The Exchanger of Deposite Water Disposal to Create New Additive Cement in Dieng Geothemal Field Central of Java

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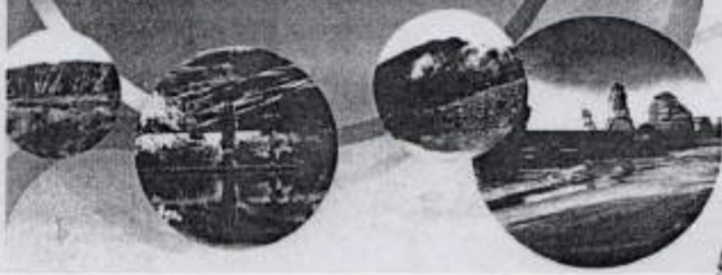

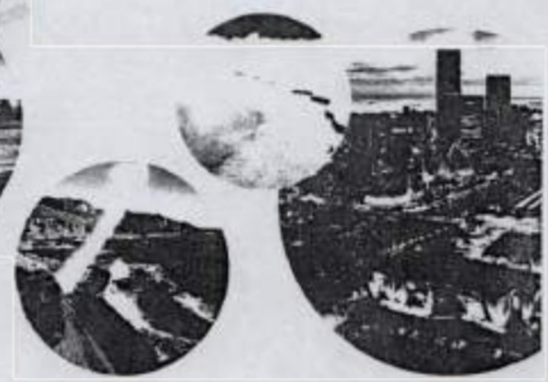

On behalf of the approximately 5000 members of the International Geothermal Association, representing 33 national and international geothermal associations and members in 67 countries, I welcome you to the World Geothermal Congress 2015 in Melbourne.

Held every five years, the World Geothermal Congress is a unique event that brings together members of the geothermal community from across the globe. Five days of technical sessions will include papers on scientific, technical, business and societal topics (more than 1000 papers in 2010). The Congress will also provide many networking opportunities through special interest group meetings, social and cultural events, field trips and short courses in Australia and New Zealand. Speaking as a New Zealander from Wairakei, I can assure you that we look forward to welcoming you to our world.

Juliet Newson
President IGA

The Organising Committee has great pleasure in inviting you to Melbourne, Australia to attend the 2015 World Geothermal Congress. With a theme of "Views from Down Under – Geothermal in Perspective", our Congress offers a splendid opportunity for delegates to share ideas and knowledge covering geothermal development worldwide. The Congress and short courses programme will cover topics relevant both to direct use and electricity generation.

The Congress will give insights into both "traditional" geothermal developments from around the world as well as new "pioneering" techniques. We also look forward to the country, regional and project updates for geothermal developments internationally. Exquisite field trips in New Zealand and Australia will be a key part of the Congress.

Please join us for an informative and exciting program of presentations, social events and tours. We look forward to seeing you in Melbourne, 19–24 April 2015.

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The Exchanger of Deposite Water Disposal to Create New Additive Cement in Dieng Geothemal Field Central of Java

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ABSTRACT

The topic a paper is from result research deposite water disposal to changes new additive for cement slurry. The methods are four steps, the first is sampling and checking field in geothermal water disposal line. The second step is put it and prepare disposal to activated by light sun and to grinding up to 325 mesh. The third step is to determine of disposal if used new additive cement slurry. The last step is how to create new additive cement from water disposal geothermal field central of java.The result of research are deposite water disposal can be create new additive cement slurry, good bonding strength, pump ability, and stable.

1. INTRODUCTION

Loss of drilling slurry (lost circulation) often occurs when the slurry pumping cement into the annulus past the rock formations are not compact (unconsolidated) and a rock that has a fracture. Lost circulation occurs due to hydrostatic pressure slurry pressures higher than the rock formation, so as to avoid the slurry that is used must have a low density (lead slurry).

