at early ages.

James et al. [32] smilarly found that specimens left uncured for the first two days had the lowest density and compressive strength among the tested curing regimes.The concrete specimens were subjected to different curing conditions (ponding, plastic sheet, sprinkling, wet-covering, entirely uncured conditions (open air), and cubes left uncured for two days before curing). According to the results, ponding had the highest density and compressive strength, next are wet covering, and sprinkling. The last is the uncured specimens for two days. The results revealed that utilizing ponding curing leads to enhancing the pore structure and minimising porosity which makes it a better method for curing concrete. This is due to the greater degree of cement hydration whithout any moisture loss from the concrete cubes. The cubes that have not been cured possess the lowest density and compressive strength, together with the highest of shrinkage.

Nhabih et al. [33] extended this observation to both high-strength concrete (HSC) and normal-strength concrete (NSC). The curing of the specimens was delayed for 0, 1, 3, and 7 days, then immersed in water before being tested at 28 days. As well as, a number of specimens were left uncured for 28 days. Delaying initial curing affects the durability and mechanical properties of both types of concrete. The degree of cement hydration and the amount of hydration products were also decreased, resulting in an increase in the mean diameter of the pores. It was also shown that delaying the start of curing for 28 days reduces the compressive strength of the HSC by 22.3% and the NSC by 15.8% compared to the compressive strength of concrete cured underwater immediately after casting. The first day of hydration was the most affected by the curing delay.

Wang et al. [34] reported that, for reactive powder concrete subjected to subsequent steam curing, an appropriate pre-steam delay improved later compressive strength and reduced long-term strength loss by allowing more favorable hydration before thermal exposure. This result does not contradict the normal-concrete studies above; instead, it shows that a controlled delay under sealed or protected conditions can be beneficial in special heat-cured systems, whereas an uncontrolled delay under drying field conditions is usually harmful. Therefore, the term “curing delay” should always be interpreted together with the environment that exists during the delay period.

From a practical perspective, delayed curing affects concrete through three linked mechanisms: moisture loss from the exposed surface, interruption of hydration in the cover zone, and growth of pore size due to insufficient product formation. These mechanisms reduce strength, increase permeability, and make later curing unable to fully recover the lost performance. For field concrete, this means that curing should begin as soon as the surface condition permits and should not be postponed because of labor gaps, holidays, or inadequate site supervision.

5.Critical Discussion and Knowledge Gaps

The start of curing might be postponed if there is a holiday following the casting day, or if building guards fail to provide proper and sufficient treatment . When curing is neglected or delayed, particularly during the early stages of the hydration process, the quality of concrete suffers irreparable damage. In general, variables such as temperature, curing time, the type of sample cured, the type of curing, and the duration and environment of curing. Whether the concrete was placed into moulds, spread out on the ground, or submerged in water have a significant effect on concrete strength development. High temperature and low humidity have a negative effect, while initial curing time has a positive effect. Water-curing methods are typically not applicable to site-specific concrete due to the inherent difficulties involved. Many concrete structures are not treated for a sufficient period to ensure obtaining the required properties. For site engineers, clarification of such matters will be valuable. Numerous researchers have investigated the effect of the curing method on the mechanical properties of concrete. However, there is limited research that mentions the effect of delaying the curing time on concrete strength considering different parameters. The important parameters are the type of cement, strength grade, the time of demoulding the specimens, or curing delay, and the inclusion of chemical admixtures. A limited number of researchers noticed that the delay in curing harms the concrete. The delay has the greatest effect on the first day, although continuing the treatment after the wait results in an increase in strength. This does not lead to repairing the reduction in strength caused by the delay. Due to the evaporation of pore water in the concrete, this may cause a partial blockage of the surface capillaries by converting the calcium hydroxide at the surface to calcium carbonate. The resultant calcium carbonate makes it difficult to get water back into the concrete.

The importance of this topic for site engineers makes it necessary to be covered more broadly, to take into account the factors mentioned previously, and to study their effect on the results of the compressive strength of concrete.

