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Properties of Portland Cement Type V Mortar Mixed with Ground Rice Husk Ash and Limestone Powder

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Abstract. The objective of this research is to study the Properties of Portland cement Type V mortar mixed with Ground Rice Husk Ash (GRHA) and two types of limestone powder (LS1 and LS2). The physical and chemical properties of Portland cement Type V, ground rice husk ash, and limestone powder were tested. The properties of mortar such as water requirement, compressive strength, compressive strength loss and drying shrinkage were investigated. The solutions used in this study were sodium sulfate (Na_2SO_4) and magnesium sulfate ($MgSO_4$). The concentrations of both solutions were 5% by weight in accordance with the ASTM C 1012 standard. GRHA, LS1, and LS2 have particle sizes of 29, 12 and 128 µm. The replacement levels of GRHA, LS1, and LS2 in Portland cement Type V were 0%, 20% and 40% wt. of cementitious materials. The ratio of water to cementitious material was controlled based on the water requirements conforming to flow value at 110 ± 5%. The results showed that the compressive strength of mortar was decreased with increase the percentage replacements of GRHA and LS in Portland cement Type V. At 180 days, the compressive strength of all mortars was lower than that of the control mortar. Mortar containing 20% of GRHA and LS (C80R10LS110) was the highest development in compressive strength and as high as that of the control mortar. From the results of sulfate resistance, it was found that the higher was the percentage replacements of GRHA and LS in Portland cement Type V, the lower was the strength loss and drying shrinkage of mortar. The strength loss of mortars in magnesium sulfate solution was more than those in sodium sulfate solution.

1. Introduction

Thailand has coastal areas, the two sides of the eastern seaboard, Gulf of Thailand, the Pacific and the west coast of the Andaman Sea in Indian Ocean. The long coastline is about 2,600 km, covering 23 coastal provinces with a population of over 11 million people live in areas that are critical habitats such as areas for industry, commerce and tourism. At present, many coastal areas have building constructions to accommodate the growth of the economy and society. Building-sites near the sea, like a dam abutment pier lighthouse, etc., must take into account the effects of corrosion due to sulfate and concrete. If you do not take into account the effects of corrosion due to sulfate in the beginning of the construction, the concrete can be damaged in the near future. The need to repair damaged concrete will be very costly. Features of the cement used must be appropriate to the use of various types. Standard testing according to ASTM C150 is divided into five of Portland cement. The Sulphate-resistant Portland cement is Portland Cement Type V. These include cement seal blue elephant seals, sharks and TPI blue.

Portland cement type 5 can withstand sulfate solution to protect steel from rust compared to other types of cement. [1] Therefore, choosing the right kind of cement and pozzolan materials can help reduce the impact of sulfates and chlorides in seawater to develop and improve some properties of concrete that can be used. Concrete includes inert materials such as limestone, crushed stone, sand and dust profile that looks quite capable of increasing the adhesion of concrete. In addition, the ability to pour reduces oily water and makes surface finishing of concrete easier. However, the use of inert material to replace cement to make concrete were reduced because of the lower volumes produced. A pozzolan material is a material with silica and alumina as the main component. It will not qualify interface by itself but when it reacts with the calcium hydroxide and water temperature, pozzolan materials substances will have capable interface. Pozzolan materials include calcined clay, coal ash or fly ash, silica fume and ground RHA.

2. Research Objective

2.1. To study the chemical composition and physical properties of powdered limestone, rice husk ash, Portland cement and its five categories.

2.2. To study the development of calcium hydroxide, cavity volume, distribution of the cavity and the durability of mortar and limestone powder, rice husk ash in cement grinding at cement type 5.

2.3 To determine the optimum proportion of powdered limestone and crushed husk ash in Portland cement type 5.

3. Scope of research

3.1. Portland cement type 5 (TPI blue) from TPI Polene Public Company Limited from Saraburi province was use in this studied.

3.2. Limestone powder from TPI Polene Public Company Limited (TPIPL) with the magnitude from 0.0 to 0.1 mm (0-100 microns) using as LS1 and the magnitude from 0.1 to 0.6 mm (100-600 microns) using as LS2.

3.3. RHA from thermal power plant RICE MILL GRANNARY Ltd. (Thailand) [2]

3.4. Water to binder ratio (w/b) based on the flow test roll to spread the flow equals 110 ± 5 mm.[3]

3.5. Physical properties and chemical properties of Portland cement type V, limestone powder and rice husk ash, including specific gravity, bulk density, moisture content, specific surface area in the form of Blaine fineness, particle size distribution, X - Ray Diffraction (XRD) and surface characteristics of the particles by using Scanning Electron Microscope (SEM).

3.6. Air content testing for the fresh properties of mortar and the mechanical properties of mortar was testing the compressive strength at the age of 3, 7, 28, 60, 90, 120 and 180 days. [4]

3.7. The Porosity testing of mortars using the Mercury Intrusion Porosimetry (MIP) technique.

3.8. Test for calcium hydroxide ($Ca(OH)_2$) of the mortar using the technique Thermal Gravimetric Analysis (TGA).

3.9 The durability testing of mortar including loss of compression, expansion, drying shrinkage, and autogenous shrinkage due to the sodium sulfate and magnesium sulphate attack.

4. Benefits of research

4.1. Keeping in mind the basic features of the five types of Portland cement, rice husk ash and limestone powder.

4.2. Keeping in mind the capabilities and behavior to get underway to replace Portland cement type V with rice husk ash and limestone powder.

4.3. Keeping in mind the mixture of Portland cement type V husk ash and suitable limestone powder.

5. Framework

The concept of bringing powdered limestone and rice husk ash, which is produced by the agricultural industry from grain mills came from power plants that use heat energy from burning the chaff. Brick kiln as inert materials and pozzolan supplies in concrete improves certain properties of the concrete and reduce the cost of it. There is also a byproduct of the domestic materials to make useful and add value to the RHA.

6. Results and discussions

6.1. Chemical composition and Physical properties

The test results of the chemical composition of the powders are shown in Table 1. It shows that Portland cement type 5 has CaO as its main component with 60.50% and SiO_2 content of 18.40 %. The crushed rice husk ash amount has SiO_2 as the main component with 88.75%. The amount of CaO is the main component of limestone powder LS1 (12 μm) and LS2 (128 μm) with almost similar 46.77% and 44.94%, respectively. The amount of magnesium oxide (MaO) of the two kinds of powdered limestone were also almost similar with 2.38% and 2.92%, respectively.

