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A Study on the Structural Effects of Bagasse Sugar Cane Stem in Structural Concrete Mixture in Sulfate and Chloride Environments

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ABSTRACT

Due to the high volume of agricultural waste, the use of some of them in the manufacture of concrete reduces the production residues and the problems caused by their lack of recycling. Bagasse is a pulp produced after sugar cane extraction. The sugar cane factories produce about 1.2 million tons of excess bagasse annually due to the lack of conversion industries. In today's modern world, due to advances made in various scientific fields, the concrete industry has also evolved. The production of concrete containing pozzolan bagasse is also the result of the same improvements; concrete. In this study, for the production of synthetic pozzolan sugarcane bagasse, according to studies bagasse was burned for 30 minutes at a controlled temperature of 4 ° C. Then, by replacing 1, 2, 3, 2, and 2% of bagasse ash instead of cement in concrete, compressive strength, electrical strength, chloride penetration were evaluated by RCMT, water pressure, and sulfate resistance. The results showed an increase in compressive strength of the specimens up to 5% of cement replacement at different ages and a higher percentage of compressive strength loss was observed in the control specimen, but the electrical resistance at different ages increased by up to two-fold in the control specimen and also decreased. Before this, attention was drawn to the amount of water and chloride ion penetration. Sulfate resistance also increased by up to 5% replacement, but the highest sulfate resistance was observed in the sample by 5% replacement.

Keywords: **Sugar Cane, Pozzolan Bagasse, Sulfate Environment, Chloride Environment**

1. INTRODUCTION

In Iran and in some countries the major use of agricultural wastes, one as livestock feed and the other as fuel used in factories such as brick-and-mortar factories and so on, is due to its affordability and ease of access. Material. In many cases, it is even seen that farmers are burning these seemingly extra materials. This results in both environmental pollution and rainfalls, causing acidification of agricultural water and soil, and consequently reducing crop yields. But in recent years, with the rapid development of human beings in the field of technical and administrative issues in the field of construction and with research in the field of building materials and the use of natural materials and the reinforcement and refinement of synthetic building materials, new and very useful innovations and initiatives have taken place [1]. Is. One of the best approaches is to burn and burn off the waste products of crops such as rice husk and rice stalks (annual production of 6 ton per year), Sorghum husk or Chinese cane, wheat leaf pod, maize leaf blade, leaf And the herbaceous stalk, the Breadfruit that grows mostly in the tropics of Asia, the bagasse, the leaf and the sunflower stalk, the inner part of the Bamboo plant in high-water access areas such as the sea And lakes, rivers and marshes, etc. and eventually the replacement of ash from the burning of the above materials, albeit about thirty to forty percent, b Cement used in concrete production and thus increase the cement production and reduce its price. On the other hand, the cement price fluctuation, which has been increasing in most cases, at various times, always controls many problems for the proper and timely execution of the country's small and large-scale structural projects. On the other hand, sufficient and timely production and supply of cement to the market to the extent that it meets the country's construction needs will make the country's remote urban and rural areas particularly low-cost (lacking cement plants) that They are under construction or rebuilding, easily and quickly accessing their desired materials, including cement [2-3]. Bagasse is one of the by-products of sugar cane that is extracted from the wood chip after extraction of sugarcane. The average peat and bagasse production is about 34 ton per hectare with 55% moisture content. In other words, about 340 kg of peas and bagasse are produced per ton, of which about 35% peat and 65% bagasse. About one million ton of peas and bagasse are currently available in Khuzestan annually. The use of recycled materials in concrete structure is a way to solve environmental and related problems of recycling management. Few studies have been conducted on the use of BA as a part of cement composition. In this study, the effect of bagasse ash as a replacement part of cement on the mechanical and physical properties of hardened concrete is investigated. The properties investigated include compressive strength, tensile strength, water absorption, permeability properties, chloride ion diffusion and chloride penetration resistance. The results of this study showed that by combining 20% bagasse ash with 80% cement an effective mineral composition would be obtained [4-5].

Ajay Goyal et al, In recent years, many countries have used pozzolan materials in concrete to improve durability and durability. One of the synthetic poisonous materials used in this research is bagasse ash of sugar cane, which is a bogus after harvest. Sugar from sugar cane. Bagasse is used in the production of chipboard, semi-hardboard, paper, alcoholization, production of citric acid. Bagasse is also used for animal feed processing. Corrosion of steel in concrete today is one of the major problems of different countries of the world. It has cost a lot to repair them, even in advanced countries such as America, Canada, Japan and some European countries. For example, in the bridges' surveys in the United States, about 140,000 bridges had problems [6]. Chuslip.N et al, This problem is much more severe in the developing countries and in the Gulf states, and concrete structures have been corroded for a long time not too long. Studies in these areas show that, if suitable materials are selected, concrete with special technical specifications of these areas, concrete implementation will be used by experts, and finally, if appropriate treatment is applied, many concrete issues on the side Will return. However, in recent years, methods and materials have been advocated and used to prevent the problem. The use of stainless steel reinforcement and FRP plastic reinforcement is one of these methods, which, due to its expensive, is still not fully developed. In addition, the long-term performance of this substance should be clarified after research. Other methods of using protection in concrete are the use of reverse flow with the victim's anode, which can provide good protection for the reinforcement [7]. Chindaprasirt et al This method requires constant care and is relatively expensive, but it's a sure-tier method. For protection of the reinforcement against corrosion, it has been used for several years with an epoxy coated armature. The history of the use of these reinforcements, especially in corrosive environments, suggests that in some cases this method has been successful and somewhat unsuccessful. However, if a healthy coating is to be used, this can be a 10-15 year old corrosion. Concrete corrosion inhibitors and inhibitors have also been used for the past two decades. The use of some of these substances, such as calcium nitrate and sodium nitrate, has become commercially viable. However, the performance of these materials is suitable for delaying corrosion in both laboratory and in-situ research. Other anodic and inhibitors have been tested, but they have not yet been found to be of industrial use because of high costs. Also, one of the most common corrosion in the coastal areas of the seaside is due to chloride ions. Chloride ions can be introduced into concrete through contaminated aggregates and additive substances from external sources such as sea water. Iron ions tend to be more attracted to chloride ions than to absorb ions such as hydroxyl [8]. Fras M,Villar et al, The resulting chloride reacts with iron ions again, and the unstable acid production cycle continues, and more iron ions disappear and corrosion due to imbalance Electrochemicals are further developed at the steel surface. Thus, chloride ions with catalytic performance accelerate the corrosion reaction of the reinforcement. With the advancement of the technological revolution, especially in the production of concrete concrete, as well as concrete additives in specific areas and conditions, these concrete can be used in future construction. Proper use of materials, proper implementation and adequate treatment can increase the durability of concrete in specific areas. Extensive and extensive research is needed to determine the durability of specific concrete in both special and long-term conditions and to be planned globally. One of these methods is the use of bagasse ash [9]. Ramezanianpour et al (In 2014) conducted a study on bagasse ashes, which indicated that the use of ash of cane sugar cane (bagasse) as an alternative to cement in concrete and mortar has increased dramatically due to its properties pozzolan as well as its positive environmental effects. In this study, the compressive strength of concrete made with pozzolan bagasse with replacement percentages of 10, 15, 20, 25 and 30 percent was investigated. Then, the resistance of sulfate containing 10, 15, 20, 25 and 30 percent of bagasse ashes was investigated. And the effect of bagasse on the durability of these samples has been evaluated. Concrete samples were then treated in 5% sodium sulfate solution and 5% magnesium sulfate after 28 days of treatment and the amount of sulfate attack was evaluated by measuring the compressive strength loss, The results generally indicate the good performance of bagasse pozzolan in increasing the resistance and reducing the harmful effects of sulfate attack, and the highest sulfate resistance was observed in samples containing 20% bagasse pozzolan [10]. Corderio et al reported that the bagasse ash is classified as a pozzolan material by checking the compressive strength of the mortar, but its pozzolan activity depends on the size of the particle size [11]. Noor-ul Amin has investigated the effect of bagasse ash on compressive strength and chloride ion resistant. His research suggests that bagasse ash is a pozzolan with an optimal percentage of 20%, which reduces chloride ion penetration by more than 50% [12]. Chuslip et al in a study on the sulfate resistance of bagasse-containing malt materials found that mites with a 10% replacement of bagasse ash with LOI showed less vulnerability to sulfate attack. Also, the resistance of the pressures of bagasse-containing bagasse-containing mortars is less than that of LOI, but ultimately they reach the same resistance to different LOI specimens. The samples containing 10, 20 and 30% bagasse ash showed higher compressive strength than more samples than control samples [13]. In another study, Nasir Shaifq et al, Substituting zero to 50 percent of bagasse ashes and calculating the amount of resistance and weight loss of concrete samples, investigated the sulfate resistance, and concluded that, irrespective of the replacement rate of bagasse, adding this pozzalan to concrete increased resistances Sulfate is produced and Lee's best sulfate resistance is obtained with a 15% replacement percentage [14].

