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Water absorption capacity of concrete cubes with sorptivity coefficient

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Abstract

The quantity of water present in the concrete matrix controls many fresh and hardened properties of concrete such as workability, compressive strengths, permeability and water tightness, durability and weathering, drying shrinkage and potential for cracking. The successful key for making durable concrete is to limit its ability to transport fluids like water. In the present research work, water absorption test was carried out on concrete cubes to assess the rate of water absorption characteristics on concrete sorptivity coefficient in designed concrete mixtures type. It's confirmed from the results that, the water absorption is co-related with sorptivity coefficient of concrete by the power type of equation. It's clear from the research work that for in case of constant concrete compressive strength and varied slump value, the rate of water absorption capacity (sorptivity coefficient) was slightly increased in concrete mix design as when compared to the concrete mix design with varied concrete compressive strength and constant slump value. The rate of water absorption was increased in lower concrete compressive strength and constant slump values and goes on decreases with increase in concrete compressive strength for in concrete mix design. For in case of constant concrete compressive strength and varied slump value, the rate of water absorption was slightly increased in concrete mix design as when compared to the concrete mix design with varied concrete compressive strength and constant slump value. The rate of water absorption was increased in lower concrete compressive strength and constant slump values and goes on decreases with increase in concrete compressive strength for in concrete mix design. Water absorption is decreased in constant higher concrete compressive strength/varied slump value for in case of different concrete mixtures type and the sorptivity coefficient was observed to deceased in the concrete mix design respectively. Whereas, the rate of water absorption is increased in varied concrete compressive strength/constant slump value for in case of different concrete mixtures type and the sorptivity coefficient was observed to increase in the concrete mix design respectively. It's also confirmed from the results that, the rate of water absorption and sorptivity coefficient was goes on decreases with increase in the concrete compressive strength and constant slump value for in case of concrete mix design.

Keywords: Concrete, mixture proportion, grade of concrete, water-cement ratio, water absorption, sorptivity.

1. Introduction

The concrete infrastructures such as bridge decks, parking garages, pre-stressed concrete structures, steel structures, and marine structures may deteriorate when they are exposing to de-icing agents. The de-icing agents can be absorbed into the pores of concrete and can modify the cementitious matrix structure. Interaction between the de-icing agents and the cementitious matrix may result in the deterioration of concrete structures [W. Jones, *et al,* 2013]. Physical damage can occur due to a number of processes such as exposure of concrete with a high degree of saturation to freeze-thaw cycles [Li, *et al*, 2012], scaling of concrete surfaces [Jacobsen, *et al*, 1997], crystallization of salt in concrete pores that results in production of an internal stress [Scherer, *et al*, 1999], and expansive forces as a result of corrosion of reinforcement when a chloride-based de-icing salt is used [Wang, *et al*, 2014]. While the physical attack of de-icing salts has been widely investigated, the chemical reaction between the matrix and the de-icing salts has been investigated often less frequently. The use of de-icing salts can cause damage in cementitious materials even if a concrete does not experience freezing and melting [Marchand, *et al*, 1994]. This may be cause by the formation of Friedel's salt, Kuzel's salts [Collepardi, *et al*, 1994], and/or calcium oxychloride, changes in the pore solution properties [Farnam, *et al*, 2014], or changes in the microstructure of hydration products [Pigeon, *et al*, 1986]. De-icing salt solution, like many external solutions, dissolve calcium hydroxide, causing leaching that leads to an increase in permeability and a reduction of concrete alkalinity [Muethel, 1997]. De-icing salts have different chemical and physical interactions with cementitious materials. The use of NaCl de-icing salt increase freeze-thaw damage in concrete. This increase in freeze-thaw damage has been explain by the formation of an unexpected phases and the creation of osmotic pressures [Farnam, *et al*, 2014]. Concrete exposed to $CaCl_2$ and $MgCl_2$ de-icing salts exhibited changes in the concrete microstructure. These changes have been accompanied by a severe cracking and deterioration, even if the concrete did not experience any freeze-thaw cycles [Collepardi, *et al*, 1994]. The concrete infrastructures were deteriorating in different regions of the world without satisfying the stipulated service life. Therefore, there is a need to predict service life, which is a major task in the design of concrete infrastructures. In fact, the chloride concentration is a major cause of any early deterioration of reinforced concrete infrastructures. Because of this concrete deterioration, it may lead to cracking, spalling, and de-lamination of concrete cover, reduce load carrying capacity, and cross-sectional area of reinforcement. Whereas, in the cold countries region it may lead to pre-mature deterioration of concrete infrastructures due to the application of de-icing salts on roads and concrete infrastructures. In fact, the bridge-decks were simultaneously expose to wetting-drying condition and, it has subjected to direct impact as well as repeated loading by continuous flow of traffic. Almost all the concrete structures were working under dry conditions. Even though most of the researchers have dedicated their efforts to study transport of chloride in concrete under wet conditions with limited publication data on dry concrete. In fact, major diffusion models are applicable to the concrete structures that remains fully wet condition at all the times. They underestimate the amount of chloride penetrating a concrete structure, which is subject to wetting/drying for in case of splash/tidal zones of structures exposed to marine environment/highway structures exposed to de-icing salts. An experimental study is performing on the influence of water absorption in ordered to evaluate the effectiveness of durability of concrete by researchers [Zhang, *et al*, 2014]. In this way, service life of reinforced concrete structures erected in an aggressive environment such as marine climate can be significantly extend for long time duration.

