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THE COMPOSITION MODELS OF LOCAL MATERIALS ADDITIVE TO LIGHT WEIGHT CEMENT ON HTHP CONDITIONS

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Abstract - The composition models of local materials additive on light weight cement are very important on well completion design of borehole stability in producing process. On Geothermal fields, the effect of temperature reservoir and steam are to changes of gel calcium silicate hydrate to alpha dicalcium silicate hydrate on cement model composition, it caused cement degradation and shrinkage, as instability of borehole. On HTHP conditions caused the cement suspension was dehydration (partial of liquid loss), channeling or fuggy, shrinkage bulk volume, strength degradation, and increasing the permeability cement. For the anticipated cement degradation to added by silica flour 35% BWOS (Herianto 92) at upper temperature 110^{o}C (Nelson 93). The methodologies of researches are makes some models composition of cement slurry to anticipated of strength degradation, shrinkage volume, low permeability (impermeable), and light. They are to supported on stability of borehole completion. Local expanding additive to activate (grinding and vibration screen) on mining laboratory FIKTM ITB and burned on 1400 ^{o}C, retention time 8 – 10 hours at Balai Besar Keramik Bandung. The results of burned are Dolomite concentration neat 97.37% is pure periclase and fineness 2881 cm^2/gr have density 29.16 ppg, and Calcite 88.79% is pure lime, fineness 3763 cm^2/gr have density 21.32 ppg. After makes modeling composition researcher to new of mineral stability of borehole is called clyno tobermorite of ratio Cao and SiO_2 is 0.74 on conditions optimum temperature 200^{o}C and pressure 2000 psi on simulator curing chamber laboratories, density is 11.70 ppg, impermeable, thickening time on 70 Uc is 110 minutes, but the porosity is high.

INTRODUCTION

The high temperature cementing is one of those problem, high temperature cementing consist of steam recovery wells, geothermal wells and ultra deep wells. The recent condition of reservoir is depletion pressure and almost reservoir trap found any fault and crack. Anticipated that used gradient pressure cement is low density and strong. Cementing is to isolate the annulus between the casing and wellbore in order to prevent communication between the various fomation layers.

Besides its function as previously mentioned, cementing in the drilling operation may carry the following objectives :

1. Support the casing against the formation.
2. Protects the casing against underground environmental effects, such as high pressure.
3. Prevent gas or high-pressure formation fluids movement into annulus casing-wellbore that may raise trouble at the surface.
4. Reduce gas-oil ratio, water-oil ratio and water-gas ratio.
5. Minimize casing wear.

In order to achieve a good cementing job it requires accurate data obtained from the well bore, good cementing technique, proper cement suspension characteristics and cement quality.

This paper will discuss the effect of the addition of Expanding additive local from Wonosari and Tuban to performance of cement slurry and quality cement hardener on HTHP conditions.

Nearly all cement slurry characteristics will affect the cement quality upon placement. A low cement slurry density will result in a low compressive strength, which may be caused by a high water cement ratio (WCR) used in the preparation of the cement slurry.

Cementing at high temperature requires a low cement density, impermeable and high cement strength by occurs formed mineralization, on first gel C-S-H, alpha diCa-S-H, Tobermorite etc. Because that, cement slurry has density is high, to reduce it to used ceramic powder. Meanwhile in order to increase the cement strength at high temperature can be attained by use of silica flour as special additive, and prevent shrinkaged by expanding additive.

REVIEW OF LITERATURES

Cement and additive if mixed with water results in a cement hydration process followed by a cement setting process. The definition of cement hydration process itself can be described as a chemical reaction between solids and liquids, in which mixtures eventually sets. On cement suspension, the hydration process happens between clinker, calcium sulfate and water, which causes the cement slurry to set.

The hydration of Portland cement is a sequence of overlapping chemical reactions between clinker components, calcium sulfate and water, leading to continuous cement slurry thickening time and hardening. Although the hydration of C_3S is often used as a model for the hydration of Portland cement, it must be kept in mind that many additional parameters are involved.

The hydration of Portland cement is a complex process of crushing/settling. Unlike in the pure single phase, the various multi component hydration reaction works at different rates. It influences between phases for example : the C_3A hydration modified by the presence of C_3S in which the formation of calcium hydroxide will reduce the C_3A by gypsum. The clinker contains certain impurities, this depends on the composition of its raw material in which within each composition contains different oxides.

As a consequence of the impurities the hydration also becomes impure, in which C-S-H gel tends to bond with aluminate, iron oxide and sulphur, meanwhile ettringite and monosulpho-aluminate contains silica. Calcium hydroxide in this case also contains certain amount of other ions.

2.1. Hydration Processes

Hydration is a chemical reaction between solids and liquids, in which mixtures of both will eventually sets into solid. In the cement slurry used in the cementing job, the hydration taking place is between clinker, calcium sulfate and water, which results in a set cement at the end of the process.

Among the main factors affecting the hydration process of Portland cement is formation temperature. High temperature may accelerate the rate of hydration, but in the other hand it can affects the cement stability and change the cement component morfology. The hydration phenomenon of Portland cement based on temperatures can be classified into two categories, that is : low temperature and high temperature hydration.

At low temperature hydration, the components of Portland cement is anhydrous, which means when it comes in contact with water the cement components breaks apart and hydrates in which eventually turns to set cement. Meanwhile at high temperature hydration above 110^0C, the process begins with the formation of Alpha Dicalcium Silicate Hydrate (α-C_2SH) which changes the cement components composition that can affect the cement strength usually known as Strength Retrogression (introduced by Swayze 1954). Strength retrogression is overcomed by addition of silica flour as special additive into the cement prior of mixing it with water.