6.Conclusions

This review confirms that initial curing is a decisive stage in concrete production because it governs the continuity of hydration and the development of the near-surface microstructure. Temperature, relative humidity, curing duration, exposure condition, and curing method all interact to determine the final mechanical and durability performance of concrete.

The first 24 h after casting is the most sensitive period. Water curing and other moisture-retaining methods consistently outperform air curing, while low humidity and high temperature accelerate evaporation and reduce later-age strength. Differences among published results are mainly attributable to differences in the actual exposure condition, mixture design, and curing sequence rather than to contradictions in the basic curing mechanism.

Delayed curing is generally harmful for normal concrete exposed to drying conditions because early moisture loss cannot be fully compensated by later curing. However, controlled delay periods may be beneficial in specialized heat-cured systems such as reactive powder concrete, which highlights the importance of distinguishing between unprotected field delay and protected pretreatment delay. For ordinary site concrete, curing should start as early as practicable and should be maintained continuously during the initial hydration stage.

7.Future Research Needs

Future studies should quantify allowable curing delays under realistic site conditions, especially in hot and arid climates. Additional research is required on blended cements, self-curing systems, and concretes containing supplementary cementitious materials or chemical admixtures. It is also recommended that future experiments combine compressive strength, permeability, shrinkage, and microstructural analysis so that the influence of delayed curing can be assessed in a more comprehensive and practice-oriented way.

References

[1] A. A. Raheem, A. A. Soyingbe, and A. J. Emenike, “Effect of curing methods on density and compressive strength of concrete,” International Journal of Applied Science and Technology, vol. 3, no. 4, 2013.

[2] R. P. Memon, A. R. M. Sam, A. Z. Awang, and U. I. Memon, “Effect of improper curing on the properties of normal-strength concrete,” Engineering, Technology & Applied Science Research, vol. 8, no. 6, 2018.

[3] D. Gowsika, P. Balamurugan, and R. Kamalambigai, “Experimental study on curing methods of concrete,” International Journal of Engineering Development and Research, vol. 5, no. 1, 2017.

[4] M. S. Mamlouk and J. P. Zaniewski, Materials for Civil and Construction Engineers. London, UK: Pearson, 2014.

[5] A. M. Neville, Properties of Concrete, 5th ed. Harlow, England: Prentice Hall, 2011.

[6] N. Gowripalan, “Effect of curing on durability,” Concrete International, vol. 12, no. 2, pp. 47–54, 1990.

[7] Wang, J., Long, G., Xiang, Y., Dong, R., Tang, Z., Xiao, Q., ... & Ma, K. (2022). Influence of rapid curing methods on concrete microstructure and properties: A review. Case Studies in Construction Materials, 17, e01600.

[8] Chróścielewski, J., Mariak, A., Sabik, A., Meronk, B., & Wilde, K. (2016). Monitoring of concrete curing in extradosed bridge supported by numerical simulation. Advances in Science and Technology. Research Journal, 10(32).

[9] H. Lee, V. Vimonsatit, and P. Chindaprasirt, “Residual strength of blended cement pastes and mortar exposed to elevated temperatures,” Electronic Journal of Structural Engineering, vol. 16, pp. 26–37, 2016.

[10] M. Kioumarsi and H. Vafaeinejad, “Effect of initial curing temperature on mechanical strength of concrete,” in Proceedings of the Sixth International Symposium on Life-Cycle Civil Engineering (IALCCE 2018), Ghent, Belgium, Oct. 2018, pp. 637–643.

[11] A. Mardani-Aghabaglou, S. Özen, and M. G. Altun, “Effect of curing conditions during the first 24 hours after casting on the properties of mortar mixtures,” Revista de la Construcción, vol. 19, no. 1, pp. 68–79, 2020.

[12] M. Safiuddin, A. B. M. A. Kaish, C.-O. Woon, and S. N. Raman, “Early-age cracking in concrete: Causes, consequences, remedial measures, and recommendations,” Applied Sciences, vol. 8, no. 10, p. 1730, 2018.