2. Research objectives

The importance of water absorption as a durability-based material property has received greater attention only after the revelation that water induced corrosion is the major problem for concrete durability. The present research work is made an attempt to interpret the concrete water absorption in ordered to characterize the different concrete mixtures design for in case of concrete cubes. Thus, the objectives of this present research are to examine the influence of concrete water absorption on the results of rate of water absorption (sorptivity coefficient) in different concrete mixtures type. In which slump, and w/c ratio value varied with constant compressive strength as in the First case and compressive strength, and w/c ratio value varied with constant slump as in the Second case. Seventy-two concrete cubes (100 mm^3) with grades of concrete ranges from 25-40 N/mm^2 were prepared and evaluate for the rate of water absorption with sorptivity coefficient in the designed concrete mixes.

3. Experimental program

In the present research work, six different mixtures type were prepared in total as per [BRE, 1988] code standards with concrete cubes of size (100 mm^3). Three of the mixtures type were concrete cubes (100 mm^3) with a compressive strength 40 N/mm^2, slump (0-10, 10-30, and 60-180 mm), and different w/c (0.45, 0.44, and 0.43). These mixtures were designate as M1, M2, and M3. Another Three of the mixtures type were concrete cubes with a compressive strength (25 N/mm^2, 30 N/mm^2, and 40 N/mm^2), slump (10-30 mm), and different w/c (0.5 0.45, and 0.44). These mixtures were designate as M4, M5, and M6. The overall details of the mixture proportions were represented in Table 1-2. Twelve concrete cubes of size (100 mm^3) were casted for each mixture and overall, seventy-two concrete cubes were casted for six types of concrete mixture. The coarse aggregate used was crush stone with maximum nominal size of 10 mm with grade of cement 42.5 N/mm^2 and fine aggregate used was 4.75 mm sieve size down 600 microns for this research work.

Table 1
Variable: slump and W/C value; constant: compressive strength

Mix ID	Comp/mean target stg, N/mm^2	Slump (mm)	W/C	C (Kg)	W (Kg)	FA (Kg)	CA (Kg) 10 mm	Mix proportions
M1	40/47.84	0-10	0.45	3.60	1.62	5.86	18.60	1:1.63:5.16
M2	40/47.84	10-30	0.44	4.35	1.92	5.62	16.88	1:1.29:3.87
M3	40/47.84	60-180	0.43	5.43	2.34	6.42	14.30	1:1.18:2.63

Table 2
Variable: compressive strength and W/C value; constant: slump

Mix ID	Comp/mean target stg, N/mm^2	Slump (mm)	W/C	C (Kg)	W (Kg)	FA (Kg)	CA (Kg) 10 mm	Mix proportions
M4	25/32.84	10-30	0.50	3.84	1.92	5.98	17.04	1:1.55:4.44
M5	30/37.84	10-30	0.45	4.27	1.92	6.09	16.50	1:1.42:3.86
M6	40/47.84	10-30	0.44	4.35	1.92	5.62	16.88	1:1.29:3.87