Utilization of perlite additive and fly ash as extender has been used by companies drilling for cement hydrostatic pressure of the drilling cement, but the additional material has a relatively high price, and very limited in supply. Bentonite is also often used as an extender companies drilling cement in the cement slurry . The increase in the use of bentonite will cause a decline in compressive strength of cement drilling. Deposition of scale silica precipitate which is one of the waste heat in the form of solid earth containing silica dioxide (SiO_2) by 90 % - 98 %, have not been utilized as much as possible, so we need to study the utilization of the waste.

Regional Geology of Dieng Field

The Dieng volcanic complex (figure 2) is part of the E-W trending mountain range in Central Java that extends from Slamet mountain on the west to Ungaran mountain on the east and this chain of volcanoes has been identified as geothermal prospect by Pertamina (1994). The Dieng complex is composed of Quartenary stratovolcanoes and smaller craters and cones which are distributed over an area of 14 km x 6 km at an elevation of 2000 m above sea level. Based on morphological characteristics, the complex can be grouped into four regions (figure 1) namely Batu Raden, Sidongkal Graben, Rataamba Horst and Old Dieng Caldera. This field is characterized by ten lithological units which include, from oldest to youngest products of G. Prau (lava and tuffaceous breccias, 3.60 ma), G. Nagasari (andesite, 2.99 ma), G. Bisma (basaltic andesite, 2.5 ma), G. Pagerkandang (andesite, 0.46 ma), G. Merdada and Pangonan (andesite, 0.37 ma), G. Kendil (dacitic andesite lava, 0.19 ma), G. Pakuwaja (quartz latite, 0.09 ma), G. Seroja (lava dome, 0.07 ma), volcanic pain and hydrothermally altered rocks. A simplified geological map of the Dieng geothermal field is shown in figure 1.

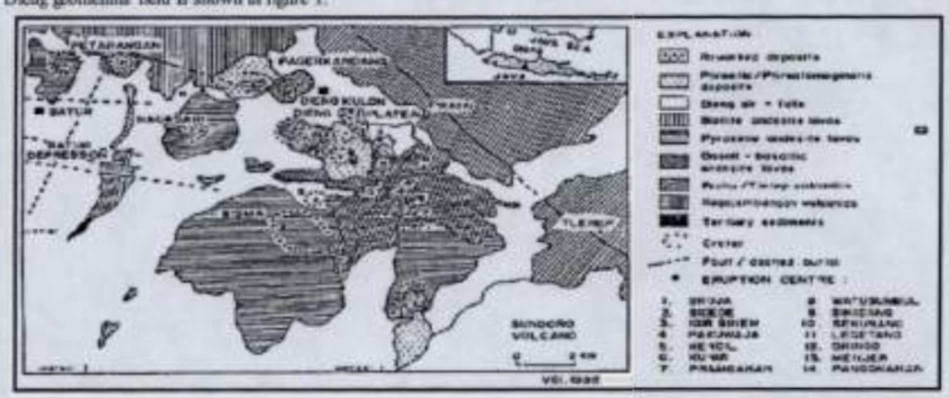

Figure 1. Geological Map of The Dieng Geothermal Field, Central of Java (from Sukhyar, 1994)

