A Study of the Admixture (Water Reducing-Accelerating) to Develop the Compressive Strength of Concrete Used Crushed Dust as Fine Aggregate

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ABSTRACT:

This research is related to study the compressive strength of concrete used crushed dust as fine aggregate instead of all amount of sand or some amount of sand and mixing and without mixing with water reducing and accelerating admixture. Mixed ratio 1: 2: 4 (by weight) and water to cement ratio 0.45 without mixing the admixture were found that the mixed concrete at 7 days presented the compressive strength used crushed dust instead of sand 70%, 90% and 100% by weight (sieve analysis) and 100% (not sieve analysis) resulted 275, 260, 241 and 234 ksc respectively and after mixing water reducing and accelerating admixture resulted 292, 287, 276 and 258 ksc respectively and the averaged slump showed at 6.25 cm more than the concrete without admixture about 2 cm. In case of comparing the compressive strength at 28 days between concrete mixed crushed dust and sand the most value of compressive strength showed at the concrete mixed with crushed dust instead of sand 70% = 407 ksc and at normal concrete = 348 ksc and after using the crushed dust instead of all amount of sand the compressive strength appeared nearly same. From this research the crushed dust could be used instead of sand in general concrete structures and could be developed more in the high strength concrete in the future.

KEYWORDS: Crushed dust, Fine aggregate, Compressive strength, Concrete, Admixture

1. INTRODUCTION

Concrete has been the popular construction material used since the past until now. Normally the concrete was mixed from cement, sand, stone, water and admixture. At the present time the cost of sand and stone were higher because the material for using has been lost and the pumping of sand from the river effects to the environment problems. From the exploding the mountain the stone has been crushed to be small size for using and with this method the crushed dust was occurred and was less useful material for working. That makes air pollution too.

In year 2004 the construction business in all part of Thailand has been extended continuously effected to increasing the stone production to support the demand for the construction works. Nowadays there were about 476 grindstone houses operated and the total production in a year show about 300 million tons per year. In Thailand there were 7930 million tons stone for the reserved

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material from 325 sources [1] from this statistic the quantity of crushed dust would be high too. (Figure 1) Therefore, the crushed dust should be used in construction works, then the expenses of construction would be saved more and the natural resources would be used valuable.

Figure 1. Big amount of crushed dust at grindstone house in Saraburi

When the crushed dust was observed with eyes, their size was nearly same as sand so much, then the crushed dust is examined to research the physical properties by the same standard with fine aggregate [2]. The following results were obtained: fineness modulus = 3.682, specific gravity = 2.71, absorption = 0.47 %, organic impurities of mineral dust = number 5 (compared with organic plate), unit weight = 1,695 kg/m^3, bulking of crushed dust = 33.333 %, clay and silt = 4.34 %, soundness of crushed dust by use of sodium sulfate = 5.134 %. After comparing with sand that could be used for mixing in concrete instead of sand because that is nearly same [3] and after the examining the crushed dust instead of sand in concrete by using the water to cement ratio 0.45 the averaged compressive strength of concrete specimens at 28 days is 323.36 ksc [4].

The occurred problem while continuing the mixing of concrete by using crushed dust instead of sand was that the concrete was too dry, then it was very difficult for mixing and the water was needed more than normally. This research has aimed to study about water reducing and accelerating admixture for the concrete and to study the general properties of concrete and compressive strength of the concrete sample that would be useful in developing mixture of concrete used crushed dust as fine aggregate instead of sand in the construction projects in the future.

2. MATERIALS AND PROCEDURE

2.1 Preparing materials for mixing

1) Portland cement type I

2) River sand (saturated surface dry)

3) Stone size 3/4 in. (clean and saturated surface dry)

4) Crushed dust from Saraburi, keep the sample overall of the crushed dust sources, obtain in the bag, mix and divide in 4 amounts and keep it safely from dampness (Figure 2)

5) Clean water

6) Water reducing and accelerating admixture, followed ASTM C 49 [5]

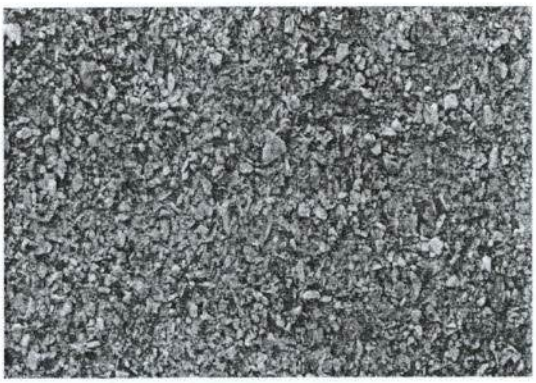

Figure 2. Crushed dust for testing (form real size)