3.1 Water absorption test

The size (100 mm^3) of concrete cubes after casting was immersed in water for about 28 days curing. These specimens were then oven dried at 50 ±2º C for 3 days until the mass became constant and again weighed. This weight was noted as the dry weight (W1) of the concrete cube. After that, specimens were put in contact with water from one surface with water level not more than 5 mm above the base of specimen and the flow from the peripheral surface is prevented by sealing it properly with non-absorbent coating for a specified time interval as per [ASTM C 1585] with their arrangement as shown in Figure 1. Then this weight is noted as the wet weight (W2) of the concrete cube.

Fig. 1. Water absorption in concrete cubes

$$\text{Water absorption } (\%) = \left[\frac{W2-W1}{W1}\right] X100 \tag{1}$$

The water absorption test is carried out on 72 concrete cubes with size (100 mm^3) in all six mixtures type (M1-M6). In which ASTM C1585 is commonly used to determine the absorption and rate of absorption of water in unsaturated hydraulic cement concretes. The results confirm that, the water absorption testing is considerably influenced by sample preparation. Samples that were conditioned in the oven at 105^0 C do not appear to follow a similar trend as when compared with specimens conditioned in chambers at lower temperatures for a longer time duration. The absorption is also influenced by the volume of paste in the samples. The experiments show that, a lack of control on moisture content or lack of consideration of the material composition may lead to a misunderstanding of the actual absorption behaviour. The water absorption is increased (49.76%) at time duration 5 min as when compared to initial time duration 0 min in all mixtures type (M1-M6). The water absorption (87.98%) is predominantly increased at longer time duration (28 day). The water absorption (48.91-50.57%) at 0 min as well as (87.82-88.13%) at 28 days is little bit varied as when compared to different mixtures type (M1-M3) and (M4-M6). Similarly, the water absorption is more increased in mixture type (M4) for lower compressive strength with constant slump value. Also, the water absorption is goes on decreased with increased compressive strength in case of mixture type (M5), but increased with compressive strength in mixture type (M6) at an initial stage as well as at longer time duration at 28 days. The variation of average water absorption is slightly increased with constant higher compressive strength and varied slump value. It's found to be higher with lower compressive strength and constant slump value and it goes on decreases with increased compressive strength [Balakrishna, *et al*, 2018].

3.2 Interpretation of sorptivity coefficient

It's defined as a measure of the capacity of the medium to absorb/de-sorb liquid by capillarity. The sorptivity is widely used in chacterizing soils and porous construction materials such as brick, stone, and concrete respectively.

$$\text{Sorptivity coefficient } (S) = \frac{i}{\sqrt{t}} \tag{2}$$

S = Sorptivity in mm
i = cumulative absorption at time (t), m/s
$\sqrt{t}$ = square root of elapsed time in min
I= Δ w/Ad
Δ w= change in weight = W2-W1

A= surface area of the specimen through which water penetrated
d= density of water

The sorptivity coefficient (rate of water absorption) is found to be increased at initial time duration (0.0009-0.0011 m/min$^{0.5}$) as when compared to longer time duration (4.2E-05-5.4E-05 m/min$^{0.5}$). The sorptivity coefficient is increases at initial time duration, this may be due to unsaturated pore structure, and in turn the rate of absorption is more at that time. As time increases, the rate of absorption goes on decreases with increased time duration in turn indicates that, pore structure may be reached fully saturated condition. Sorptivity test is a very simple technique that measures the capillary suction of concrete when it comes in contact with water. This test is used to determine the rate of absorption (sorptivity) of water by measuring the increase in the mass of a specimen resulting from absorption of water as a function of time when only one surface of the specimen is exposed to water ingress of unsaturated concrete by capillary suction during an initial contact with water.