Table 1. The Chemical Composition of Portland Cement, Rice Husk Ash and Limestone Powder

Chemical composition (Percentage by Weight)	Portland cement Type 5	RHA crushed	Limestone Powdered LS1	Limestone Powdered LS2
1. Silicon dioxide (SiO_2)	18.40	88.75	8.97	11.27
2. Aluminium oxide (Al_2O_3)	4.80	0.85	1.02	0.80
3. Iron oxide (Fe_2O_3)	3.50	1.07	0.37	0.32
$SiO_2+Al_2O_3+Fe_2O_3$	26.70	90.67	10.36	12.39
4. calcium oxide (CaO)	60.50	0.44	46.77	44.64
5. magnesium oxide (MgO)	1.00	0.07	2.38	2.92
6. Potassium oxide (K_2O)	0.40	1.74	0.13	0.14
7. sodium oxide (Na_2O)	0.30	0.05	0.02	0.02
8. Sulfur trioxide (SO_3)	2.60	0.02	0.33	0.12
9. free lime (Free CaO)	1.30	0.06	-	-
10. Percent weight loss,burn (LOI)	1.82	7.27	39.54	38.68

The physical properties of the materials used in the study are shown in Table 2, the specific surface area by Blaine of cement, rice husk ash, crushed limestone powder LS1 and LS2 is equal to 3400, 4900, 6375 and 409 cm^2/ g. The specific gravity of 3.17, 2.12, 2.76 and 2.77, respectively, the demand for water is equal to 100, 109, 101 and 105, respectively, the index was compared with mortar cement, usually when the mortar cement is already 7 days existing. 96, 82, 84 and 79%, respectively, at 28 days is equal to 94, 86, 89 and 81 respectively.

Considering the chemical composition and physical properties of rice husk ash in Table 3, which is a material pozzolan properties through standards ASTM C 618 [5] RHA grinding four hours so it can be used in place of cement. (Purachatra and baby Anay, 2008).

Fine limestone powder is a semi-inert material that reacts chemically and dissipates the powder. The cement reacts with water to hydrate faster. Calcium oxide (CaO) reacts with water to form calcium hydroxide. $Ca(OH)_2$ can be used as a basic substance in the pozzolanic reaction.

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Table 2. The physical properties of rice husk ash, Portland cement and limestone powder.

Physical Properties	Portland Cement Type 5	RHA crashed	Limestone Powdered LS1	Limestone Powdered LS2
1.motar cement (percent)	0.46	0.26	0.15	0.17
2.With Blaine specific surface area (Sq. Cm per gram)	3.400	4.900	6.375	409
3.specific gravity	3.17	2.12	2.76	2.77
4.Resolution (parade size, percentage holding)				
- 75 micrometer	0.61	13.00	11.04	88.98
- 45 micrometer	4.47	30.34	19.90	91.12
- 36 micrometer	6.89	39.00	23.40	91.68
5.Saength Index				
At the age of 7 days (the equivalent of the control sample)	100	82	84	79
At the age of 28 days (the equivalent of the control sample)	100	86	89	81
6.The demand of water (per cent)	100	109	101	105

Table 3. The properties of the rice husk ash compared with ASTM C 618 standard.

Chemical composition (Percentage by weight)	ASTM C 618 (Class N)	RHA crushed
1. Silicon dioxide (SiO_2)	-	88.75
2. Aluminium oxide (Al_2O_3)	-	0.85
3. Iron oxide (Fe_2O_3)	-	1.07
$SiO_2+Al_2O_3+Fe_2O_3$	lowest 70 percent	90.67
4. calcium oxide (CaO)	-	0.44
5. magnesium oxide (MgO)	-	0.07
6. Potassium oxide (K_2O)	-	1.74
7. sodium oxide (Na_2O)	Up 1.5 percent	0.05
8. Sulfur trioxide (SO_3)	Up 4.0 percent	0.02
9. free lime (Free CaO)	-	0.06
10. Percent weight loss,burn (LOI)	Up to 10 percent	7.27
Physical Properties		
1. moisture content (percent)	Up 3.0 percent	0.26
2. With Blaine specific area. (Sq.Cm per gram)		4,900
3. Specific gravity	-	2.12
4. Resolution (particle size , percentage holding)	-	
- 75 micrometer	-	13.00
- 45 micrometer		30.34
- 36 micrometer		39.00
5. Strength Index		
At the age of 7 days (the equivalent of the control sample) At the age of 28 days (the equivalent of the control sample)	lowest 75 percent	82 86
6. The demand of water (per cent)	lowest 75 percent Up to 115 percent	109

6.2. Characteristics of the powder Particles

6.2.1. Particle Portland Cement Type 5. The characterize the particles of Portland cement type 5 with SEM, magnified 7500 times, respectively, in 1500 and found that the particles of Portland Cement Type 5 has edges. Amorphous Surface roughness and particle size mixed together as shown in Figure 1(a) and (b).

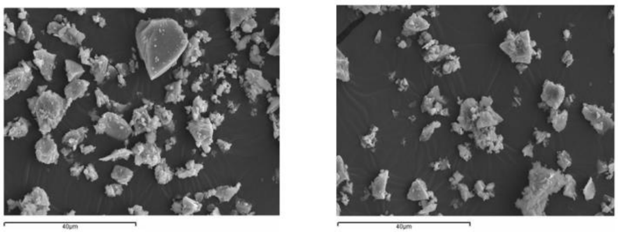

Figure 1 (a) SEM 1500-fold magnification

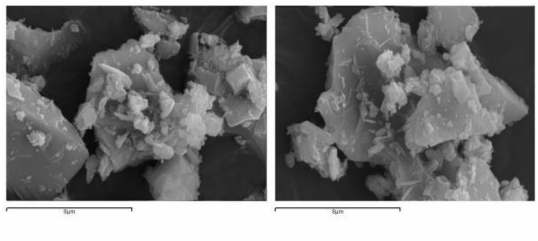

Figure 1 (b) SEM 7500-fold magnification

6.2.2. Particle RHA. The characteristics of rice husk ash particles before grinding with SEM, it was expanded in 1500 and 7500 and found that a relatively coarse particles has a high porosity, smooth and hollow as shown in Figure 2(a) and (b).

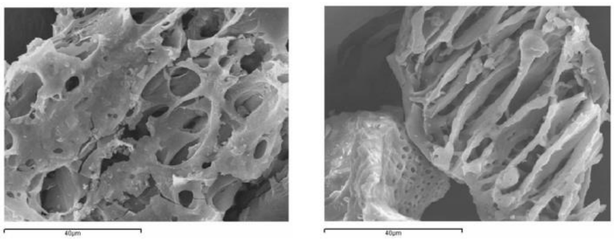

Figure 2 (a). SEM 1500-fold magnification

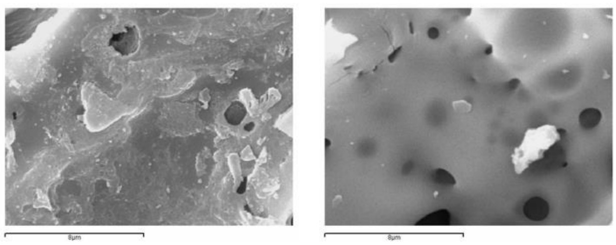

Figure 2 (b). SEM 7500-fold magnification

6.2.3. RHA grinded for four hours. The enlarged photos of RHA grinded for four hours were smaller in size. There's Resolution Cavities and the pores are small compared with RHA that are not crushed as shown in Figure 3.