2.2 Process

2.2.1 Mix design

Create the suitable mixing for Thailand [5], use mixed ratio 1: 2: 4, water to cement ratio 0.45 and divide signs for each types as the table 1

Table 1. Signs and significances especially in research

Sign	Significance
CD	Concrete mixed crushed dust instead of sand (sieve analysis), without mixing with water reducing and accelerating admixture
ACD	Concrete mixed crushed dust instead of sand (sieve analysis), mixing with water reducing and accelerating admixture
OD	Concrete mixed crushed dust instead of sand (not sieve analysis), without mixing with water reducing and accelerating admixture
AOD	Concrete mixed crushed dust instead of sand (not sieve analysis), mixing with water reducing and accelerating admixture
SC	Normal concrete (mixed with sand 100%)
D100	Crushed dust instead of sand 100%
D90	Crushed dust instead of sand 90%
D70	Crushed dust instead of sand 70%
0.45	Water to cement ratio 0.45

2.2.2 Preparing concrete specimens

Mix concrete followed as each ratio and examine slump of concrete followed as ASTM C 143 and found cylinder size 15×30 cm (Figure 3) followed as ASTM C 192 [6], make 48 samples. Take the sample off and cured in clean water at 7, 14, 21 and 28 days. (Figure 4)

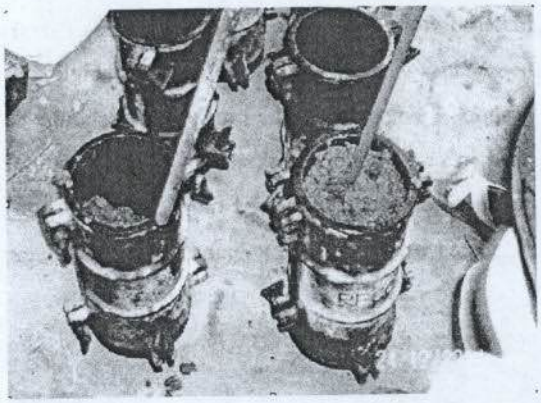

Figure 3. Founding concrete specimens

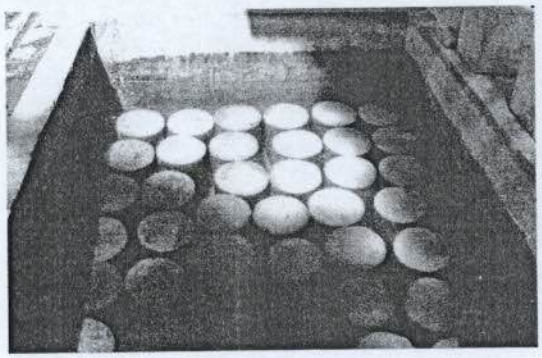

Figure 4. Curing of specimens in clean water

2.2.3 Testing concrete specimens

Examine the concrete specimens to search the compressive strength followed as ASTM C 39. [6]

2.2.4 Relation of result examination

Design the graph of result examinations, analyze and compare the slump and compressive strength of concrete used crushed dust by mixing instead of sand and normal concrete.

2.2.5 Summary the result examinations and present

3. RESULTS AND DISCUSSIONS

Compressive strength results of concrete specimens mixed with crushed dust instead of sand and with water reducing and accelerating admixture and without admixture compare with normal

concrete present the relation followed as graphs in figure 5 and 6.

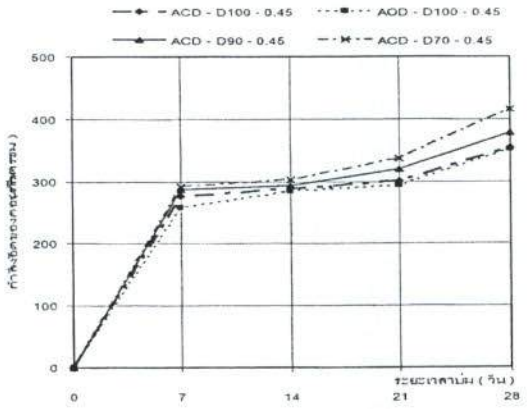

Figure 5. *Relationship between compressive strength and age specimens of concrete used crushed dust instead of sand (mixing with admixture)*