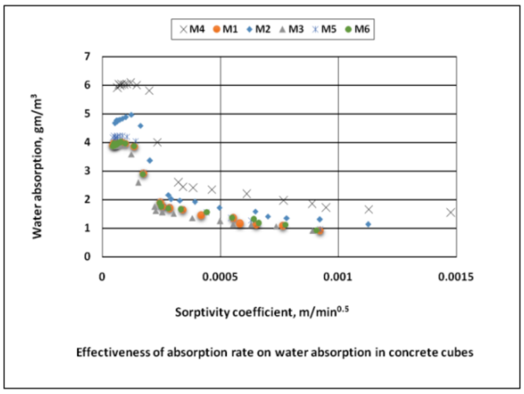

Fig. 2. Water absorption in DCC concrete cubes.

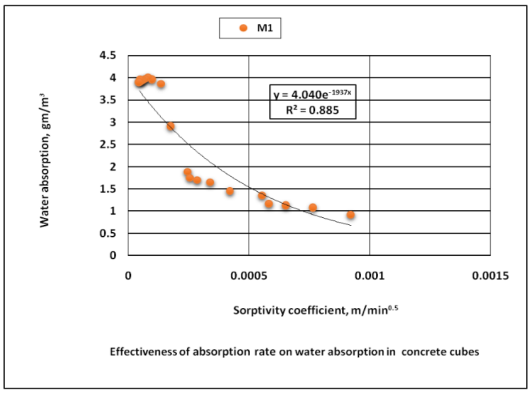

Fig. 3. Water absorption in PSC concrete cubes.

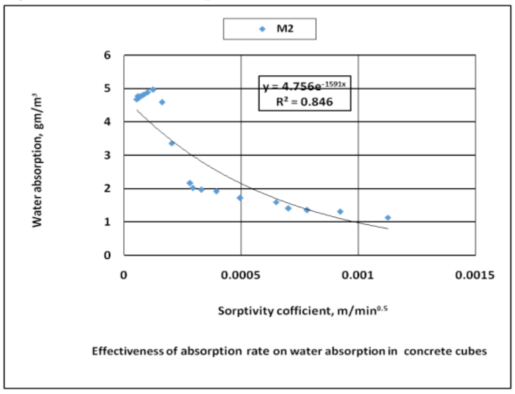

Fig. 4. Water absorption in concrete cubes.

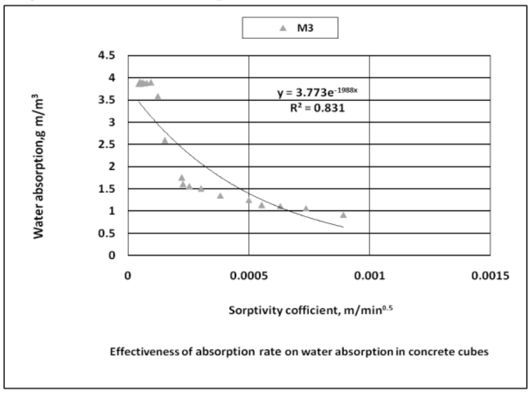

Fig. 5. Water absorption in PSC concrete cubes.

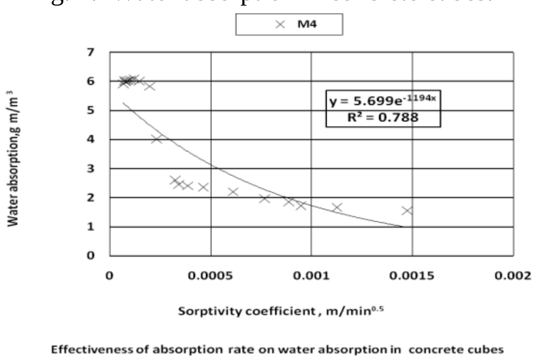

Fig. 6. Water absorption in concrete cubes.

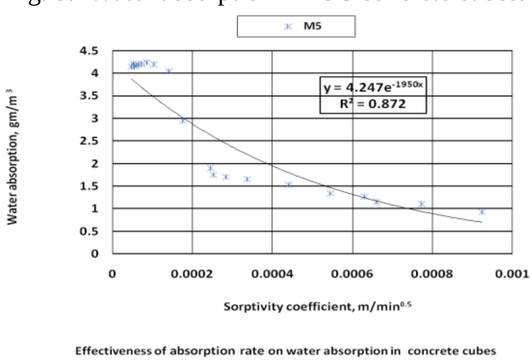

Fig. 7. Water absorption in concrete cubes.