Larissa C. et al Using mineral additives, such as sugarcane bagasse ash (SCBA) and metakaolin, are solutions to produce self-compacting concrete (SCC) with low cement content, having lower impacts on the environment. SCC with low cement content and high sugarcane bagasse ash and metakaolin contents provides a different microstructure and porosity regarding SCC without these additives, therefore when submitted to high temperatures they may present a different behaviour. Therefore, this study aims to evaluate the behaviour of SCC at high temperatures replacing cement by sugarcane bagasse ash and metakaolin at contents of 30% to 50%. For this purpose, five SCC compositions were assessed for self-compactness by slump-flow, J-ring, L-box and V-funnel tests, as well as visual stability index. After curing at room temperature, the SCC were subjected to exposure at temperatures of 200 °C, 400 °C, 600 °C and 800 °C, and then analysed by visual and tactile inspection, mass loss, compressive strength, ultrasonic pulse velocity, absorption by capillarity and immersion, void index and X-ray diffraction. Results showed that SCC with up to 40% of sugarcane bagasse ash and met kaolin is less sensitive to high temperatures presenting less cracking and lower strength losses compared to room temperature [15,16].

Prinya Chindaprasirt et al in this research, the durability and mechanical properties of pavement concrete containing bagasse ash was studied. The pavement concrete containing bagasse ash was made from Portland cement, sand, limestone aggregate, water, and bagasse ash. The bagasse ash was the waste from biomass power plant boiler of Sakaeo, Thailand. It was used to replace Portland cement at the level of 0 - 60 % to produce pavement concrete. Compressive strength, density, water absorption, porosity, modulus of elasticity, thermal conductivity and durability of pavement concrete were investigated. At the age of 28 days, the pavement concretes containing bagasse ash had compressive strength of 11.0 - 35.0 MPa, density of 2210 - 2400 kg/m3, water absorption of 15.00 - 20.82 %, porosity of 6.74 - 10.21 %, modulus of elasticity of 14.48 - 23.98 GPa, and thermal conductivity of 1.49 - 1.91 W/mK. In addition, the pavement concretes containing bagasse ash of 20 and 40 % with compressive strengths not less than 17.5 Mpa as required by ACI 211 for a normal weight concrete showed good durability in terms of abrasion resistance and acid resistance. Thus, this concrete could be used for pavement where the durability of concrete is a prime concern [17,18].

A.Rajasekar et al This paper discusses the feasibility of utilizing sugarcane bagasse ash as a pozzolan material in the production of Ultra High Strength Concrete (UHSC). Ordinary Portland Cement was replaced with Treated Bagasse Ash (TBA) in this investigation. The replacement dosage varied from 5% to 20% by weight of cement. The effect of bagasse ash on workability, compressive strength, chloride penetration resistance and sorptivity was examined. In addition to this, the effect of different curing regimens on hardened properties of UHSC was carried out. The results proved that it is possible to produce UHSC with cylinder compressive strength more than 160 MPa by incorporating bagasse ash. Optimum replacement ratio of 15% yielded better performance in all the tests, without having any adverse effects on hardened concrete. Convincingly, 20% substitution of sugarcane bagasse ash is good enough for producing UHSC [19]. Zareei et al This paper presents an extensive experimental study to investigate the possibility of using sugarcane bagasse ash (SCBA) as a partial replacement of cement in ordinary, lightweight, and self-compacting concretes. For this purpose, specimens containing 5, 10, 15, 20, and 25% SCBA in addition to a control specimen were prepared. To evaluate the mechanical properties of concrete specimens, compressive strength, tensile strength, impact resistance, workability, water absorption, and ultrasonic pulse velocity (UPV) tests were performed. The results indicated that improvements in strength and impact resistance in lightweight concrete are observed as compared with the control sample when cement was replaced with bagasse ash at 5%. It was also found incorporation of BA improved durability and quality of SCC [20]. Franco et al The corrosion of reinforced ternary concretes containing fly ash (FA) and untreated sugarcane bagasse ash (UtSCBA) was evaluated. Chloride-ion diffusion at 28 and 90 days, as well as microstructural properties, percentage of voids, and compressive strength (CS) in cylinders were evaluated at 2500 days of age. Moreover, corrosion was monitored in prismatic specimens exposed to a NaCl solution by corrosion potentials and linear polarization resistance techniques. Results show that the combination of FA plus UtSCBA decreased the chloride-ion diffusion and did not affect the compressive strength (CS) of the concrete. For the studied concretes, the combination of FA plus UtSCBA appears a suitable option against chloride-induced corrosion. Supplementary cementitious materials are commonly used in concrete due to their superior performance such as higher strength and low heat of hydration when compared to ordinary Portland concrete. In addition to pozzolan benefits, utilization of these materials leads to durable and sustainable concrete. Although several pozzolan materials are available including industrial by-products for use in concrete, their utilization is considerably restricted due to inadequate performance evaluation in concrete. Sugarcane bagasse ash is a by-product from the sugar industries that is directly disposed as a waste material which leads to significant environmental degradation. Pozzolan characteristics of sugarcane bagasse ash have been evidently reported in the previous research studies. However, durability of bagasse ash blended concrete and its service life prediction are not reported in the existing literature. In the study, sugarcane bagasse ash was processed based on appropriate characterization scheme and bagasse ash blended cements were produced. Permeability of bagasse ash blended concrete was investigated and compared with Portland cement concrete and fly ash blended concrete. Moreover, influence of cover depth on service life of concrete structure was investigated. Results of accelerated durability test were correlated with the parameters influencing the long term performance of the concrete. The service life of bagasse ash concrete structures was found to be higher than the ordinary concrete structure in the same exposure conditions [21]. Moretti et al The aim of the current study is to assess the feasibility of incorporating sugarcane bagasse ash (SBA) from the sugar and ethanol industry as a filler material in the production of self-compacting concrete (SCC). For this purpose, paste composition was designed in the first stage of this study by conducting an experimental plan at the mortar level. During the second stage, SCC mixture properties were evaluated by considering the paste mixture proportions defined in the first stage. The study at the mortar level was conducted based on a statistical factorial design approach, which offers a valid basis for developing empirical models that allow determination of optimal settings of the design variables to satisfy all performance requirements. At the concrete level, the impact of three optimised paste mixtures on SCC properties was assessed. Fresh state, mechanical, and durability properties were evaluated. Mortar and concrete test results revealed that SBA can be used successfully in powder-type SCC as a filler material, and it exhibits good self-compacting ability and strength levels, which are adequate for many current civil engineering applications [22].