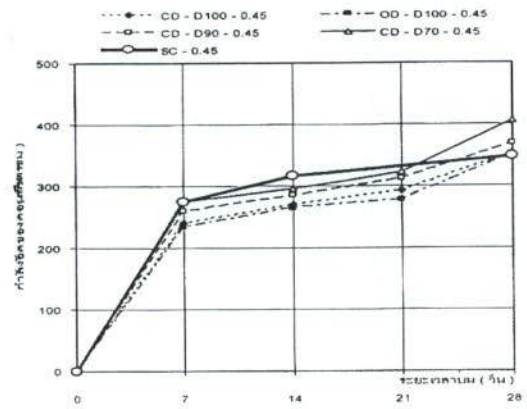

Figure 6. *Relationship between compressive strength and age specimens of concrete used crushed dust instead of sand comparison with normal concrete (without mixing with admixture)*

From the figure 5 after mixing with water reducing and accelerating admixture in the concrete was found that the concrete used crushed dust when mixing instead of sand 70% (sieve analysis) showed the maximum of compressive strength at 7 days = 292 ksc and the most to the less of compressive strength at 28 days = 415 ksc, next crushed dust when mixing instead of sand 90% (sieve analysis), crushed dust when mixing instead of sand 100% (sieve analysis) and 100% (not sieve analysis) respectively. Because of size crushed dusts that is smaller than stone and bigger than sand a little appeared that the fine aggregate of concrete used crushed dust instead of sand 70% (sieve analysis) infiltrated completely good, then there is less space in concrete effecting to the quality of compressive strength better than the concrete used the crushed dust instead of all amount of sand when mixing and from the graph above is found the concrete at 28 days showed the compressive strength more than 300 ksc That could be used to create the mixing concrete in general construction projects.

From the figure 7 that was the comparing the compressive strength of the normal concrete and concrete mixed with crushed dust by water to cement ratio at 0.45 without the water reducing and accelerating admixture found that the compressive strength concrete with crushed dust 70% (sieve analysis) showed the compressive strength nearly same as normal concrete at most at 7 days and the most value of compressive strength is 407 ksc at 28 days. So that is observed that the concrete used crushed dust instead of all amount of sand (sieve and not sieve analysis) showed the compressive strength nearly same as the normal concrete (mixed with all amount of sand) so much but there was less value than the concrete mixed crushed dust 70% (sieve analysis) and 90% (sieve analysis) respectively because the crushed dust could be infiltrated to cover the voids efficiently [5] and the compressive strength of concrete at 28 days of all mixed ratios are more than 300 ksc. So the crushed dust could be use in the concrete works and that is possible to be developed the creating of mixing concrete in the high strength concrete in the future.

After comparing the compressive strength of concrete mixed with and without admixture was found that the concrete with admixture showed the

slump of concrete more than the concrete without admixture about 2 cm and the compressive strength more than the concrete without admixture just a little in every mixed ratios. Because of Polymer in the admixture helping to reduce the exceeded water in the concrete, the water to cement ratio was reduced and because of calcium in the admixture having the reaction between cement and water faster the compressive strength in the first period was higher and more high efficacious and more when the concrete had many ages. Moreover, the admixture helped the electron on the surface of particles becoming the same thing, and then the pressure between particles was occurred to reduce the viscosity of cement paste and effect to the slump of concrete more than before. The compressive strength of concrete used the crushed dust as fine aggregate instead of some sand at 28 days appeared higher than normal concrete because the crushed dust infiltrated in space between sand and stone. Also there were less void in the concrete and the density was increased as followed as spoken above.

4. CONCLUSION

From the studying the compressive strength of concrete used crushed dust instead of all amount of sand and some amount of sand by mixed ratio 1: 2: 4 by weight and after mixing with the water reducing and accelerating admixture is found that the averaged slump is 6 cm more than the normal concrete 2 cm, the water to cement ratio at 0.45 showed the most value of compressive strength of concrete used crushed dust instead of sand 70% by weight (sieve analysis) at 7 days = 292 ksc and at 28 days = 415 ksc. Without admixture the most value of the compressive strength showed at 28 days = 407 ksc which is higher than the compressive strength of the normal concrete = 348 ksc and in every mixed ratios the compressive strength of concrete with and without admixture showed more concrete structures while creating the mixed ratio of aggregates including to sand, crushed dust and stone in the suitable mixed ratio so that the crushed dust could infiltrate the voids between sand and stone so well. Moreover, the water reducing should be mixed in concrete so that the concrete could be workability better and in the next research will examine the endurance and compressive strength in long period and the resistance to acid and sulfate more and more.

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