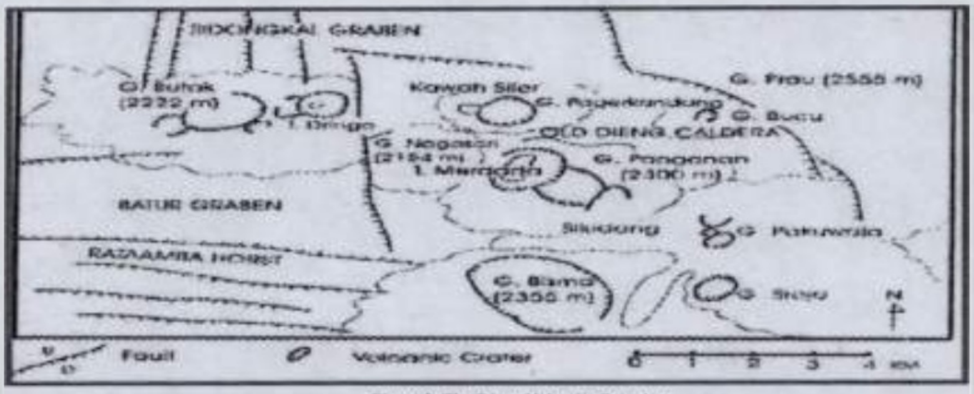

Figure 2. The Dieng Vulcanic Complex

Silica

There are two forms of the division of silica used in drilling cement, namely α-quartz and Condensed Silica Fume. As α-quartz silica is mostly used to increase the strength of the cement to the effects of high temperature (strength retrogression) when the cement placed in a thermal well. Based on the size of the silica particles, mostly used Silica sand (100 µm) and silica flour (15 µm). Condensed silica fume (microsilica) is a product of the production of Silicon, Ferrosilicon, and other Silica mixture. Berfasa particle glasses (amorphous silica) with a particle size of 0.1 lm - 0.2 lm, approximately 50-100 times finer than portland cement, therefore its surface area (surface area) is very high (15000-25000 m2/kg) (6).

Cementing Process

Cementing is a process of pumping the slurry (which has been designed) into the annulus through the equipment-cementing equipment for a particular purpose. Cement slurry (slurry) which used to be planned (slurry design) prior to cementing in wells drilling, cementing job in order to run smoothly as planned. There are some important things to consider in planning the slurry, one of which is the physical properties of cement slurry which density.

Cement slurry density is the most important factor in planning a slurry because the density affects the nature - the physical properties of the cement slurry such as thickening time, rheology, compressive strength and others. Large slurry used minimum density must be greater than 2 ppg of drilling mud density. So in its implementation in the field, the density is the main thing that should be monitored, so that is always stable in the mixing process .

II. MATERIALS AND METHOD

Equipment and Materials

The equipment used for laboratory testing of the preparation, manufacture of cement, cement rheological measurements and density, to measure compressive strength of cement, namely:

a. Scales Digital (Digital Balance)

b. Mixing Blender

c. Mud Balance

d. Measuring cups (100 and 250 cc)

e. Fann Viscometer

f. Carver Hydraulic Press

g. Mold

h. Oven

Materials and additional materials used in testing include :

a. Drilling cement (Class G)

b. Silica scale

d. Bentonite

e. Water distillation

Research Variables

a. Variables

Use of silica scale and bentonite

b. Variable Depending

Research and Preparation Procedure on Laboratorium

Waste geothermal silica Deposition (silica scale) is a precipitate formed from geothermal fluid (Geothermal Brine) that flows to the surface through a pipe from the reservoir to temperatures over 1800 C under the surface, towards the low temperatures at the surface. Most sewage sludge geothermal (scale) was found in geothermal areas that have high subsurface temperatures (indicated by the appearance of boiling hot spring and geysers on the surface). Place the discovery of Scale in Indonesia located in Central Java, and also a little in other geothermal areas.

The effects of the addition of replacement material (Silica Scale) and the percentage of decline in some bentonite slurry density. It is also seen an increase in compressive strength of the effect of the addition of a substitute material (silica scale) and additives (bentonite) to the slurry in some temperature conditions with a fixed slurry density.

a. Silica scale preparation

Silica scale is taken in powder form directly geothermal field. The next process is sifting the two materials. Sieving is done by using a screen size of 60 mesh. Materials - materials that qualify silica scale of the screen, it can be used as a material in the slurry langsusng drilling cement

b. Measurement of the percentage content of SiO_2 in silica scale

Measurement of the amount of SiO_2 content of the silica scale performed using x-ray beam in the laboratory chemical analysis.

c. Measurement of density and absolute volume of silica

The process of silica scale density measurements done using mud balance

d. Design of low-density slurry

The design is done in a laboratory slurry cement drilling The design can be done using the calculation table 1. But it must first know the absolute volume of new additives are used. To determine the absolute volume of additive, can be done by weighing the additive increments of 1 pound, and in measuring the volume in gallons additivenya. So to make a low-density slurry can be done using additional additive that can increase the volume of slurry is high but has a light weight.