Parada et al The effects of the addition of a Mexican sugarcane bagasse ash to binary concrete prepared with blended Portland cement (CPC) and fly ash (FA) were studied. The sugarcane bagasse ash was used practically as received (UtSCBA), with the only post-treatment application sieving through a No. 75 µm (ASTM) mesh for four minutes. The characterization of the materials used for the concrete preparation was carried out using RXFE, XRD and SEM/EDS, and the BET methods. Besides the control mixture, three ternary concrete mixtures were prepared: the control mixture (C) with 100% CPC; a mixture with 80% CPC, 20% FA and 0% UtSCBA (T0); a mixture with 70% CPC, 20% FA and 10% UtSCBA (T1); and a mixture with 60% CPC, 20% FA and 20% UtSCBA (T2). The properties of the concretes in fresh and hardened states were studied. In the fresh state, slump, volumetric weight, air content and temperature were estimated, while in the hardened state microstructure, mineral phases, compressive strength, moduli of elasticity and Poisson ratios were investigated.The results indicate that UtSCBA can be considered as a pozzolan even though the LOI content is higher than the maximum allowed in the Standard. UtSCBA particles are heterogeneous (in shape and size) with a specific surface area similar to that of the CPC. Because it has a larger volume of total pores, the use of UtSCBA leads to a reduction of workability and volumetric weight; however, the air content and the temperature in the fresh state are not affected. The results of XRD and SEM/EDS suggest that at early ages both a physical effect of dilution of the CPC and the high carbon content in the SCBA negatively affect the compressive strength of the concretes. However, the pozzolan reaction of the SCBA is beneficial at later ages. The combination of 10% UtSCBA plus 20% FA did not affect either the development of the strength of the concrete or its modulus of elasticity. On the other hand, the addition of 20% UtSCBA decreased the strength of the concrete at early ages, but after 90 days it was similar to the strength of the control mixture[23]. Sounthararajan et al This paper has been investigated the effect of steel and polypropylene fibres addition in concrete and evaluating the mechanical properties of concrete. In this research work has focused on concrete specimens for compression and flexural rigidity prepared with steel fibres and polypropylene fibres along with the different percentage of SCBA for various moist curing. The experimental test results were proved a better improvement in strength gain up to16.37% and 27.01% for 7 and 28 days respectively when the dual fibre combination of 1.5% of steel (by volume fraction) along with 0.2% of polypropylene fibres along with 20% of SCBA. Also, there was an increase in flexural strength up to 57.14% in concrete with steel and polypropylene fibre combinations than compared to conventional concrete [23,24].

2. MATERIALS AND METHODS

2.1. INTRODUCTION OF MATERIALS

Most commonly used aggregates in coastal areas are sandstone, limestone and dolomitic rocks. Due to intense evaporation, the salts are deposited on the surface of these rocks and a hard layer with a large amount of salt is formed. The high amount of salts in this material is an agent for corrosion of steel in attacking corrosive agents on concrete. The aggregates used in this experiment are sand wash, natural sand, with a water absorption of 2.1% by weight. The gravel consumed is broken gravel with a maximum diameter of 17 mm and a water absorption of 1.65% by weight Granular curve of aggregates used in the manufacture of concrete samples is shown in Figure 1 in the accepted area of the Ash mixing plan for aggregate with a maximum diameter of 17 mm aggregate. The aggregates used are broken type grains with a specific gravity of 2.75 grams per cubic meter with a water absorption of 1.65 percent by weight. Also, natural sand with a specific gravity of 2.34 grams per cubic meter with a water absorption of 2.47 percent by weight.

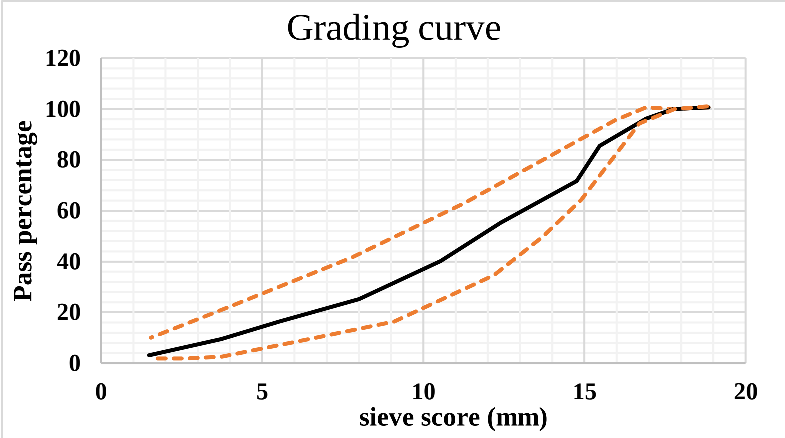


Figure 1. Grading curve

2.1.1. Cement

The cement used in this test is type 1 525 cement

2.1.2. Bagasse ash

Bagasse ash (Figure 2) was used in the existing kiln of the laboratory at 850 ° C, which was identified as the optimal temperature for the preparation of bagasse ash. After the production of ash in the furnace, it started to mill in a ball mill for 15 minutes. The mechanical properties of cement and bagasse ash are shown in Table (1).