[13] A. M. Zeyad, “Effect of curing methods in hot weather on the properties of high-strength concretes,” Journal of King Saud University – Engineering Sciences, vol. 31, no. 3, pp. 218–223, 2019. doi:10.1016/j.jksues.2017.04.004.

[14] Z. Mi, Y. Hu, Q. Li, and Z. An, “Effect of curing humidity on the fracture properties of concrete,” Construction and Building Materials, vol. 169, pp. 403–413, 2018.

[15] L. Li, V. Dao, and P. Lura, “Autogenous deformation and coefficient of thermal expansion of early-age concrete: Initial outcomes of a study using a newly developed temperature stress testing machine,” Cement and Concrete Composites, vol. 119, p. 103997, 2021.

[16] C. Zou, G. Long, C. Ma, and Y. Xie, “Effect of subsequent curing on surface permeability and compressive strength of steam-cured concrete,” Construction and Building Materials, vol. 188, pp. 424–432, 2018.

[17] T. Lee and J. Lee, “Setting time and compressive strength prediction model of concrete by nondestructive ultrasonic pulse velocity testing at early age,” Construction and Building Materials, vol. 252, p. 119027, 2020.

[18] B. B. Das, D. N. Singh, and S. P. Pandey, “Influence of initial curing humidity on compressive strength and ultrasonic properties of concrete,” Indian Concrete Journal, vol. 88, pp. 48–55, 2014.

[19] H. Samouh, E. Rozière, and A. Loukili, “Influence of formwork duration on the shrinkage, microstructure, and durability of cement-based materials,” in CONCREEP 10, 2015, pp. 1119–1128.

[20] N. Bakir, “Experimental study of the effect of curing mode on concreting in hot weather,” Journal of Composite and Advanced Materials, vol. 31, no. 4, 2021.

[21] I. G. Amadi and K. I. Amadi-Oparaeli, “Effect of curing conditions on durability and strength of concrete containing chemical admixtures,” IOSR Journal of Mechanical and Civil Engineering, vol. 16, no. 3, pp. 53–59, 2019. doi:10.9790/1684-1603045359.

[22] N. A. Abdulla, “Assessment of Key Parameters Affecting Compressive Behavior of uPVC-Confined Concrete,” Journal of Civil Engineering and Construction, vol. 11, no. 2, pp. 89–103, 2022. doi:10.32732/jcec.2022.11.2.89.

[23] A. E. Abalaka and O. G. Okoli, “Effects of limited initial curing durations on mechanical properties of concrete,” Journal of Civil Engineering and Construction Technology, vol. 4, no. 3, pp. 104–109, 2013.

[24] M. Arslan, M. A. Saleem, M. Yaqub, and M. S. Khan, “The effect of different curing conditions on compressive strength of concrete,” Pakistan Journal of Scientific and Industrial Research, Series A: Physical Sciences, vol. 60, no. 3, pp. 147–154, 2017.

[25] K.-H. Yang, J.-S. Mun, and M.-S. Cho, “Effect of curing temperature histories on the compressive strength development of high-strength concrete,” Advances in Materials Science and Engineering, vol. 2015, 2015.

[26] A. Anwar, H. Tariq, S. Adil, and M. A. Iftikhar, “Effect of curing techniques on compressive strength of concrete,” World Journal of Advanced Research and Reviews, vol. 16, no. 3, pp. 694–710, 2022. doi:10.30574/wjarr.2022.16.3.1379.

[27] I. I. Akinwumi and Z. O. Gbadamosi, “Effects of curing condition and curing period on the compressive strength development of plain concrete,” International Journal of Civil and Environmental Research, vol. 1, no. 2, pp. 83–99, 2014.

[28] D. Y. Osei, Z. Mustapha, and M. D. H. Zebilila, “Compressive strength of concrete using different curing methods,” Journal of Social Development Sciences, vol. 10, no. 3(S), pp. 30–38, 2019.

