Rice Husk Ash as Additive For Cement in Petroleum Well Drilling

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ABSTRACT:*Compressive strength tests were carried out on five cement paste cubes with cement replaced by rice husk ash (RHA) at four levels (0, 5, 10, 15 and 20%). After the curing age of 3, 7, 14, 28 and 56 days. The compressive strengths of the cubes were increased with age of curing and replacement of RHA. The chemical analysis of the rice husk ash revealed high amount of silica oxide (96.72%), calcium oxide (1.33%), potassium dioxide (1.92%), and other (0.03). High amount of silica which is responsible for the strength. This result indicated that RHA can be used as cement substitute at 10%, 20% of replacement cause of setting time stop decrease after 10%wt.*

Keywords: *Rice Husk Ash, Compressive strength, Setting time, Permeability*

I. Introduction:

Cement is one of important material in petroleum industry especially well drilling processing. Largest number of cement is used in petroleum well drilling in high cost. One approach to reduce cost in petroleum well drilling methodology is mixing cement with additive. The additive which is interesting is rice husk ash.

Thailand is an agriculture country that exports rice mainly. It can produce 5 million tons rice husk from all of 25 million tons rice per year. [(1)] In production process, a great number of rice husk often remain.

Rice husk waste will bring to burn and mix with cement to add in well drilling.

In this paper, rice husk ash is blend with oil cement to test about 3 points. The first one is compressive strength that test by Compressive strength machine, the second is setting time that test by Vicat apparatus in different ratio and the last one is permeability that test by Permeameter. Rice husk has recently been recognized as pozzolona.

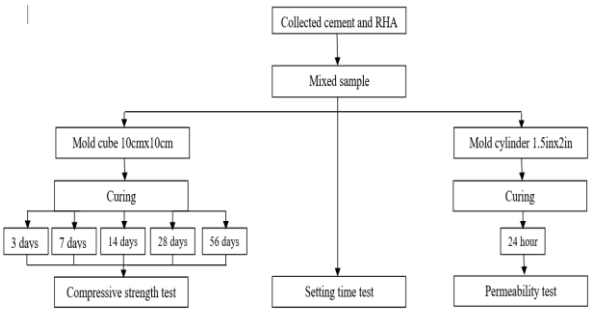
Pozzolona is a siliceous/aluminous material which in itself has little or no cementitious value, but chemically reacts with calcium hydroxide liberated during the hydration of cement to produce stable, insoluble cementitious compound which contributes to its strength and impermeability. [(2)]Rice husk ash is one of the promising pozzolanic materials that can be blended with cement for the production of durable concrete and at the same time it is a value added product. Addition of rice husk ash to cement does not only improve the early strength of concrete, but also forms a calcium silicate hydrate (CSH) gel around the cement particles which is highly dense and less porous, and may increase the strength of concrete against cracking.[(3)]Rice husks are used as building material; lightweight concrete briquettes have been made from partly burnt husk.Insolating blocks have also been made with cement and husk ash that resists very high temperatures. [(4)]

II. MATERIALS AND METHOD

Sampling

Rice husk ash

RHA in this research has been buying from Thai Naronk Kut Chik Limited Partnership. In this experiment is not burn by myself but buying from vendor because when use in industry it will increase cost if try to control temperature instead order it from the usually have in market. Samples are transported to Geotechnology Laboratory of Suranaree University of Technology, Nakhon Ratchasima province. Dried RHA is taken out and dried in a hot-air oven at 140°C for at least 24 hours.



Cement

Oil well cement class G is used in conforms to the API (10A) standard. Oil well Cement of TPIPL brand, bag cement 50 kg, used in this study is from the TPI POLENE Public Company Limited, Thailand. The cement is kept in plastic bag sealed to prevent moisture and stocked cool-dry area.

Mixture proportioning

Samples were mix by ratio w:c was 0.5 and added RHA instead of cement 0%, 5%, 10%, 15% and 20% by weight respectively.[5]

Curing

Cubes were kept inside water bath for 3, 7, 14, 28 and 56 days. The cubes were crushed on their respective days and the compressive strength determined.