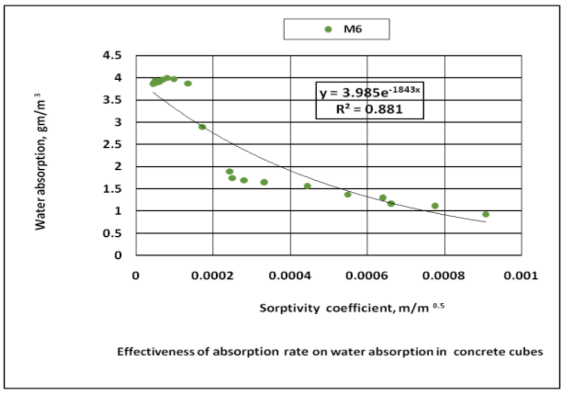

Fig. 8. Water absorption in concrete cubes.

The rate of sorption is the slope of the best-fit line to the plot of absorption against square root of time. As observed from the results that, the sorptivity coefficient is increased at initial time duration with decreased cumulative water absorption in all mixtures type as when compared to longer time duration. The sorptivity coefficient at initial time duration is found to be in the range (0.0009-0.0014 m/min$^{0.5}$) and (4.5E-05-5.5E-05 m/min$^{0.5}$) at final time duration. Cumulative absorption varied at an initial stage between (0.002-0.003 m) at an early time duration and (0.008-0.013 m) at longer time duration. Finally, the sorptivity coefficient is decreases with decreased rate of cumulative absorption at longer time duration in turn it indicates that, the pore structure reaches fully saturated condition in all mixtures type. The sorptivity coefficient is decreased as when compared to initial time duration (5-10) min. In fact, there is decrease in sorptivity coefficient (21.89%) at 10 min as when compared to initial time duration (5 min) for in case of all mixtures type (M1-M6). Similarly, Sorptivity coefficient is goes on decreases gradually at certain point, it reaches parabolic pattern, and afterwards it reaches equilibrium (28 day) in turn sorptivity coefficient is found to be decreased (95.18%). Whereas at 1 day, the increase in sorptivity coefficient is found to be 82.07% for in case of all mixtures type (M1-M6). The sorptivity coefficient for in case of mixtures type (M1-M3) at an initial time duration (10 min) is found to be increased (21.32%) as when compared to time duration (5 min). Similarly, at 10 min, there is an increase in sorptivity coefficient (22.46%) as when compared to time duration (5 min) for in case all mixtures type (M4-M6). The rate of absorption is always more at an initial time duration because of differential gradient is exists between higher to lower concentration gradient section, where there is a variation in the rate of absorption up to certain time duration after that, it reaches parabolic pattern which is very smooth flow of rate of absorption. Once it reaches that, pore structure, cement paste, and concrete matrix reaches fully saturated condition in turn finally the sorptivity coefficient reaches equilibrium state. Thus, in the present research work water absorption test was carried out on concrete cubes (100 mm^3) in order to evaluate the effectiveness of water absorption on rate of water absorption capacity (sorptivity coefficient) in the designed concrete mixes [Balakrishna, *et al*, 2018].

4. Discussion about results

The deterioration of concrete is caused by the movement of aggressive gases/liquids from the surrounding environment into the concrete which is followed by physical/chemical reaction within its internal structure, and that leads to an extensive damage to the concrete structures. The one of the most important properties of a good quality concrete is low permeability. A concrete with low permeability resists ingress of water and is not as susceptible to freezing and thawing. Water enters pores in the cement paste and even in the aggregate. Permeability relates to the size of the pores, their distribution and most importantly their continuity. As a result, permeability is not necessarily directly related to absorption. It has been related to water-cement ratio of concrete. The lower the sorptivity value, the higher the resistance of concrete towards water absorption. It's mainly depending on the pore distribution and micro structural properties of concrete as noted by the researchers [Abdul Razak, *et al*, 2004]. The cumulative water absorption of the concrete mixtures decreases with the decrease in w/cm ratio for all the concrete due to less amount of water in the mix, resulting into dense concrete. Concretes with lower w/cm ratio have lower water absorption for all the mixtures. The sorptivity values are least due to lower amount of water in the mix, resulting in lower porosity. The higher the porosity of the specimens causes the reduction of pervious concrete density, which in turn that affects the compressive strength. The higher level of porosity can be resulted from the higher level of water absorption that exceeds the required limit of water infiltration. Moreover, the mechanical properties of concrete are highly influenced by its density. A denser concrete generally provides higher strength and fewer number of voids and porosity. Smaller the voids in concrete, it becomes less permeable to water and soluble elements. The water absorption will also be lesser and better durability is expected from this type of concrete mixture proportion. Thus, the minimum water-cement ratio is desirable to maintain appropriate compressive strength and durability of the concrete. The water is usually provided externally by curing/internally by using water saturated porous aggregates. By proper curing, reduces the rate of moisture loss and provides a continuous source of moisture required for the hydration that reduces the porosity and provides a fine pore size distribution in concrete as pointed out by [Alamri, 1988].