Table 1. Density of Cement Slurry

No	Slurry Composition	Density, ppg
1	Cement Base	15.80
2	Cement + 1% Bentonite	15.40
3	Cement + 2% Bentonite	15.00
4	Cement + 3% Bentonite	14.60
5	Cement + 4% Bentonite	14.30
6	Cement + 5% Bentonite	14.00
7	Cement + 6% Bentonite	13.80
8	Cement + 7% Bentonite	13.60
9	Cement + 8% Bentonite	13.40
10	Cement + 9% Bentonite	13.20
11	Cement + 10% Bentonite	13.00
12	Cement : Silica Scale (95 : 5)	15.75
13	Cement : Silica Scale (90 : 10)	15.66
14	Cement : Silica Scale (85 : 15)	15.57
15	Cement : Silica Scale (80 : 20)	15.48
16	Cement : Silica Scale (75 : 25)	15.39
17	Cement : Silica Scale (70 : 30)	15.30
18	Cement : Silica Scale (65 : 35)	15.20
19	Cement : Silica Scale (60 : 40)	15.11
20	Cement : Silica Scale (55 : 45)	15.01
21	Cement : Silica Scale (50 : 50)	14.91

e. Slurry density measurements

The process slurry density measurements done using mud balance.

f. Testing the compressive strength

Compressive strength testing of cement drilling using silica flour additive of obsidian stone.

II. RESULTS AND DISCUSSION

Utilization of silica scale that have been deposited from geothermal production has a chemical composition of SiO2 at 93 337%, tested in the form of a fine powder 60 mesh size. Silica scale is taken directly from Dieng geothermal field.

Table 2. Physical and Chemical Properties New Additive

No	Material	Density (gr/cc)	Absolute Volume (bbl/lb)	% SiO_2 (%)
1	Silica Scale	2.328	0.091	93.337

Based on the " Spec 10 A API " Cement Class " G " has a standard density of 15.8, with a standard required in the mixing water by 44 % (BWOC) .

Through measurements of the material density is known that silica scale has a volume of 0.0910 absolute gall/lb with specific gravity of 2.328 gr/cc, the organic silica has a volume of 0.117 absolute gall/lb and a specific gravity of 2.116 gr/cc and fly ash have absolute a volume of 0.0483 gall/lb with a specific gravity of 2.48 gr/cc . This is caused , if the scale silica and rice has mixed into the slurry will result in a decrease in density is higher than fly ash (extender standard in the company). Unlike the case with bentonite, bentonite despite having a volume of 0.0454 absolute gall/lb with a specific gravity greater than the material above was third in the amount of 2.65 gr/cc, but bentonite slurry density can lower significantly than 2 surrogate material (silica scale and fly ash). This happens because at the time of the addition of bentonite in the slurry, then additional water must be added into the slurry at 5.3 % BWOC any usage of 1 % bentonite (according to the API), so that the bentonite + additional water that is involved in producing a lower density than the material other extenders. As an example can be seen in the results of studies in table 1, the cement slurry composition : silica scale (50 : 50) can manghasilkan density of 14.91 ppg to the composition of cement slurry : fly ash (50 : 50) can only produce a density of 15:09 ppg, while adding only 10 % BWOC bentonite clay can be managed to reduce the density of the slurry into a standard 13:00 ppg. Density test results can be seen from the appendix 1 (figure 3).

In the samples that have been tested (silica scale), it is known that the addition of a substitute material above 10 % into the slurry, followed by the addition of water should be done. The addition of water proficiency level can be done by adding clay, so that the slurry viscosity is not too high .