III. Experimental

Compressive strength test

Sample blocks were crushed each at 3, 7, 14, 28 and 56 after casting at different replacement levels using the compressive testing machine.

Setting time

Sample mixtures were tested by vicat apparatus

Permeability

Samples were prepared in cylinder mold having diameter 1.5 inch and length 2 inch. Then taken sample to Permeameter.

Instrument was full filled with the liquid in core permeameter and then injected gas into permeameter core. Once a stabilized flow rate was established, recorded the Upstream Pressure (P1, psig), Over burden pressure (Pc, psi), Flow volume (cm3), flow time (second), Barometric pressure (atm), and temperature-(Celsius) from instrument. The injected gas permeability (Kg) can be calculated by using Darcy's Law

Figure 1: Flow chart of procedure

IV. RESULT AND DISCUSSION

Compressive strength

Table 1: Mixtures Used for the Compressive Strength and Setting time

Experiment	Cement (g)	RHA (g)	Water (g)
1	1200	60	600
2	1080	120	600
3	1020	180	600
4	960	240	600
5	840	360	600

RHA=Rice Husk Ash

Table 2: Compressive Strength tests

Cement(%)	RHA (%)	Design Strength (KN)				
		3 Days	7 Days	14 Days	28 Days	56 Days
100	0	80.94	112.34	115.64	117.48	123.63
95	5	81.08	111.11	125.22	136.16	145.20
90	10	81.35	136.60	146.38	154.76	175.07
85	15	81.80	142.17	149.67	157.40	178.68
80	20	83.10	145.85	152.24	158.78	182.67

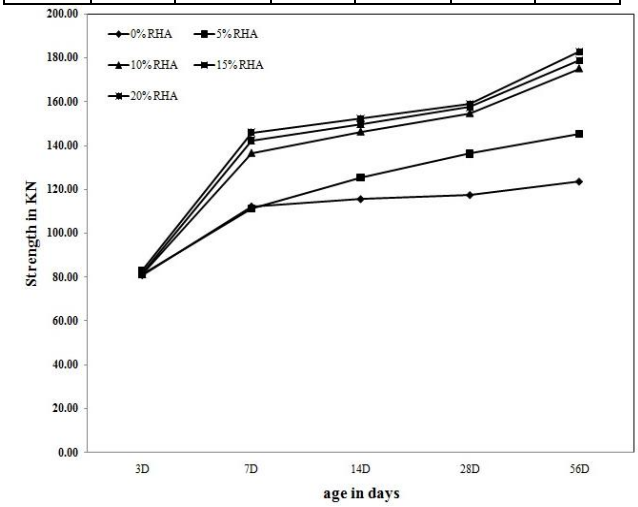


Figure2: Compressive strength graph

Cement paste is a structural material which consists of cement, and water. It is believed that the compressive strength of cement paste is influencedby curing condition, specimen preparation and age at testing.Compressive strength is usually considered as one ofthe most important properties of concrete and a major indicator of general quality control. [6] The results of compressive strength tests are shown in Table 2 and Figure 2. The compressive strength tests carried out on five mortar cubes showed that the strength of the blocks for all mix increases with age at curing and RHA. The best compressive strength result was obtained with the percentages of cement replaced by 20% RHA. The strength showed impressive increase with ageing, with highest compressive strength encountered in the 56 days.