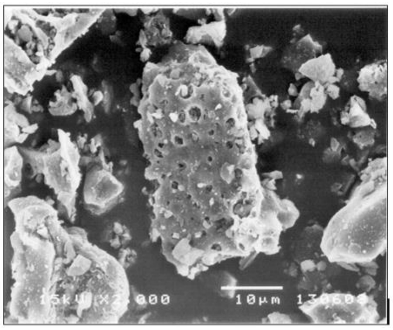

Figure 3. SEM 7500-fold magnification

6.2.4. limestone powder particles. The characterized the particles of powdered limestone LS1 that was expanded in 1500 and 7500, respectively, found that powdered limestone particles are smaller and more close to the Portland Cement Type 5 which is a triangle. Overall particle size is not much different as shown in Figure 4(a) and (b).

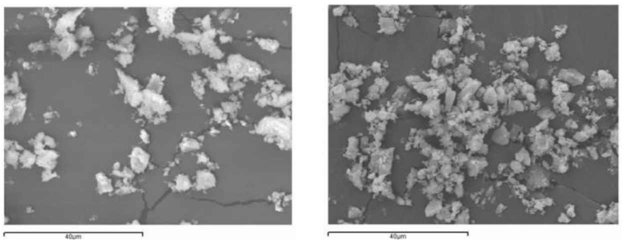

Figure 4 (a). SEM 1500-fold magnification

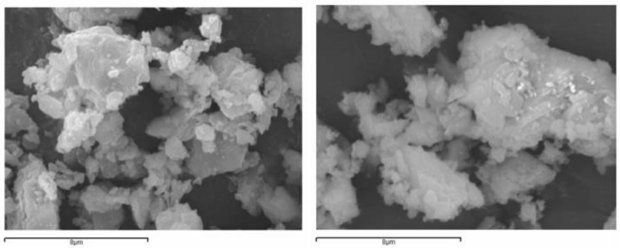

Figure 4 (b). SEM 7500-fold magnification

The characterized the particles of powdered limestone LS2 that was expanded in 1500 and 7500 respectively as a shaped texture mixed with angles and particle size larger than the LS1 as shown in Figure 5(a) and (b).

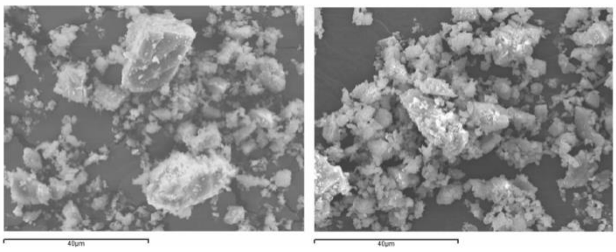

Figure 5 (a). SEM 1500-fold magnification

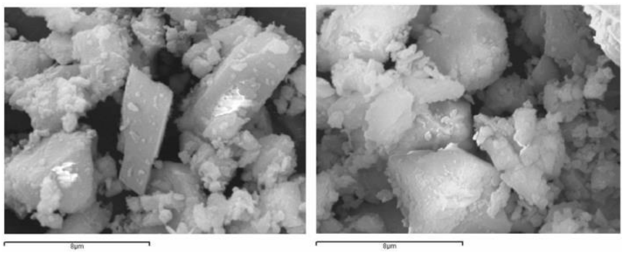

Figure 5 (b). SEM 7500-fold magnification

6.3. Strength of cement mortar

Test compressive strength of mortar mix, rice husk ash, crushed and powdered limestone to replace Portland cement type 5 percent 0, 20, 30 and 40 shown in Figure 1.1 to 1.3 showed that at the age of 180 days Morse. Guitar mix crushed rice husk ash and limestone powder every test. Compressive strength less mortar control. The test is similar compression control most. Cement is a collection of 80 RHA crushed limestone powder, 10 percent LS1 (12 micron) of 10 (C80R10LS1 # 10) was 96%. Replacing Portland cement type 5 with crushed rice husk ash and limestone powder in a ratio of 20 percent by weight of the series of mortar mix, rice husk ash and limestone powder grinding LS1 (12 microns) with the most strength. Followed by a mortar mixer were crushed husk ash. And testing of mortar mix, rice husk ash and limestone powder grinding LS2 (128 micron) in order to extract the details below.

Ages 3-28 showed that compressive strength test of mortar mixed with crushed rice husk ash and limestone powder LS1 most valuable is a collection tested C80R10LS1 # 10 with a compressive strength at 28 days was 89%. Ages 28-90 day test mortar mix crushed husk ash and limestone powder LS1 most valuable is a collection tested C80R10LS1 # 10 with a compressive strength at 90 days was 94%. The age range 90-180 days with test compression is most C80R10LS1 # 10 sets a compression of 96% in this segment has been observed that the compressive strength of the mortar mix all RHA. 20 has compressive strength better. The compression of 96%, which is close to the test mortar mix husk ash and limestone powder LS1.

Replacing Portland cement type 5 with crushed rice husk ash and limestone powder was found that 30 % of test mortar mix husk ash and limestone powder LS1 has the most strength. Followed by mortar mix husk ash plain. And testing of mortar mix, rice husk ash and limestone powder LS2, respectively, as detailed below.

Ages 3-28 showed that compressive strength test of mortar mixed with crushed rice husk ash and limestone powder LS1 most valuable is a collection tested C70R20LS1 # 10 with a compressive strength at 28 days was 69%. Ages 28-90 day test of mortar mix, rice husk ash and limestone powder LS1 most valuable is a collection tested C70R20LS1 # 10 with a compressive strength at 90 days was 75%. The age range 90-180 days with test compression most C70R20LS1 # 10 is set equal to 82 % and compressive strength of mortar mixed with 30% of all RHA crushing compressive strength better. The compression of 80%, which is close to the test mortar mix husk ash and limestone powder LS1.

Replacing Portland cement type 5 with crushed rice husk ash and limestone powder was found that 40 percent of test mortar mix crushed husk ash and limestone powder LS1 has the most strength. Followed by mortar mix husk ash plain. And testing of mortar mix, rice husk ash and limestone powder LS2 respectively. Ages 3-28 showed that compressive strength test mortar mix husk ash and limestone powder LS1 most valuable is a collection tested C60R30LS1 # 10 with a compressive strength at 28 days was 61%. Ages 28-90 day test of mortar mix, rice husk ash and limestone powder LS1 most valuable is a collection tested C60R30LS1 # 10 with a compressive strength at 90 days was 65%. The age range 90-180 days with test compression most C60R20LS1 # 10 is set equal to 65 % and compressive strength of mortar mixed with 40% of all RHA crushing compressive strength better. The compression of 65%, which is close to the test mortar mix husk ash and limestone powder LS1. Test results can be deduced. LS1 replaced with limestone powder particle size is small and the nearby cement. [6]Can interpolate the distribution of cement, as well as small particles also help fill the gap of

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the cavity. Make the structure more dense paste. The ability to get a reaction and hydration thus outperformed LS2 limestone powder particles which are larger.