It is possible to explain the process of water transport satisfactorily for early ages in dry samples and without additions. It's clear from the results that, if a mortar or concrete surface is exposed to wetting by water, then the cumulative water absorption (normalized to the exposed surface area) is proportional during an initial absorption period, to the square root of elapsed wetting time as confirmed by investigator [Hall, 1989]. After a period of sorption, an initial rate of ingress observed to be decreases as the water has accessed all the major capillary pores. The decrease in gradient of the straight-line portion of the water uptake versus square root of time indicates that sorptivity is now occurring via the finer pores and its indicates that, an increasing importance of small pores with time [Martys, and Ferraris, 1997]. In addition to that, some materials with extremely coarse pore structure, experiences little capillary suction and may show significant deviation from linearity after prolonged wetting. It is widely known fact that, in dry/partially dry mortars or concretes, the predominant mechanism in the water absorption is the capillary suction and when the time lapses, and the material begins to be saturated, the predominant mechanism is the diffusion in turn through the finer and gel pores [Martys, and Ferraris, 1997]. It's a known fact that, the materials with extremely coarse pore structure experience little capillary suction and may show significant deviation from linearity after prolonged wetting. Sorption does not take place in saturated materials/totally dry materials. It's due to substantial absorption of water by the gel which will distort the results. The sorptivity will depend on the initial water content and its uniformity throughout the specimen under test. It is, therefore, essential that materials under test be consistent and homogeneous, point of origin, and frequently the very early readings, are omitted when determining the slope of the graph. This is due to an increase in the mass of the specimen caused by the filling of the open surface pores on the inflow face and the sides of the specimen when it is submerged. In order to reduce these effects to a minimum, it is essential that, the specimen be submerged in water to no more than 2-5 mm as confirmed by researcher [Neville, 1995]. Thus, in the present research work water absorption test was carried out on concrete cubes (100 mm^3) in order to evaluate the effectiveness of water absorption on the rate of water absorption capacity (sorptivity coefficient) in the designed concrete mixes. Research was carried out on experimental results of compressive strength and sorptivity for normal concrete and PET fiber reinforced concrete (PFRC). It was found that the compressive strength of PFRC increased and the sorptivity of PFRC was decreased with respect to normal concrete. The addition of PET fibers in concrete tends to restrict water propagation in the concrete and causes reduction in sorptivity. The decrease in sorptivity of PFRC is favorable to the durability of the reinforced cement concrete structures [Nibudey, *et al*, 2014]. Similarly previous studies on cement concrete had shown that specimen with higher sorptivity recorded lesser durability. Some authors describe sorptivity as the measure of durability [Sabir, *et al*, 1998]. It was noticed that specimen with higher sorptivity recorded lesser retention of compressive strength after 24 weeks immersion in sulphuric acid.