Figure 2. View of Pozzolan bagasse ash

Table 1. Chemical composition of binder materials

Chemical compounds (%)	**Sample type**	
	Bagasse ashes	Bagasse ashes
SiO_2	20.90	64.88
Al_2O_3	4.76	6.40
Fe_2O_3	3.41	2.63
Cao	65.41	10.69
MgO	1.25	1.55
SO_3	2.71	1.56
LOI	0.96	8.16
$SiO_2+Al_2O_3+Fe_2O_3$	-	73.91

In this study, we used 10 samples of different mixing patterns in order to study the effect of bagasse ash on concrete and its resistance to sulfuric and chloride environments. These 10 samples were prepared with different amounts of pozzolan ash of bagasse, which is the percentage of variation Vegetable bagasse will vary from 0% to 50% of cement weight in the sample. It is worth mentioning that all samples have a water-to-concrete ratio of 0.38 and cement content of 410 kg/m3. In the Table 2, we can look at the general overview of the analysis model.

Table 2. Mixing scheme of tested specimens

Sample name	The amount of bagasse ash (Kg)	Cement (Kg)	Coarse grains (Kg)	Fine grains (Kg)	amount of water (Kg)	Replacement percentage
Model-1	0	410	712	635	156	%0
Model-2	43	367				%5
Model-3	61	349				%10
Model-4	86	324				%15
Model-5	97	313				%20
Model-6	106	304				%25
Model-7	123	287				%30
Model-8	134	276				%35
Model-9	141	269				%40
Model-10	148	262				%45

2.2. INTRODUCTION OF RESEARCH EXPERIMENTS

2.2.1. Verification

To verify the results of the experimental sample of this paper we used Modani et al [25]. In this study, 5 study sample with a percentage of bagasse of 0%, 10%, 20%, 30% and 40% percent was used. The difference between the results of the laboratory samples and that of Modani et al. Was about 2%. Figure 3 shows the verification diagram 28-day compressive strength.

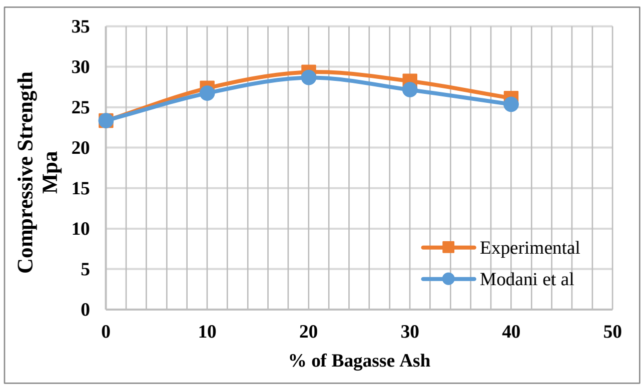


Figure 3. Validation chart (28 Day- compressive strength)

2.2.2. AASHTO TP64 Immersion Test (RCMT)

One of the important methods and tests to determine the coefficient of ion-chloride release in concrete is a common practice for the standard AASHTO TP64, a RCMT test, where the concrete surface is exposed to a chloride solution and the amount of chloride ion at a particular age and at depths Specific measurements are made and the depth of penetration of ion chloride is obtained, which helps to evaluate the quality of concrete in comparison with each other, and concrete can be classified in this regard. However, the result of this test is not permeability, but it shows permeability [26-27]. In this research, the determination of the ion-chloride emission coefficient was carried out using RCMT ion-chloride migration test on cylindrical sample with diameter of 10 cm and thickness of 5 cm. The degree of permeability of concrete against chloride ion through breaking and direct measurement of penetration by spraying The silver nitrate solution is measured and then the magnitude of the permeability coefficient is shaken by the formula [26-27].

2.2.3. AASHTO T358 Test (RCPT) Electrical resistance test

Today, concrete non-destructive testing has the effect and proper function of concrete repairs on concrete structures. Concrete non-destructive testing, with the availability of various data structures for existing structures, will provide experts and experts with the expertise to judge and decide on the performance, requirements, and methods of repairing and repairing concrete structures. Concrete non-destructive testing is a test for determining the electrical resistance of concrete [28]. This test, by providing the electrochemical resistance of the concrete, allows designers and experts to decide on retrofitting and reinforcement plans or validation operations. The ease or hardness of the flow of electrical current from saturated concrete can be a sign of its permeability to water, especially ion release and migration (especially chlorine ion), especially if saturated with salt water. In this experiment, an assessment of the potential corrosion rate of probable concrete samples armed in a chloride attack is investigated, in which samples made in the form of a cylinder of diameter 10 cm and resistance of 520 cm to ages 28 to 90 days in a solution of lime water The saturation is maintained and then the electrical resistance of each sample is examined [29-30].

2.2.4. Compression strength test

The compressive strength of concrete is, so called, the test result of determining the compressive strength of a concrete. This test is performed on standard cubic or cylindrical samples. The amount of concrete in the sample at a specified age when the specimen is broken down per square centimeter. Concrete compressive strength unit, kg / cm2, Pascal, Newton per square inch and ... This unit can also be converted to other units. One of the most effective and efficient tests on the quality control of hardened concrete is the determination of the compressive strength of concrete. The compressive strength of concrete for seven days can vary depending on the type of cement used. But as a standard, the compressive strength of seven-day concrete is about 75% concrete for 28 days. The final compressive strength of concrete (28-day resistance) is proportional to mixing design, water to cement ratio, and concrete cement grade. Usually, according to Iran's standards, 28-day resistance is considered to be the resilience of the design. In this test, a compressive strength test was made according to ASTM C172 standard, cube samples of 10 cm in size and maintained to saturation in the lacquer solution until the age of the test. Resistance test of the ages 7, 28, 90 and 180 days on the samples done [31-32].