Based on the testing of chemicals , known to the chemical composition of silica scale and organic silica which has a fairly high content of SiO_2, so to see the effects of compressive strength development of cement replacement materials as a result of the use of extender in cement slurry, cement testing the compressive strength of cement + silica scale and also performed as a comparison and measurement of the cement + bentonite, the density is fixed at 15.7 ppg at sev eral temperatures. Compressive strenght test results can be seen from appendix (table 2).

Through the table 2, it can be seen that the use of silica scale as an extender, compressive strength of cement drilling at high temperature is 302 ° F at 3853.44 psiso it can be seen that the addition of silica scale can give effect increase in compressive strength higher than the addition of rice husk . This happens because the content of SiO_2 in silica scale is larger. Unlike the case when compared to the use of bentonite as an extender in cement slurry. Through drawing 5.2 also, it can be seen that the addition of 0.3 % BWOC bentonite to produce a density slurry constant at 15.7 ppg has a tendency to decrease at high temperature, ie the temperature of the surface of the resulting compressive strength of 3463.66 psi, while at a temperature of 302 ° F generated compressive strength at 2922.32 psi. So a decrease in compressive strength of cement around 541.34 psi. Test results of compressive strenght vs temperature of various materials can be seen from appendix (figure 4).

III. Conclusion

1. Based on the chemical analysis performed, the chemical composition of the silica containing SiO_2 scale is quite high is 93.34%

2. In addition extender with the composition ratio of cement and extender for 50:50 , then the density of silica scale is 14.91 ppg. It will be different with the addition of bentonite to the cement which is accompanied by the addition of water , thus causing the density of cement down too sharply .

3. Use of substitute materials (silica scale) on the addition of above 10 % should be followed by the addition of water to prevent the high viscosity of the cement slurry .

4. Adding silica scale as extenders in oil drilling density cement slurry 15.7 ppg at 3020 °F (high temperature) produces compressive strength of 3853.55 psi while for comparison, namely the addition of fly ash extender and bentonite produces compressive strength of 3296 psi (based on Final Thesis, Dwi Ambarwati 2003, UPNYK) and 2922.32 psi

5. Utilization of silica scale as an alternative to cement extenders drilling, has the advantage that it generates range denistas further decrease the quality of cement compressive strength better than the use of fly ash (extenders are used at present in the field) at high temperature (3020 ^{0}F).

IV. Recomendation

Utilization of silica scale can be used as an extender in drilling cement slurry and its use in combination with bentonite, then it will be able to increase the range of a good decrease in density, compressive strength with high resistance to high temperatures.