A polynomial trendline drawn for the relationship showed a regression coefficient of 1 for the corresponding equation [Suresh Thokchom, *et al*, 2009]. The current study is carried out to investigate the performance of compressive strength, permeability and sorption and investigate the relation with durability of concrete in the presence/absence of silica fume under four different curing conditions. Test results indicated that concrete sorptivity decreased by 42.7% when cement content was increased from 350 kg/m^3-450 kg/m^3 for specimens cured in water for 28 days at 20^0 C. Also, for the same cement content, utilization of 10% SF as a partial replacement of cement resulted in sorptivity decrease by 64.5% and 68.3% with cement content 350kg/m^3- 450kg/m^3 respectively, for specimens cured in water for 28 days at 20^0 C. Although specimens stored in air experienced 11.6% loss in compressive strength, the sorptivity increased by 80.4% while permeability increased by nearly 345.3%. Specimens with lower sorptivity possessed lower permeability, and higher compressive strength [Esam Elawady, *et al*, 2014]. It's observed from researcher that, 10% replacement with fly ash and hypo sludge increases in water absorption is found to be 1.23% for M25 and 1.07 for M40 and sorptivity is found to be 3.29 mm/min^{0,5} for M25 and 1.94 mm/min$^{0.5}$ for M40 with respect to reference mix for age of 90 days. The water absorption and sorptivity of fly ash and hypo sludge concrete shows lower water absorption and sorptivity than conventional concrete. The water absorption and sorptivity of M25 fly ash and hypo sludge concrete is higher water absorption and sorptivity than M40 grade concrete [Jayeshkumar Pitroda, 2015]. Thus, there is need to investigate variations in the water absorption to sorptivity coefficient in the concrete cubes in order to characterize different designed mixtures type in the present research work. The combined variation of water absorption with sorptivity coefficient at different time interval for in case of different designed mixtures type is as shown in Figures 2-8 respectively. It's possible to establish a relation between the water absorption and sorptivity coefficient in concrete cubes with power type of equation.

It's observed from the results that, the average rate of water absorption (sorptivity coefficient) is varied in the different concrete mixtures design (M1-0.00029, M2-0.00034, M3-0.00027, M4-0.00042, M5-0.00030, and M6-0.00029) m/min$^{0.5}$ respectively. Whereas the minimum as well as maximum values (sorptivity coefficient) were varied in the range (M1:4.48E-05-0.00092, M2:5.37E-05-0.0011, M3:4.34E-05-0.0008, M4:6.59E-05-0.0014, M5:4.72E-05-0.0009, M6:4.37E-05-0.00091) m/min$^{0.5}$. Also, the standard deviation was varied in the designed concrete mixtures type (sorptivity coefficient) as in the following range (M1-0.00029, M2-0.00032, M3-0.00025, M4-0.00041, M5-0.00027, and M6-0.00027) respectively. It's confirmed from the research work that for in case of constant concrete compressive strength and varied slump value, the rate of water absorption (sorptivity coefficient) was slightly increased in concrete mix design (M1-M3) as when compared to the concrete mix design (M4-M6) with varied concrete compressive strength and constant slump value. The rate of water absorption was increased in lower concrete compressive strength and constant slump values and goes on decreases with increase in concrete compressive strength for in concrete mix design (M4-M6). Furthermore, it's possible to interpret the variations in the rate of water absorption capacity (sorptivity coefficient) as well as water absorption of concrete at different time intervals in the concrete mix design (M1-M6) as representing in the Figures 9-10.

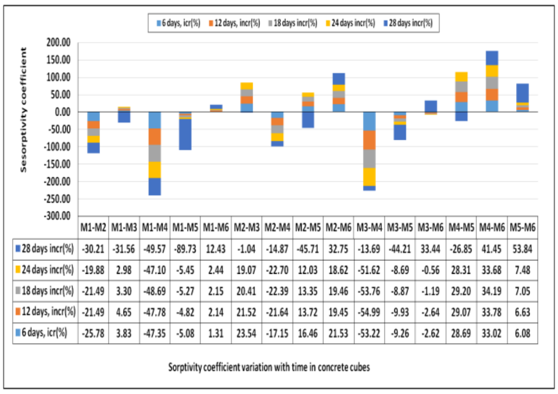

Fig. 9. Sorptivity coefficient in Mixes type.

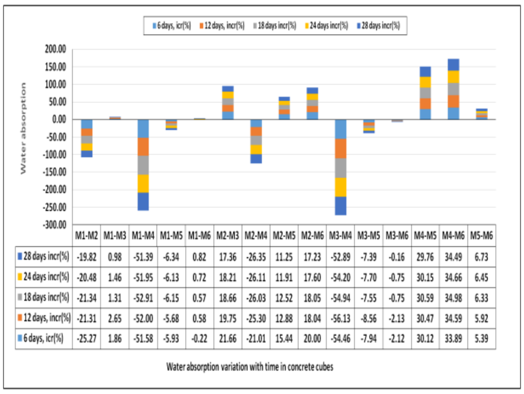

Fig. 10. Water absorption in Mixes type.