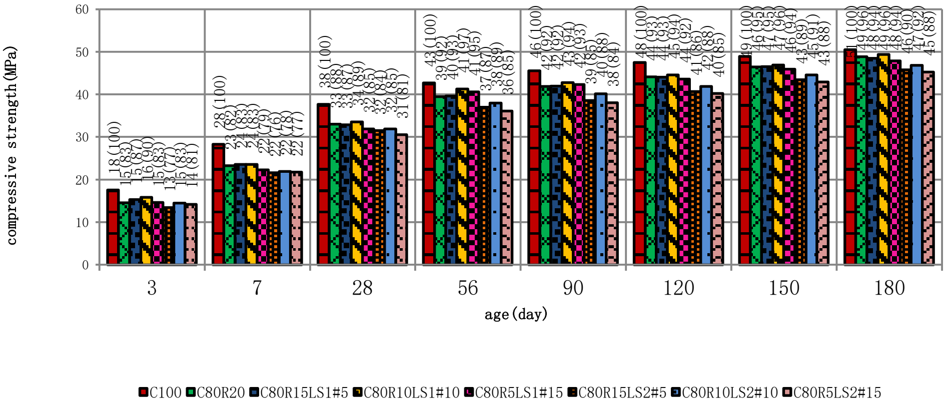

Figure 6. The compressive strength of the mortar mix, rice husk ash, crushed limestone powder and 20 percent. Replace Portland cement in five categories.

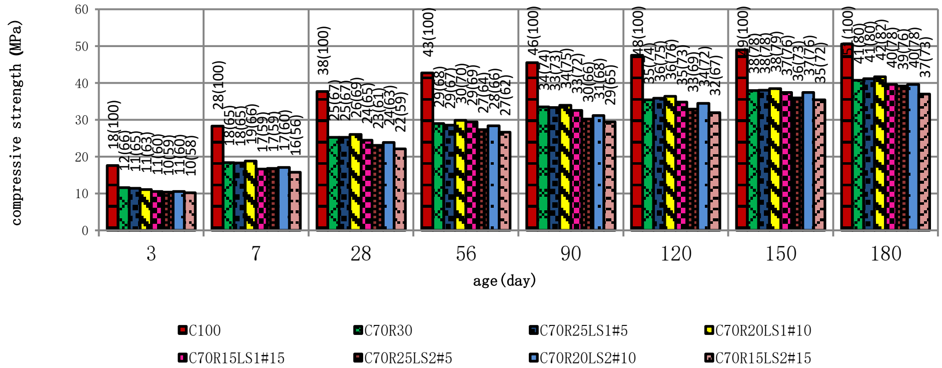

Figure 7. The compressive strength of the mortar mix, rice husk ash, crushed limestone powder and 30 percent. Replace Portland cement in five categories.

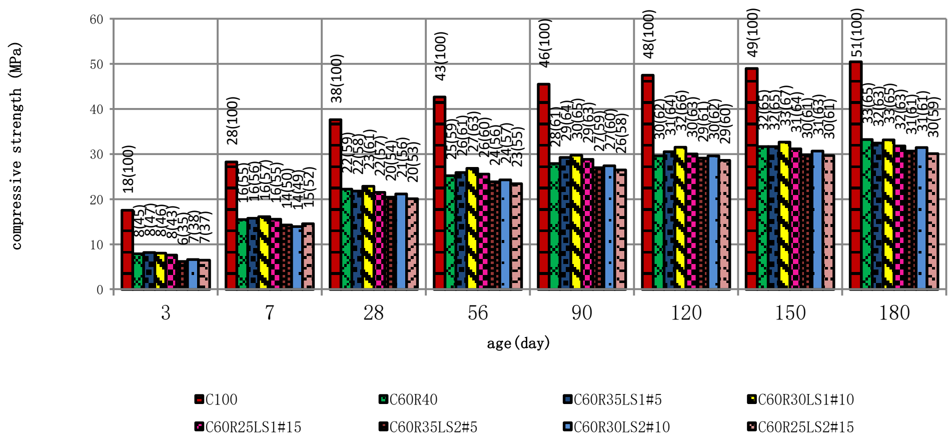

Figure 8. The compressive strength of the mortar mix, rice husk ash, crushed limestone powder and 40 percent. Replace Portland cement in five categories.

6.4. Loss of strength due to sulfate solution

6.4.1. The loss of strength due to the solution of sodium sulfate (Na_2SO_4). When the tension caused by the expansion force over the surface of the mortar can cause skin cracking mortar. Sodium sulfate solution can penetrate into the expansion pack sample within the clot causing cracking mortar, resulting in decreased strength.

Test loss of strength mortar mix crushed husk ash and limestone powder. Replace the cement sector at five in the ratio of 0, 20, 30 and 40 wt soaked in a solution of sodium sulfate concentration of 5 percent by weight shown in Figure 5.39 (a) 5.45 (a) the mortar control. The loss of strength at 180 days of age was 28.70 percent. Replacing Portland cement by RHA crushed all five categories. The ratio of 0, 20, 30 and 40 was found that at the age of 180 days are likely to lose strength decreased. RHA crushed by replacing all of 30 (C70R30) are losing strength lowest percentage of 15.50.
Replacing Portland cement type 5 with rice husk ash and limestone powder series LS1 (12 microns) were more likely to lose strength increased by test C70R25LS1 # 5 with a loss of compressive strength compared to the age of 180 days. 16.38 percent due to the replacement of limestone powder to reduce the amount of rice husk ash. As a result, the amount of SiO_2 reduced the amount of $Ca(HO)_2$ reacts with sulphate ions can be increased. Gypsum was born and tourism guide ring, which is causing the expansion. [7]
Replacing powdered limestone LS1 (12 micron) are losing strength less than replacing powdered limestone LS2 (128 micron) is because the particle size LS1 is smaller than the LS2 ability to interpolate better structured tightening force. Compressive strength is less loss. [8]
The hydrolysis of rice husk ash with Portland cement consisted of hydration of Portland cement with water. The calcium hydroxide from the hydride product reacts with the rice husk as calcium silicate hydrate. The structure of rice husk ash paste is similar to that of Portland cement paste. The amount of calcium silicate hydrate is increased and the calcium hydroxide is reduced. Depending on the amount of rice husk ash Calcium hydroxide is reduced when the amount of rice husk is increased. Due to high silica content and low calcium hydroxide, CSH has a lower C: S ratio than CSH obtained from Portland cement reaction with water. This is the main reason that concrete with rice husk ash has resistance to corrosion of acid and sulfate.