2. 2.5. Test of sodium sulfate and magnesium attack

Due to the chemical reaction between sulfates and cement paste, formed crystalline ettringite crystals have a volume of 200% and cause cracking. In fact, the presence of the following three factors in the concrete leads to a sulfate attack: the higher the permeability of the concrete or the greater porosity between the concrete components, the more ions in the soil itself and the task of transferring the ion sulfate to Inside the concrete. Sulfate ions are present in the form of sulfate salts in a concrete environment that has a high dissolution rate in water and is widely distributed in penetrating bonds. One of the ways to prevent concrete corrosion from attacking sulfate ions is to use anti-sulfate cement. In this type of cement due to the limited amount of tertiary calcium aluminate phase, the possibility of reaction of sulfates with cement paste and finally formation of ettringite crystals is strongly reduced. However, the use of anti-sulfate cement is not recommended if concrete is simultaneously exposed to the threat of chlorine ion attack. The use of anti-sulfate cement, especially type 5 cement, exacerbates the amateur corrosion performance due to the presence of chlorine ion and ultimately causes cracking and reduction of concrete durability [33]. Hence, since the attack of sulfates into concrete is a serious deterioration in concrete structures. In a variety of studies, this phenomenon and its effects have been investigated. Researchers have introduced various methods for this attack, one of the methods is to place concrete samples in a solution of sodium sulfate and to check their weight change and compressive strength over time. Cubic cubes with 10 cm dimensions were prepared in a solution of Saturated Lime until 28 days, then treated with sodium sulfate 5% and magnesium sulfate solution 5%. Weight of specimens related to weight change before sucking in sodium sulfate solution was measured and recorded. The 28-day compressive strength of concrete samples was also determined. The specimens were placed in a container where the sodium solution was molded. Since sodium sulfate reacts with cement hydration products over time, and its amount is reduced in solution, it should be kept in a constant solution in a constant solution. Due to the fact that the soluble PH increases with decreasing of sodium sulfate content, pH of solution of solution of sodium sulfate was kept constant. The procedure was followed by recording that the pH of the sulfate solutions was initially recorded, and then this pH was controlled several times daily by adding sulfuric acid to the solution. Of course, the pH changes after about 120 days, and no longer needed to adjust on a daily basis. The specimens inside the container, however, were moved once and for all to apply the effect of sodium sulfate uniformly on all surfaces. At the age of testing, concrete specimens related to weight change were removed from the dish and, as with the first reading of their weight, their surfaces dried and the weight of the gauge was measured. The compressive strength variations were also measured as compressed compressive strength compression strength samples. Also, the pH of the magnesium solution was measured, although the pH changes in these solutions were less than that of sodium sulfate [34-35].

2.2.6. Pressure water penetration test (BS EN-12390-8)

Since water permeability tests are associated with many challenges, in some European countries, such as Germany, another test was carried out that at water pressure, at a given time, water penetration depth was obtained in concrete (DIN 1048-5) [36]. Then, in EN 12390-8, with a slight change, this experiment was presented with ease, in which a concrete sample of three days from the underlying surface is pressurized at a pressure of 0.5 MPa (5 times), and then the maximum penetration depth of the water is obtained Is a parameter for assessing the water penetration in concrete [36]. In various sources, the classification of concrete is included in the DIN 1048 test, but this classification has not yet been submitted for testing according to the EN method. The dispersion of the results of various test specimens of a concrete type in this experiment is high and not very reliable [36-37]. There are various water absorption experiments, the most important of which are:

Early Water Absorption

Ultimate water absorption (long term) for 2 days or more under normal or boiled conditions (Final Water Absorption)
Initial Surface Water Absorption Test (ISAT)
Capillary Water Absorption
Each of these experiments displays a specific feature of concrete, and it is necessary to use any test that is similar to the actual reality [38]. For this purpose, in this study, BS EN-12390-8 was used to conduct water penetration testing, and this experiment was performed on cubic samples measuring 15 cm at the age of 28 days and 90 days and penetration Water was measured in samples with different substitution percent after three days at atmospheric pressure of 5 atmospheres by fracturing the samples (Figure 4).

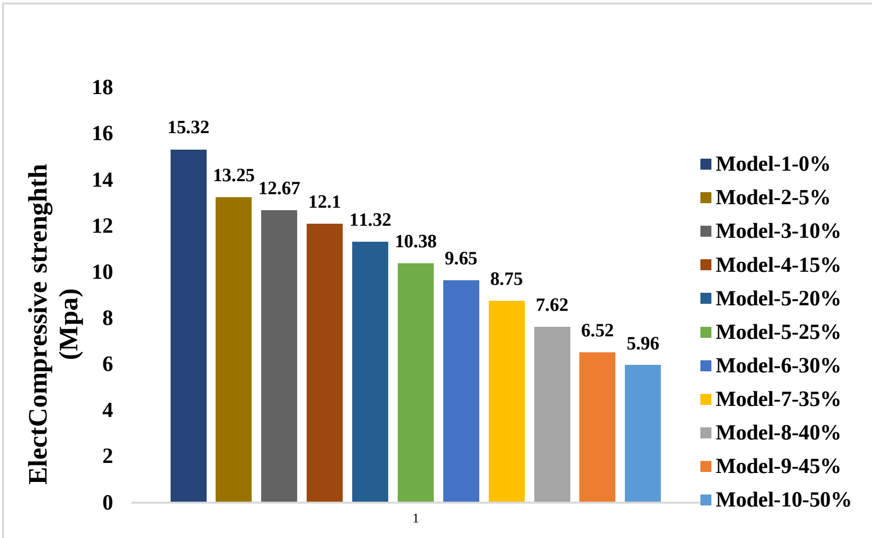
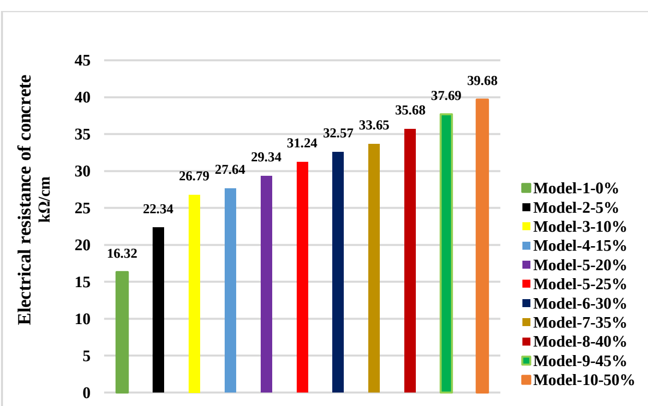


Figure 4. Compressive strength Graf 28-day concrete

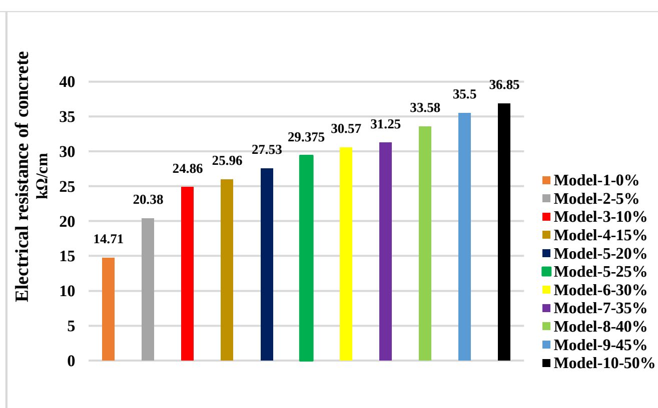
3. RESULT AND DISCUSSION

3.1. ELECTRICAL RESISTANCE TEST

After performing the electrical resistivity test on ten different samples with different 0-50% of the bagasse ash, Figure 5 shows the electrical resistivity values of the study samples at the age of 28, 56 and 90 days. Based on electrical resistivity test, it was observed that with the addition of bagasse ash in the mixing scheme, the amount of electrical resistance of the concrete increased. Also, the effect of bagasse substitutes on older ages has increased the electrical resistance by an average of about 2.3 times the sample without the pozzolan. By conducting an electrical resistivity test on these ten samples, it was observed that the increase in the electrical resistance to the 25% subsidence is very high and fast, the rate of increase in electrical resistance is much higher than the previous ones. According to this point, concrete with a resistivity of more than 20 kΩ ohms-cm, the corrosion rate of the bars in them is very low and insignificant. Considering this important point, it has been found that the use of bagasse ash in the concrete mixing scheme is noticeable in reducing the corrosion of buried cages in concrete in chloride and acidic environments.