It's observed from the results that, the average rate of water absorption is varied in the different concrete mixtures design (M1-2.62, M2-3.14, M3-2.52, M4-3.93, M5-2.74, and M6-2.63) gm/m^3 respectively. Whereas the minimum as well as maximum values (water absorption) were varied in the range (M1:0.92-4.01, M2:1.13-4.96, M3:0.91-3.90, M4:1.54-6.08, M5:0.93-4.23, M6:0.92-3.99) gm/m^3. Also, the standard deviation was varied in the designed concrete mixtures type (water absorption) as in the following range (M1-1.28, M2-1.58, M3-1.27, M4-1.97, M5-1.38, and M6-1.26) respectively. It's confirmed from the research work that for in case of constant concrete compressive strength and varied slump value, the rate of water absorption was slightly increased in concrete mix design (M1-M3) as when compared to the concrete mix design (M4-M6) with varied concrete compressive strength and constant slump value. The rate of water absorption was increased in lower concrete compressive strength and constant slump values and goes on decreases with increase in concrete compressive strength for in concrete mix design (M4-M6). As observed from the results that, the rate of water absorption is decreased in constant higher concrete compressive strength/varied slump value for in case of different concrete mixtures type (M1-4, M2-4.5, M3-3.5) gm/m^3 and the sorptivity coefficient was observed to deceased in the concrete mix design (M1- >0.0005, M2- >0.001, M3- <0.01) m/min$^{0.5}$ respectively. Whereas, its observed from the results that, the rate of water absorption is increased in varied concrete compressive strength/constant slump value for in case of different concrete mixtures type (M4-5.9, M5-3.9, M6-3.55) gm/m^3 and the sorptivity coefficient was observed to increase in the concrete mix design (M4- 0.0015, M5- >0.0008, M6- <0.0008) m/min$^{0.5}$ respectively. It's also confirmed from the results that, the rate of water absorption and sorptivity coefficient was goes on decreases with increase in the concrete compressive strength and constant slump value for in case of concrete mix design (M4-M6).

5. Conclusion

In the present research work, water absorption test was carried out on concrete cubes to assess the rate of water absorption characteristics on concrete sorptivity coefficient in designed concrete mixtures type. It's confirmed from the results that, the water absorption is co-related with sorptivity coefficient of concrete by the power type of equation. It's clear from the research work that for in case of constant concrete compressive strength and varied slump value, the rate of water absorption capacity (sorptivity coefficient) was slightly increased in concrete mix design (M1-M3) as when compared to the concrete mix design (M4-M6) with varied concrete compressive strength and constant slump value. The rate of water absorption was increased in lower concrete compressive strength and constant slump values and goes on decreases with increase in concrete compressive strength for in concrete mix design (M4-M6). It's noted from the present work that for in case of constant concrete compressive strength and varied slump value, the rate of water absorption was slightly increased in concrete mix design (M1-M3) as when compared to the concrete mix design (M4-M6) with varied concrete compressive strength and constant slump value. The rate of water absorption was increased in lower concrete compressive strength and constant slump values and goes on decreases with increase in concrete compressive strength for in concrete mix design (M4-M6). As observed from the results that, the rate of water absorption is decreased in constant higher concrete compressive strength/varied slump value for in case of different concrete mixtures type (M-M3) and the sorptivity coefficient was observed to deceased in the concrete mix design (M1-M3) respectively.

Whereas, its observed from the results that, the rate of water absorption is increased in varied concrete compressive strength/constant slump value for in case of different concrete mixtures type (M4-M6) and the sorptivity coefficient was observed to increase in the concrete mix design (M4-M6) respectively. It's also confirmed from the results that, the rate of water absorption and sorptivity coefficient was goes on decreases with increase in the concrete compressive strength and constant slump value for in case of concrete mix design (M4-M6).

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