6.4.2. The loss of strength due to the solution of magnesium sulfate ($MgSO_4$). Loss of strength due to magnesium sulfate solution is the reaction of magnesium sulfate and calcium hydroxide creating gypsum and magnesium hydroxide. The magnesium hydroxide, thus, lowers the pH of the solution causing an instability of calcium silicate hydrate. Calcium silicate hydrate ruptures so that the pH value increases creating Calcium hydroxide solution and silicon. Magnesium hydroxide can react with the silicon solution creating a magnesium silicate hydrate, which is capable of interfacing.
Test loss of strength mortar mix crushed husk ash and limestone powder. Replace Portland cement in five categories in the ratio of 0, 20, 30 and 40 wt soaked in a solution of magnesium sulfate. The concentration of 5 percent by weight shown in Figure 5.39 (b) of 5.45 (b), the mortar has lost control over the 180-day compressive strength of 34.30 percent.

Replacing Portland cement type 5 with rice husk ash and limestone powder series LS1 (12 microns) were more likely to lose strength decreased by test (C80R5LS1 # 15) are losing strength lowest at age 180. at 30.10 percent due to the replacement of limestone powder to reduce the amount of rice husk ash. Water demand reduction Free water in the cavity left by the reaction is reduced. When the hollow spaces and reduced absorption of sulfate ions into the more difficult to reduce the sulfate corrosion. [9], [10]
Replacing Portland cement type 5 with rice husk ash with powdered limestone LS2 (128 microns) tend to lose strength increases. The LS2 limestone powder particle size. A material fielded poorly. The structure is less tight. The absorption of sulfate ions reacts easier. Loss of strength is increased.

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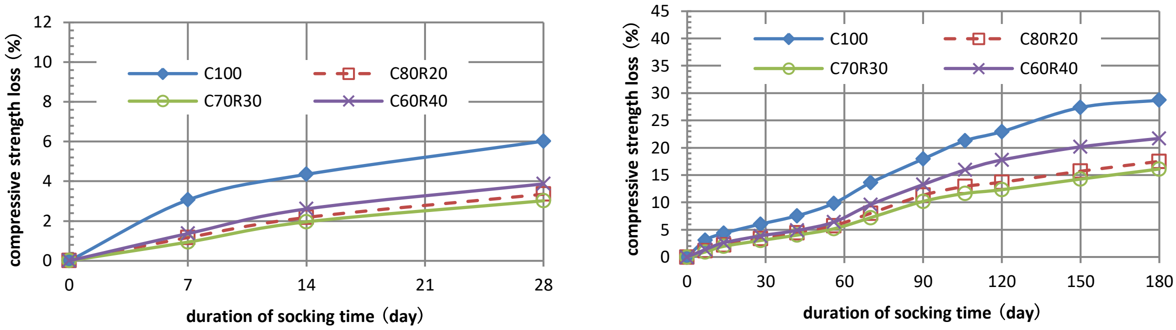
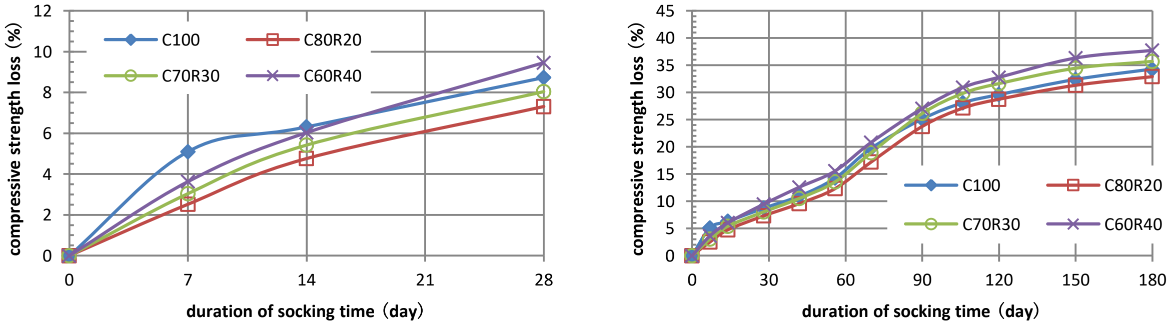
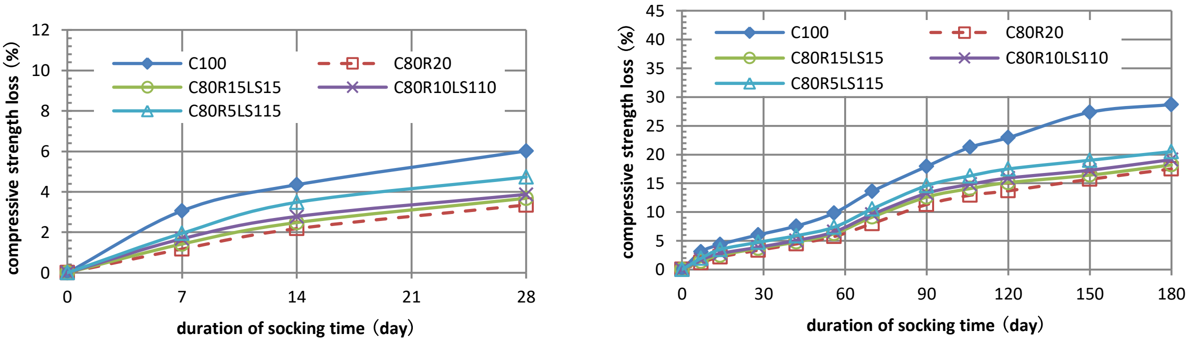


(a) Soak in a solution of sodium

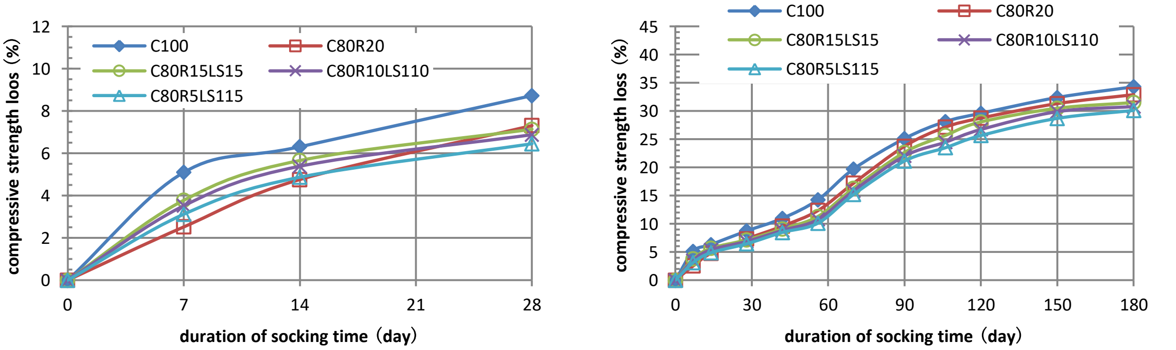


(b) Soak in a solution of magnesium sulfate

Figure 9. Losing strength as sodium sulfate and magnesium sulfate slurry of mortar mix RHA are crushed. Replacement of Portland cement in the ratio of 5 to 20 percent, by weight, 30 and 40.