a) 28-day electrical resistance graph



b) 90-day electrical resistance graph

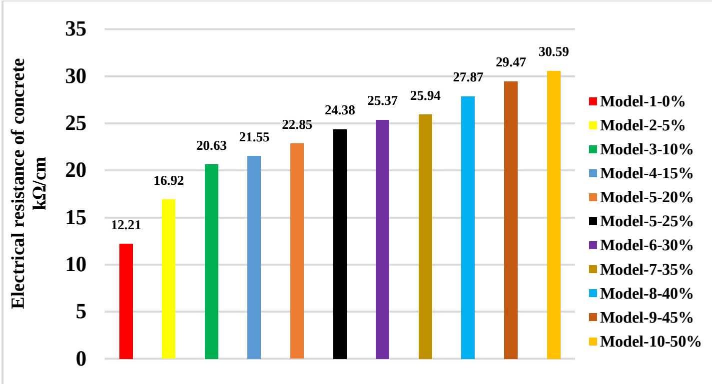


Figure 5. 120-day electrical resistance graph

3.2. ACCELERATED IMMERSION ION CHLORIDE (RCMT)

After an accelerated migration test of ion chloride, based on the AASHTO TP 64 standard, on 10 samples with different percentages containing bagasse substitutes, the results obtained from the accelerated migration of chloride ion were presented. , Increase in the amount of bagasse ash in samples studied with different percentages of pozzolan bagasse has reduced the chloride ion penetration in samples, It was observed that among samples of study with percentage of pozzolan from 0 to 50% of pozzolan bagasse, the sample with 25% pozzolan bagasse with a 28-day interval had a penetration coefficient of 50% ionic chloride compared to the sample without pozzolan. In addition, the results of the accelerated migration test for ion chloride at 56 days of age showed a 53% increase in ion chloride penetration coefficient compared to non-pozzolan specimens. Among these percentages, pozzolan was observed among these ten samples, with a rise in the amount of pozzolan by the percentage of substitution to The 25% permeability coefficient of chloride ion had the highest reduction compared to the bagasse substrate sample, In general, according to the results of the migration test of ion chloride, it can be said that using these bagasse ash bags can increase the durability of concrete in chloride corrosive media

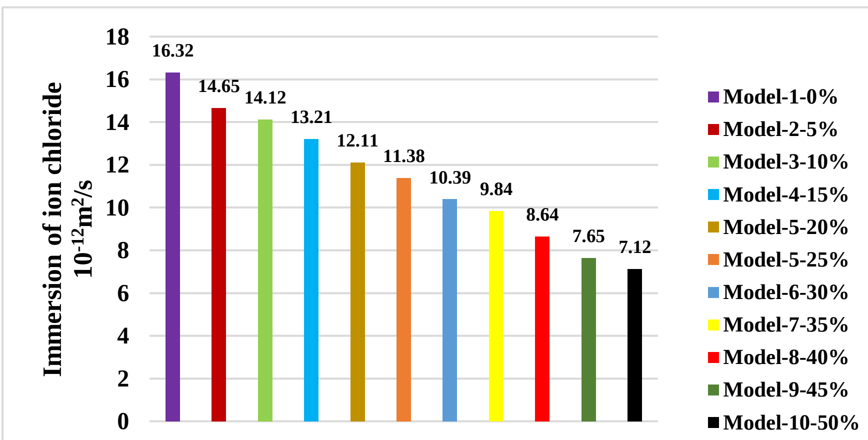


Figure 6. Accelerated Immigration Experiment Results of Chloride ion -28 day Reagent Concrete Samples

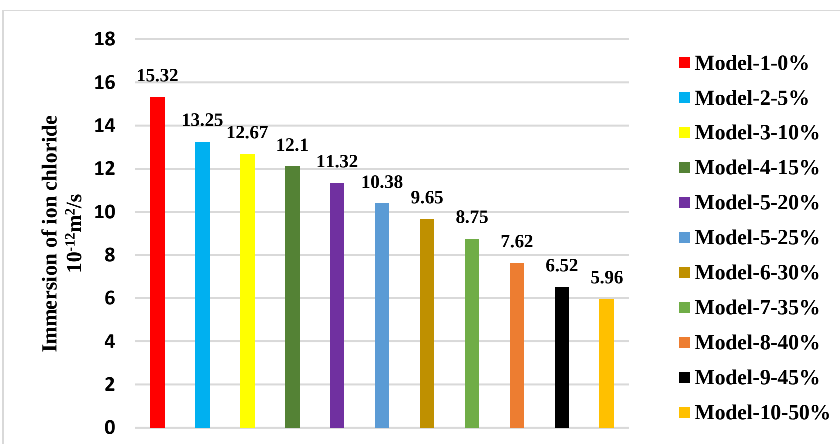


Figure 7. Test of weight change of concrete samples in the attack on sodium sulfate and magnesium

After testing, sodium and magnesium sulfate attack (Figure 6 and 7) can be observed on 10 samples with percentages of 0- 15%. All of the tested specimens were subjected to changes in the sodium sulfate solution and to the weight gain of pozzolan and without subacute until 60 days of age. This is quite commonplace, in general, the effect of reducing the weight of concrete in magnesium and sodium sulfate is observed after a long time and several months. The reason for weight gain in concrete samples is due to the formation of and gypsum due to ionic sulfate reactions with calcium hydroxide and also C3A. These products are placed in vacant concrete spaces, and add to concrete specimen weights. In the long run, due to the fact that these products have a larger volume of material than the raw materials, they cause the cement matrix to be discontinued and degrade and lose weight. Also, sodium and magnesium sulfate was tested on samples of 90 days old, which, after 90 days of age, reduced the weight of the samples tested in magnesium and sodium sulfate. The reason for this weight loss is that more ettringite and gypsum are produced in these concrete samples. And the empty spaces of these samples are filled and cause expansion and cracking on the studied samples. Of course, at the same age and in sodium sulfate samples, no weight loss was observed, due to the lower degradation of the samples due to the low degradation rate of sodium sulfate. In general, there is another factor that causes less damage and, consequently, weight loss of pozzolan samples in a sulfate solution. Lowering the amount of C3A and Ca (OH) 2 in these samples leads to a reduction in the potential of ettringite and gypsum production in the samples. At the age of 180 days, the effect of this factor can be seen in the results.