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APPENDIX

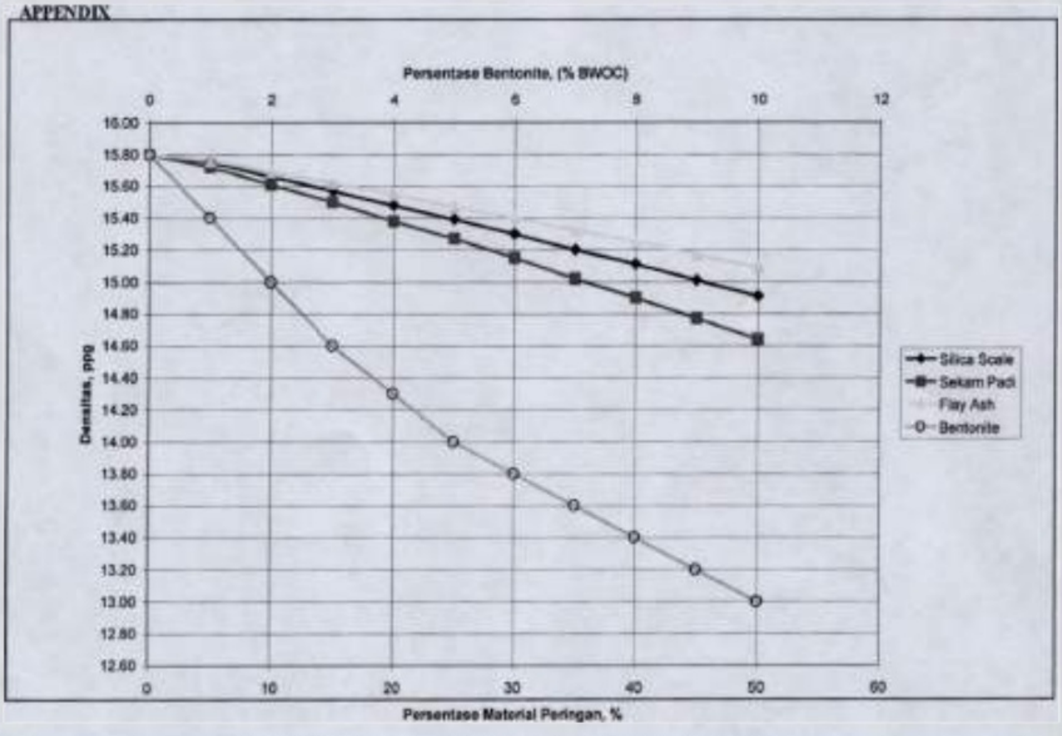

Figure 3. Percentage of Substitute Materials and Additive Vs Density

Table 2. Strength of Bonding Cement

No	Composition	Temperature (°F)	Sample	Diameter (cm)	Diameter (in)	Height (cm)	Height (in)	t/d	K	A1	A2	Reading (psi)	CS (psi)
1	Cement - Bentonite	60	1	4.9	1.93	4.68	1.84	0.96	0.8592	33.58	3.72	444.44	3445.69
2		60	2	4.7	1.85	3.9	1.54	0.83	0.8291	33.58	3.42	472.22	3839.98
3		140	1	3.7	1.46	4.6	1.77	1.22	0.9219	33.58	2.12	222.22	3241.96
4		140	2	3.85	1.52	4.6	1.77	1.17	0.9105	33.58	2.30	250.00	3327.02
5		194	1	4.9	1.93	4.4	1.73	0.90	0.8455	33.58	3.72	388.89	2966.89
6		194	2	4.85	1.91	4.52	1.78	0.93	0.8537	33.58	3.65	402.78	3166.81
7		230	1	4.9	1.93	4.2	1.65	0.86	0.8357	33.58	3.72	388.89	2932.52
8		230	2	4.85	1.95	3.4	1.34	0.69	0.7948	33.58	3.80	472.22	3318.69
9		302	1	4.8	1.89	3.62	1.43	0.75	0.811	33.58	3.57	389.89	2965.60
10		302	2	4.9	1.93	4.3	1.69	0.88	0.8406	33.58	3.72	416.67	3160.41
11		302	3	5.15	2.03	4.9	1.93	0.97	0.8583	33.58	4.11	411.11	2882.41
12		302	4	5.1	2.01	4.75	1.87	0.93	0.8535	33.58	4.03	416.67	2962.23
11	Cement - Scale	60	1	5.2	2.05	4.82	1.90	0.93	0.8525	33.58	4.19	361.11	2466.36
12		60	2	5.2	2.05	4.9	1.93	0.94	0.8562	33.58	4.19	333.33	2286.48
13		140	1	3.65	1.44	5	1.97	1.37	0.9444	33.58	2.06	166.67	2559.58
14		140	2	5.15	2.03	5	1.97	0.97	0.863	33.58	4.11	333.33	2349.76
15		194	1	5.15	2.03	5.1	2.01	0.99	0.8677	33.58	4.11	444.44	3149.93
16		194	2	5.12	2.02	5.15	2.03	1.01	0.8714	33.58	4.06	430.56	3100.65
17		230	1	5.2	2.05	4.15	1.63	0.80	0.8215	33.58	4.19	555.56	3656.79
18		230	2	5.2	2.05	4.9	1.93	0.94	0.8562	33.58	4.19	500.00	3429.76
19		302	1	5.2	2.05	4.68	1.84	0.90	0.846	33.58	4.19	388.89	2635.96
20		302	2	4.6	1.81	4.05	1.59	0.88	0.8413	33.58	3.28	333.33	2871.18
21		302	3	5.2	2.05	4.6	1.81	0.88	0.8423	33.58	4.19	569.44	3842.91
22		302	4	5.2	2.05	4.7	1.85	0.90	0.8469	33.58	4.19	569.44	3863.97