(a) Soak in a solution of sodium



(b) Soak in a solution of magnesium sulfate

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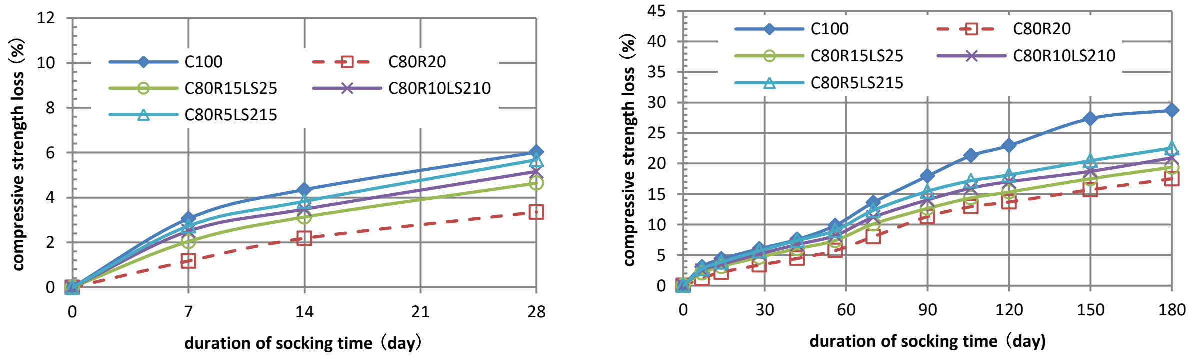
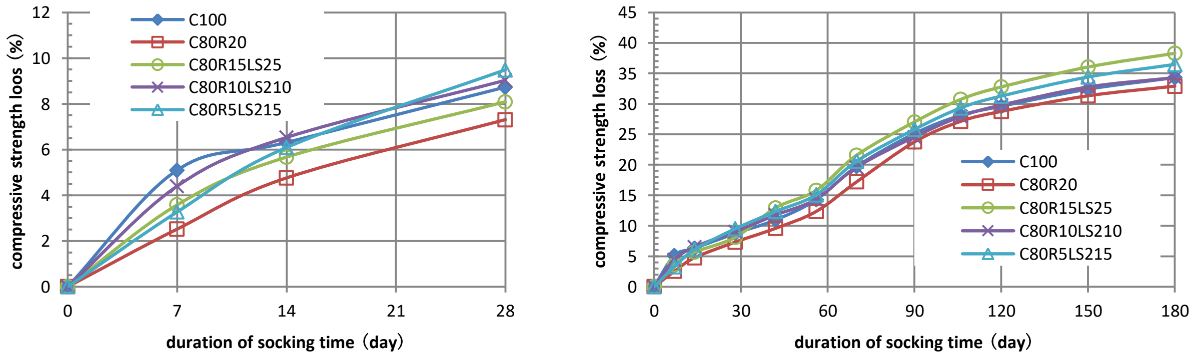
Figure 10. Losing strength as sodium sulfate and magnesium sulfate slurry of mortar mix, rice husk ash and limestone powder grinding LS1.Replacement of Portland cement in the ratio of 5 to 20 percent by weight.

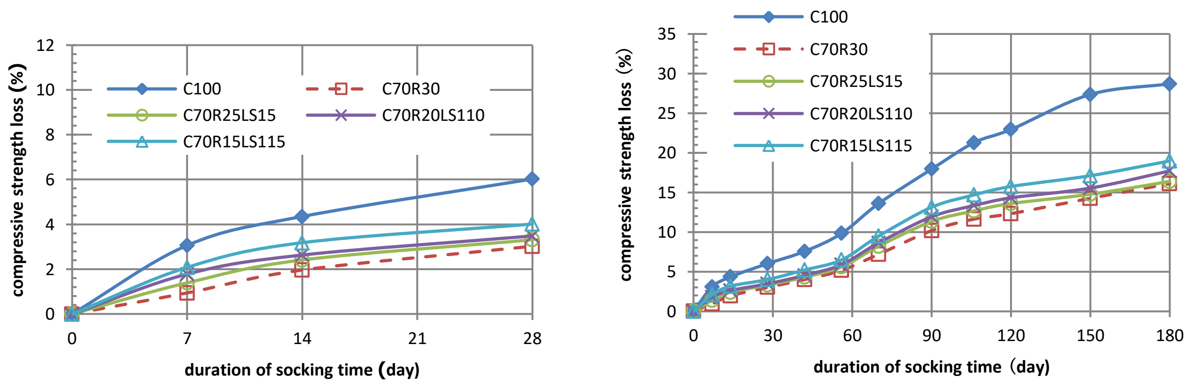


(a) Soak in a solution of sodium



(b) Soak in a solution of magnesium sulfate

Figure 11. losing strength as sodium sulfate and magnesium sulfate slurry of mortar mix, rice husk ash and limestone powder grinding LS2. Replacement of Portland cement in the ratio of 5 to 20 percent by weight.