According to study samples at age 180 days, this study showed that at this age of 180 days, the percentage of weight loss in all samples containing pozzolan bagasse is lower than other samples. At 180 days of age, the effect of pozzolan on bagasse ash can be clearly seen in reducing the potential of ettringite and gypsum. By studying and performing the experiments, these ten samples were observed with 0% to 50% percent of bagasse percent. In laboratory samples, with the addition of pozzolan of bagasse ashes, the weight loss of concrete samples was decreased. Among the ten samples in which the percentage of pozzolan bagasse was between 0% and 50%, a 25% pozzolan specimen with bagasse ash had the least weight loss compared to other samples. Also, after testing the sodium and magnesium sulfate attack in Tables 3 and 4, the percent weight loss of the samples in magnesium sulfate solution is more than that of sodium sulfate.

Table 3. Change in weight of concrete samples relative to the initial weight in sodium sulfate 8%

Sample names	**Primary sample weight (kg)**	**Percentage change in weight after 30 days relative to the initial weight**	**Percentage change in weight after 60 days relative to the initial weight**	**Percentage change in weight after 90 days relative to the initial weight**	**Percentage change in weight after 120 days relative to the initial weight**	**Percentage change in weight after 150 days relative to the initial weight**	**Percentage change in weight after 180 days relative to the initial weight**
Model-1-0%	2410	0.28	0.24	0.24	-1.82	-2.12	**-1.42**
Model-2-5%	2453	0.34	0.26	0.21	-1.26	-1.42	**-2.11**
Model-3-10%	2368	0.31	0.34	0.32	-0.87	-2.14	**-2.14**
Model-4-15%	2634	0.23	0.31	0.27	-1.42	-1.52	**-1.42**
Model-5-20%	2689	0.27	0.29	0.29	-1.53	-1.34	**-1.49**
Model-6-25%	2575	0.16	0.23	0.19	-0.82	-1.03	**-1.12**
Model-7-30%	2398	0.26	0.33	0.23	-1.3	-1.63	**-2.15**
Model-8-35%	2435	0.33	0.29	0.34	-1.3	-1.75	**-1.86**
Model-9-40%	2514	0.29	0.36	0.29	-1.3	-2.16	**-1.63**
Model-10-45%	2451	0.31	0.33	0.38	-1.45	-2.02	**-1.78**

Table 4. Weight variation of concrete samples relative to the initial weight in magnesium sulfate 8%

Sample names	**Primary sample weight (kg)**	**Percentage change in weight after 30 days relative to the initial weight**	**Percentage change in weight after 60 days relative to the initial weight**	**Percentage change in weight after 90 days relative to the initial weight**	**Percentage change in weight after 120 days relative to the initial weight**	**Percentage change in weight after 150 days relative to the initial weight**	**Percentage change in weight after 180 days relative to the initial weight**
Model-1-0%	2410	0.23	0.26	0.24	-1.82	-2.12	**-2.42**
Model-2-5%	2453	0.18	0.27	0.21	-1.26	-1.42	**-1.17**
Model-3-10%	2368	0.24	0.31	0.32	-0.87	-2.14	**-2.32**
Model-4-15%	2634	0.17	0.19	0.27	-1.42	-1.52	**-1.53**
Model-5-20%	2689	0.26	0.29	0.29	-1.53	-1.34	**-1.19**
Model-6-25%	2575	0.13	0.23	0.19	-0.82	-1.03	**-1.13**
Model-7-30%	2398	0.21	0.33	0.23	-1.3	-1.63	**-1.45**
Model-8-35%	2435	0.29	0.29	0.34	-1.3	-1.75	**-2.85**
Model-9-40%	2514	0.23	0.36	0.29	-1.3	-2.16	**-2.23**
Model-10-45%	2451	0.27	0.33	0.38	-1.45	-2.02	**-1.87**

3.3. TEST OF COMPRESSIVE STRENGTH CHANGE OF CONCRETE SAMPLES IN THE ATTACK OF SODIUM AND MAGNESIUM SULFATE

After testing the compressive strength of concrete specimens against sodium and magnesium sulfate, it was observed (Table 5 , 6)on samples from 0% to 50% of bagasse that reduced the compressive strength in concrete samples from the earliest ages, this decrease The compressive strength of bagasse-containing pozzolan specimens is very common at the early ages, but this 120-day-old study will be very impressive. In general, this reduction in compressive strength in a bagasse-free sample is greater than that of bagasse ash. Also, among these study samples, the least reduction in compressive strength was attributed to samples containing 25% bagasse ash, as well as the greatest reduction in compressive strength in concrete samples studied was about 15%. Also, by performing a resistance test against sodium and magnesium sulfate, among the samples studied, samples of magnesium sulfate showed a lower resistance than samples in sodium sulfate. At the end of the experiment, it was observed that concrete specimens containing bagasse pozzolan in a sulfate solution generally exhibited less compressive strength reduction than bagasse containing pozzolan specimens.

Table 5. Compressive strength of concrete specimens in magnesium sulfate 8% (Mega-Pascal)

Sample names	**Compressive strength of concrete samples in magnesium sulfate 8% 28 days**	**Compressive strength of concrete samples in magnesium sulfate 8% 90 days**	**Compressive strength of concrete samples in magnesium sulfate 8% 120 days**	**Compressive strength of concrete samples in magnesium sulfate 8% 180 days**
Model-1-0%	45.35	43.24	42.12	**41.12**
Model-2-5%	45.95	44.76	43.52	**42.26**
Model-3-10%	46.12	45.09	44.13	**43.32**
Model-4-20%	46.98	45.72	44.69	**43.69**
Model-5-25%	47.74	46.52	45.43	**44.52**
Model-6-30%	47.52	46.31	44.12	**43.62**
Model-8-35%	47.12	45.95	43.85	**42.48**
Model-9-40%	46.85	45.72	43.62	**42.13**
Model-10-45%	46.62	45.53	44.42	**43.10**

Table 6. Compressive strength of concrete specimens in sodium sulfate 8% (mega-Pascal)

Sample names	**Compressive strength of concrete specimens in sodium sulfate 8% 28 days**	**Compressive strength of concrete specimens in sodium sulfate 8% 90 days**	**Compressive strength of concrete specimens in sodium sulfate 8% 120 days**	**Compressive strength of concrete specimens in sodium sulfate 8% 180 days**
Model-1-0%	46.42	45.32	44.42	**43.23**
Model-2-5%	47.13	46.24	45.36	**44.58**
Model-3-10%	47.97	46.83	45.72	**44.94**
Model-4-20%	48.14	47.32	46.42	**45.63**
Model-5-25%	49.20	48.17	47.35	**46.75**
Model-6-30%	48.95	47.20	46.42	**45.34**
Model-8-35%	48.23	47.14	46.23	**45.11**
Model-9-40%	47.12	46.23	45.12	**44.42**
Model-10-45%	47.01	46.81	45.63	**44.23**