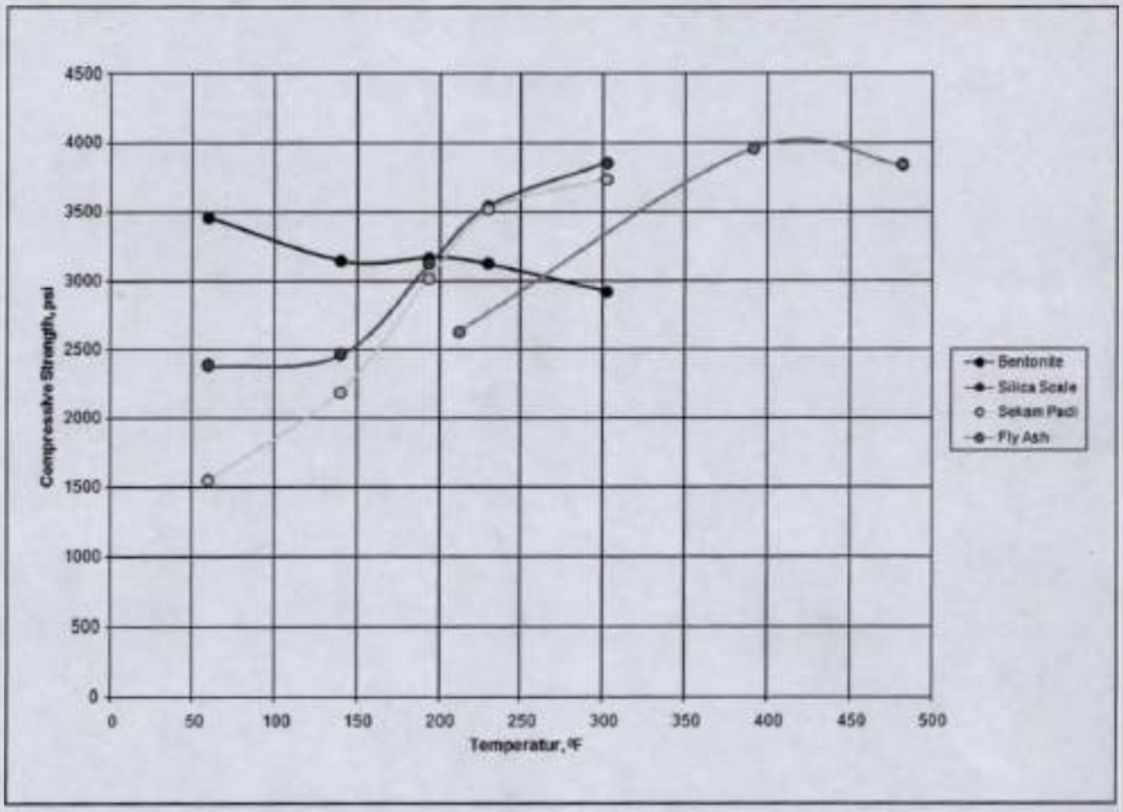

Figure 4. Compressive Strenght Vs Temperature in Addition Bentonite, Silica Scale, Organic Silica and Fly Ash (Dwi Ambarwati, 2003, Thesis)

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