(a) Soak in a solution of sodium

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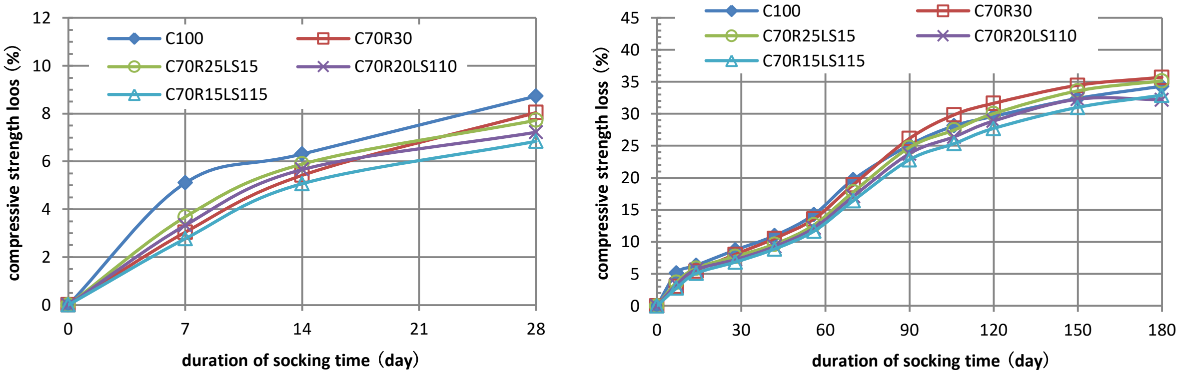
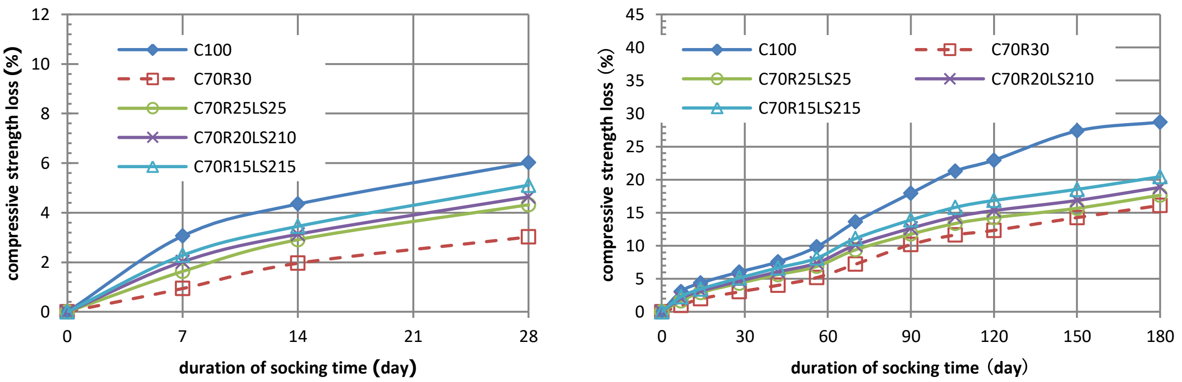
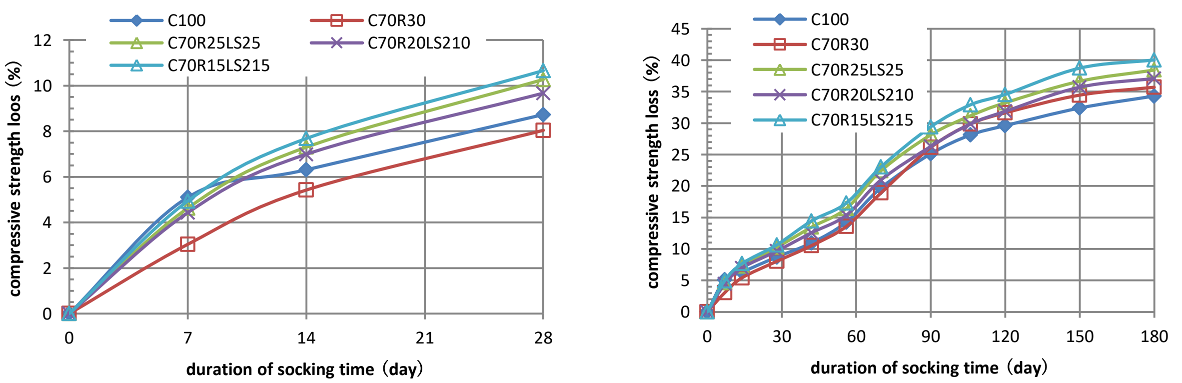


(b) Soak in a solution of magnesium sulfate

Figure 12. losing strength as sodium sulfate and magnesium sulfate slurry of mortar mix, rice husk ash and limestone powder grinding LS1. Replacement of Portland cement in the ratio of 5 to 30 percent by weight.

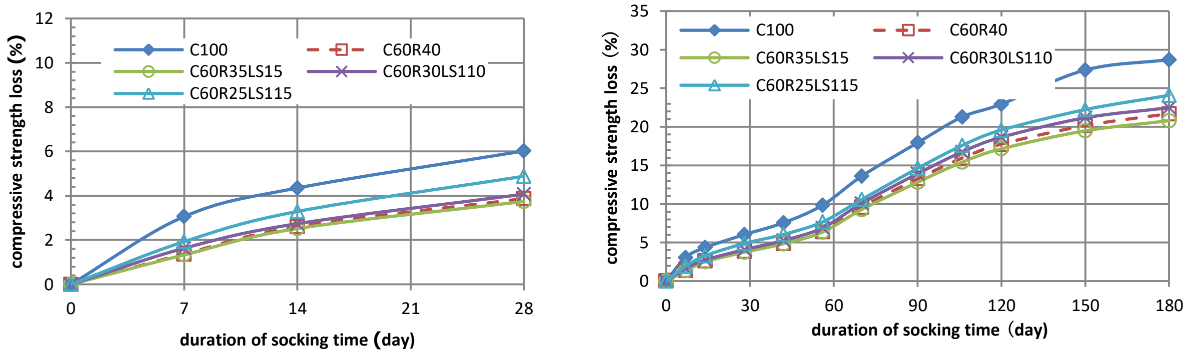


(a) Soak in a solution of sodium

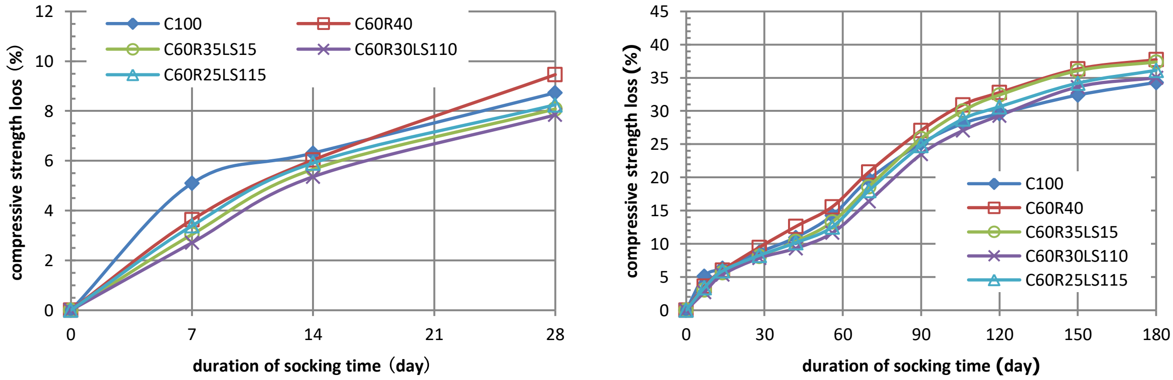


(b) Soak in a solution of magnesium sulfate

Figure 13. losing strength as sodium sulfate and magnesium sulfate slurry of mortar mix, rice husk ash and limestone powder grinding LS2. Replacement of Portland cement in the ratio of 5 to 30 percent by weight.