3.4. PRESSURIZED WATER PENETRARION TEST

After the test of penetration of water under pressure according to standard (BS EN-12390-8) on concrete specimens studied in the table, it was observed that the use of bagasse ash pozzolan instead of a percentage of cement weight reduces water penetration Pressure and permeability in bagasse ash containing pozzolan concrete samples were higher than that of bagasse free ashes. By studying samples, it was observed that by increasing the pozzolan content of bagasse, instead of percentage of cement weight, water penetration in concrete samples was very low. In this study, concrete specimens with 20 and 25% as bagasse ash, instead of cement weight at 90 days old, showed no water infiltration in concrete samples, this suggests that bagasse ash pozzolan have a very good and good performance in Reduced water penetration and also increased concrete durability (Figures 8, 9).

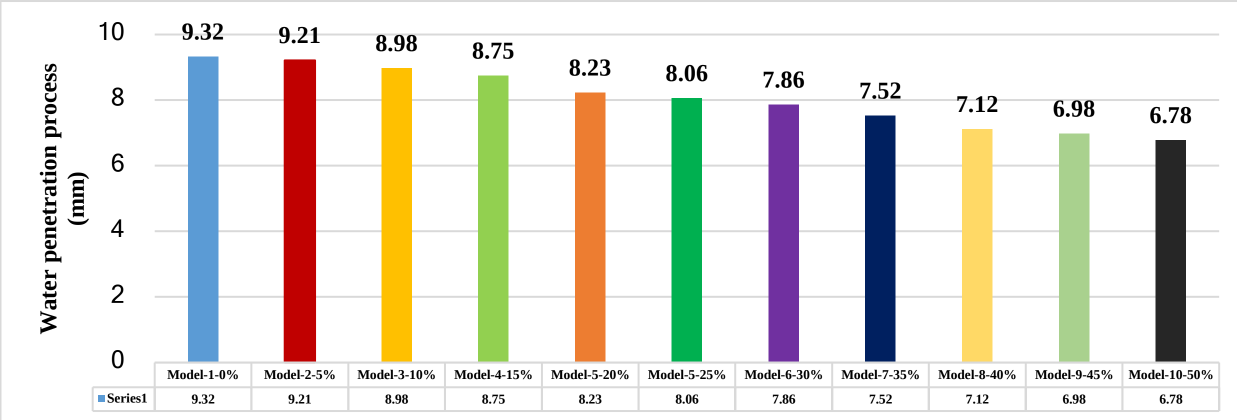


Figure 8. The process of reducing water penetration in concrete samples containing pozzolan at 90 days (mm)

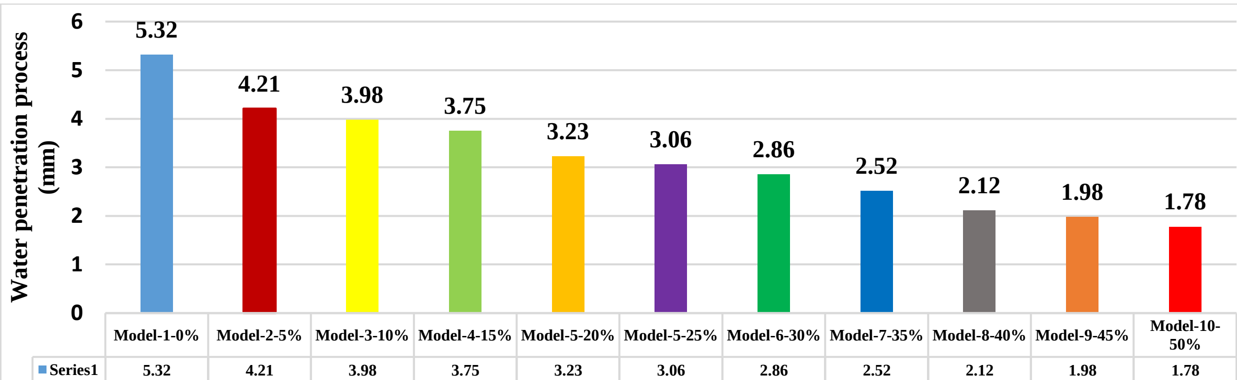


Figure 9. The process of reducing water penetration in concrete samples containing pozzolan at 120 days (mm)

4. Conclusion

In this study, the effects of pozzolan bagasse on the sample of 10 studies were as follows:
- By conducting a 28-day compressive strength test of concrete samples, it was found that the compressive strength of concrete specimens containing pozzolan bagasse at 28 days of age was higher than that of bagasse without pozzolan, and also the highest compressive strength among these 10 concrete samples, with a percentage of 0 To 50% of pozzolan, bagasse ash was observed in the sample with 25% posozlan. By measuring compressive strength at the age of 28 days, the greatest increase in compressive strength was obtained in samples with 25% pozzolan content. It is important to note that the increase of compressive strength of concrete in concrete samples with increasing of 25% has not been observed for any reduction of compressive strength, but with 30% increase in bagasse Ash ash, the compressive strength was lower than that of pozzolan. By performing the RCMT electrical resistivity test on study samples, pozzolan bagasse, with an increase in electrical conductivity, reduced the risk of corrosion of chloride in chloride environments compared to the control sample. By performing the chloride ion penetration test in accelerated concrete, the RCMT ion chloride migration on concrete specimens containing pozzolan, bagasse ash at the age of 28 and 56 days, was lower than that of bagasse free ashes, a decrease in chloride ion penetration Concrete specimens will increase the growth of concrete age. Compressive strength test and accelerated testing of RCMT ion chloride migration showed that using bagasse ash in pozzolan concrete as a cement substitute improved the performance and efficiency of concrete. Also, by checking the percentage of pozzolan from 0 to 50 percent of cement weight, the optimum percentage of pozzolan weight replacement was in the amount of 25% of this pozzolan, which is the optimal percentage of bagasse ash, causing the most compressive strength, as well as The greatest reduction in the permeability of concrete samples is made and the durability and performance of concrete are increased. By performing a weight loss test, concrete specimens in the attack on magnesium sulfate and sodium were observed in all concrete samples containing bagasse ash in 8% magnesium sulfate as compared to non-poached samples of bagasse ash, which reduced the weight loss rate of concrete samples, It is important to note that the concrete weight reduction rate for concrete specimens with a 25% percentage point of bagasse ash has the lowest weight loss compared to other samples with bagasse ash content.

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This work was carried out in collaboration among all authors.

CONFLICT OF INTEREST

The author (s) declared no potential conflicts of interests with respect to the authorship and/or publication of this paper.

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