[29] G. V. Jasmine, M. P. Kumar, and P. M. Raju, “Study on early age and ultimate compressive strength of M30 grade self-curing concrete,” IOP Conference Series: Materials Science and Engineering, vol. 1025, no. 1, p. 012018, 2021. doi:10.1088/1757-899X/1025/1/012018.

[30] F. L. Gayarre, C. L.-C. Perez, M. A. S. Lopez, and A. D. Cabo, “The effect of curing conditions on the compressive strength of recycled aggregate concrete,” Construction and Building Materials, vol. 53, pp. 260–266, 2014.

[31] S. H. Al-Ani and M. A. K. Al-Zaiwary, “The effect of curing period and curing delay on concrete in hot weather,” Materials and Structures, vol. 21, no. 3, pp. 205–212, 1988.

[32] T. James, A. Malachi, E. W. Gadzama, and A. Anametemok, “Effect of curing methods on the compressive strength of concrete,” Nigerian Journal of Technology, vol. 30, no. 3, pp. 14–20, 2011.

[33] H. T. Nhabih, A. M. Hashim, and M. M. Salman, “Effect of delay curing start on durability and mechanical properties of high and normal strength concrete,” Journal of Engineering and Applied Sciences, vol. 13, Special Issue 10, pp. 8216–8223, 2018. doi:10.3923/jeasci.2018.8216.8223.

[34] X. Wang, Q. Zhao, X. He, and S. Zhang, “Mechanism analysis of the influence of delay period on mechanical properties of reactive powder concrete,” Frontiers in Materials, vol. 7, 2021. doi:10.3389/fmats.2020.563234.

ARTICLE
JOURNAL`S UNIVERSITY OF BABYLON FOR ENGINEERING SCIENCES (JUBES)
مــــجلــة جـــــامعة بـــــابـل للعلـــــوم الهندسية
Vol. 34, No. 2. \ 2026
ISSN: 2616 - 9916

تأثير المعالجة الأولية على خصائص الخرسانة: مراجعة

حوراء نجاح عباس **تماضر ميراوي برهان**

قسم الهندسة المدنية، كلية الهندسة ،جامعة القادسية ،العراق

eng.civ.20.dip.6@qu.edu.iq tumadhir.borhan@qu.edu.iq

الخلاصة

تُعدّ معالجة الخرسانة عمليةً بالغة الأهمية في إنتاج خرسانة عالية الجودة. وتُعرّف المعالجة بأنها الحفاظ على درجة الحرارة ومستويات الرطوبة المناسبة في الخرسانة لضمان استمرار التفاعل بين الماء ومكونات الأسمنت. ومن المسلّم به أن الخرسانة تحتاج إلى معالجة كاملة للوصول إلى خصائصها المثالية. ولأسباب مختلفة، قد لا تتم المعالجة الأولية. وقد أظهرت العديد من الدراسات أن تأخير المعالجة يؤثر سلبًا على خصائص الخرسانة المتصلبة. ويمكن للتحكم في محتوى الرطوبة في الخرسانة أن يزيد من صلابتها، ويقلل من نفاذيتها، ويعزز متانتها، لا سيما عند تعرضها لظروف بيئية قاسية. كما يُحسّن ذلك من مقاومتها للضغط نتيجةً لتقليل حجم الفراغات ونسبتها. تتناول هذه المراجعة تأثير مدة تأخير المعالجة الأولية، ودرجة مقاومتها، ونسب الخلط، ونظام المعالجة على خصائصها الفيزيائية والميكانيكية. بالإضافة إلى ذلك، تُعرض دراسة لتغير بعض خصائص الخرسانة، مثل مقاومتها ومتانتها، وفقًا لنوع المعالجة ومدتها. يُعدّ هذا الموضوع بالغ الأهمية لمهندسي المواقع، إذ يجب مراعاة العوامل التي تؤثر على نتائج مقاومة الخرسانة للضغط ومتانتها. لذا، يُنصح بتوسيع نطاق التغطية.

الكلمات الدالة: مدة المعالجة، قوة الضغط، المعالجة المتأخرة، المعالجة الأولية، المتانة، الخواص الميكانيكية.