Setting time

Table 3: Final Setting Times of Cement Pastes

Cement (%)	RHA (%)	Final Setting Time (Mins)
100	0	330
95	5	315
90	10	270
85	15	270
80	20	270

Figure3: Final Setting Times of Cement Pastes

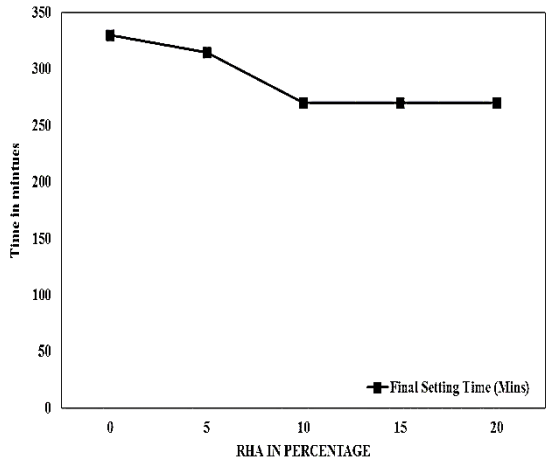


Table 3 and Figure 3 show the final setting time of the entire cubes were considered using cement and different percentage of RHA. The final setting time decreases with increase in rice husk ash.Decrease in the setting time was noticeable from 315 minutes (at 5% RHA) to 270 minutes (at 20% RHA) because the pozzolanic reaction can be taken place earliersince RHA samples used in this study contain very high SiO_2.[7]

Permeability

Permeability is the important thing of oil well cement for isolate product zone and protect well from fluid in formation.

Table 4: Permeability

RHA (%)	Pc (psi)	P_1 (psi)	P_b (atm)	K_gas (millidarcy)
0	530	10.05	1	0.644
5	580	10.04	1	0.485
10	580	10.05	1	0.384
15	510	10.03	1	0.218
20	600	10.05	1	0.183

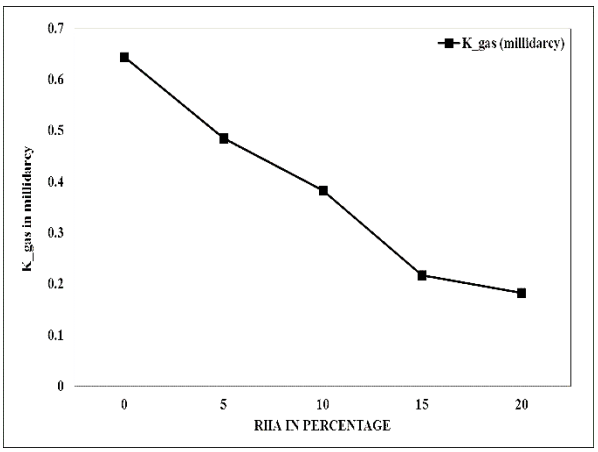


Figure 4: permeability graph

Table 3 and Figure 3 show permeability that decrease when RHA increase that noticeable from 0.485 (RHA 5%) to 0.183 (RHA 20%)

CONCLUSION

i. Chemical properties

Result from XRD analysis indicated the RHA sample used in this studied was mainly composed of SiO_2 (96.72 wt%), CaO (1.33 wt%), K_2O (1.92 wt%) and Other (0.03 wt%), respectively.

ii. Physical properties

Results from compressive strength measurement indicated that the compressive strength of set cement was direct proportional to the amount of RHA weight percent. This is because the pore space within set cement specimen is replaced by silicon dioxide and result in pore space decreasing. Moreover, since RHA samples used in this study is composed of very high SiO_2 content, this may cause the quicker pozzolanic reaction and also result in compressive strength enhancing.

This study also found that permeability of set cement specimens was reverse proportional to the amount of RHA weight percent. The reason might be the same as in the compressive strength that silicon dioxide is filled up the pore space within set cement specimen and make it smaller.

Thickening time of RHA cement was also reverse proportional to the amount of RHA weight percent. This is because the pozzolanic reaction can be taken place earlier since RHA samples used in this study contain very high SiO_2

When considered all tests and measurement results, RHA can be used as an oil well additive if it is used to replace cement. Compressive strength is higher, permeability is lower and final setting time is lower but if mix it too much effect will better and betteror not so that next study should be added more RHA and study in other properties to find out the best ratio.

RECOMMENDATION

The following recommendations are drawn.

1. Use RHA from other places and many percentage by weight for find out the difference result and looking for the best.
2. Use other raw material that rich with silica.
3. Study inother properties ex. Rheological for looking the best.

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