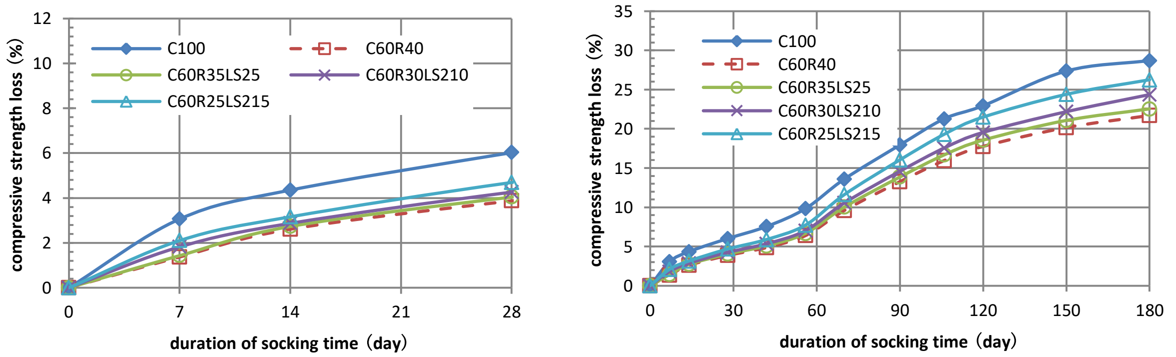


(a) Soak in a solution of sodium

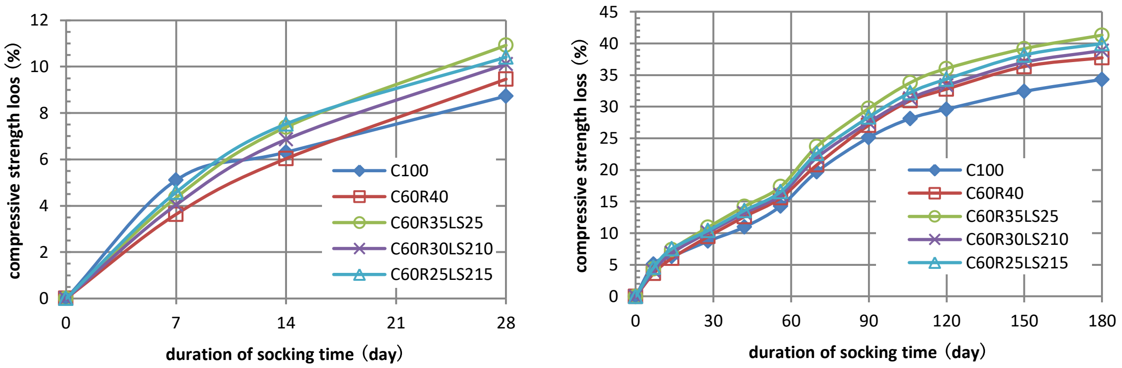


(b) Soak in a solution of magnesium sulfate

Figure 14. losing strength as sodium sulfate and magnesium sulfate slurry of mortar mix, rice husk ash and limestone powder grinding LS1.Replacement of Portland cement in the ratio of 5 to 40 percent by weight.



(a) Soak in a solution of sodium



(b) Soak in a solution of magnesium sulfate

Figure 15. losing strength as sodium sulfate and magnesium sulfate slurry of mortar mix, rice husk ash and limestone powder grinding LS2. Replacement of Portland cement in the ratio of 5 to 40 percent by weight.

7. Conclusions

7.1. Considering the physical properties of rice husk ash grinding for 4 hours, specific surface area is larger than particles and Portland cement type 5 that led to the replacement of Portland cement type 5. It was found that the demand for water and air, increasing the supply of renewable limestone powder with water and air with lower demand as the rate of limestone powder to the water needs of 12 micrometers.

7.2. Considering the chemical properties of rice husk ash grinding for four hours to compare the pozzolan materials by ASTM C 618 was found to be a pozzolan materials in accordance with ASTM C 618 C but with powdered limestone. Not according to many, it is the only renewable materials in cement.

7.3. The compressive strength of the mortar were replaced by rice husk ash grinding for four hours on at 5 am to the development of early decline. Replaced with limestone powder, 12 microns in size, together with the development are improved. But to replace it with powdered limestone measuring 128 micrometers, the development was reduced to 180 days of age showed that compressive strength of mortar test of every batch is less than the cement mortar. RHA replaced by crushed limestone powder mixed with 10 percent 12 percent 10 micrometers compressive strength similar to control of mostly 96 percent.

7.4. The tests showed that the TGA and MIP replaced RHA crushed limestone powder and 12 micrometers in size with the size and volume of the cavity Capistrano Larry Burrows all fell. RHA and reacting pozzolan Nick calcium silicate hydrate increases. Notices of calcium hydroxide is reduced because the reaction pozzolan Nick RHA.

7.5. Contractions found that replacing the four hours of grinding of rice husk ash and limestone powder in Portland Cement Type 5 reduces shrinkage dry well in the following order. Replaced with crushed rice husk ash and limestone powder, 12 microns were replaced with crushed rice husk ash. And replace it with rice husk ash, crushed limestone and powder measuring 128 microns by shrinking Genius automatically finds replaced by RHA grinding four hours and limestone powder in Portland Cement Type 5 models, reduce shrinkage and replace it with rice husk ash, crushed limestone powder. measuring 128 microns by shrinking Genius that automatically replaced with rice husk ash and limestone powder grinding four hours in Portland cement Type 5 models reduce shrinkage. Auto Genius has the following order. Replaced with crushed rice husk ash and limestone powder 128 micrometers is replaced by RHA are crushed. And replace it with crushed rice husk ash and limestone powder, 12 microns, respectively.

7.6. The solution expansion sulfate cement were soaked in a solution of sodium sulfate has expanded over magnesium sulfate solution RHA replace Portland cement grinding four hours in five categories, reduce the expansion of sodium soluble. Replacing limestone powder with a size of 12 microns to help reduce the growth of sulfate solution a bit more. But instead of powdered limestone measuring 128 micrometers to grow. Evaluation of the endurance of standard ASTM C 1157 showed that replaced RHA grinding for four hours and limestone powder mixture to the expansion of no more than 0.05%, which is an expansion of high durability, age 6 months.

7.7. Loss of strength due to the lime solution soak in a solution of magnesium sulfate, sodium sulfate particles lose strength RHA replace Portland cement grinding four hours in five categories, reduce the loss of strength in a solution of sodium sulfate. But in a solution of magnesium sulfate to change the value of the loss is less dense. Replacing limestone powder with a size of 12 microns, reducing the loss of strength due to the sulfate solution has a bit more. But instead of powdered limestone measuring 128 micrometers loss of strength due to increased sulfate solution.

7.8. The use of rice husk ash and limestone powder for construction work. It is important to thoroughly grind the rice husk ash and fine limestone powder as the cement can penetrate into the cavity of the rice husk ash. Homogeneity and consistency in the water need to be reduced because of the higher compression.

8. References

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