C-S-H gel is a material with excellent binding characteristics especially at temperatures up to 230^0F (110^0C). At higher temperature, C-S-H gel is subject to metamorphosis, which usually results in a decreased compressive strength and increase in permeability of the set cement. This process known as Strength Retrogression was first reported by Swayze (1954).

C-S-H gel often converts into a phase known as alpha dicalcium silicate hydrate (α-C_2SH), which is highly crystalline and much denser than C-S-H gel. As a result, it affects the compressive strength and permeability of set cement at a temperature of 230^0F (110^0C).

The strength retrogression can be prevented by adding silica flour into the cement prior of mixing with water. The main purpose is to approximate a C/S ratio of 1.0. It must be noted that commercial cement has a C/S ratio around 1.5, therefore the amount of silica needed to reach the desired C/S ratio value is 35% (Menzd, Klousek, Carter and Smith).

Figure 1. Location sampling of additive Calcite Wonosari Jogjakarta.

2.2. Extender Additive

Extender is an additive used in reducing the density of cement therefore it is applicable in formation that easily collapse. Microsphere is an extender having a specific gravity of 0.4 to 0.6, and as cementing technology adavances, use of microsphere becomes more common. There are two types of microsphere, glass microsphere and ceramic microsphere. This research uses ceramic microsphere. Preparation of cement slurry using microsphere is developed in order to give certain values of cement slurry static pressure having a low density which may influence the strength-density ratio of the cement. Microsphere owes some advantages and disadvantages, the higher the composition of microsphere tends to reduce the density of cement but it reduces the compressive strength and shear bond strength as well.

Figure 2. Location sampling of additive Dolomite Tuban Jatim.

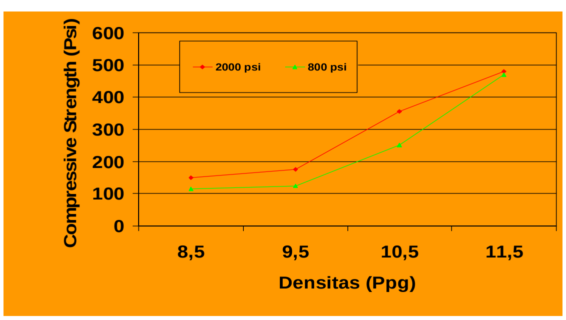


Figure 3. The Effects of Density ceramic microsphere on Compressive Strength, Nelson 90.

2.3. Expanding Additives

Expanding of cements means that expanding of cement relative volume due to cement bulk expansion (Danjuschewskij, 1983). It is caused by:

1. Chemical contraction that formed another hydrated product on liquid phase condition, i.e. crystallizing of dissolved salt at high temperature.
2. The presence of expanding materials in cement slurry before hardened condition, i.e. lime, periclase, $CaSO_4$, etc.

3. The presence of electrolyte around the cement bulk after the hardened condition.

The part 2 is merit condition that might bring to increase the shear bond strength, and also the expansion effect could be controlled by arranging the burning temperature and surface area of the expanding materials.

During the interim, a number of expanding additives have become available from the service industry; most of these are patented and therefore unknown composition and efficacy.

Under borehole conditions, many of the known additives, such as powdered alumunium or ettringite-forming products, present problems with respect to affectivity or controllability, or both, because of the expansion mechanism involved. Even under atmospheric conditions, several cements do not exhibit any expansion at all, but merely a decrease in volumetric shrinkage.

Danjuschewskij in 1980 proposed lime and periclase as expanding additives to create expanding cement. He found the expansion effect more than 1% and up to 25% in specific condition. Several other investigations also had been conducted on the effectivity of expanding cements based on these calcium and magnesium oxide additives. Both materials are characterized by the capability of influencing the reactivity and thus the swelling behavior by way of the manufacturing process.

Industrially, lime and periclase are usually manufactured by calcining of calcium and magnesium carbonates (liberation of CO_2, deacidification). In contrast to other expanding additives, lime and periclase provide two possibilities of influencing the reactivity (hydration activity) by means of the manufacturing process.

Decreasing the reactivity by increasing the calcining temperature during manufacture of the swelling additive, as well as increasing the reactivity by augmenting the specific surface area of fineness during grinding of the swelling additive.

3. Design Experiments

3.1. Design Simulator Curing Chamber

The specification was designed a physical simulator model as a modification of pressure curing chamber that could be operated under 350^{o}C operating temperature and 3000 psi operating pressure, see Figure 4. The advantages of the simulator, besides could handle large amount of sample (30 samples), it was designed that could be operated using formation

water both from oil-gas field or geothermal field. It was also equipped with CO_2 and H_2S injection appliance.
The main parts of simulator are listed below:

1. Simulator tubes were equipped with heater and thermocouple.
2. Maximator pump, pressure source that could supply hydraulic pressure up to 6500 psi.
3. Safety valves and rupture disc.
4. Formation fluid injector.
5. Automatic thermo controller.
6. Gas injection flow meter.
7. Outlet exchanger and reservoir chamber.
8. Manometer and in/out simulator liquid gas regulator valves.

The test required 3 types of specimen molds as cement slurry chamber that should be treated during hardening. The specimen molds describe as referred to below:
Cubic type, with dimensions 2” x 2” x 2”, to determine the tensile and compressive strength of the cement
Cylindrical type, with 1” diameter and 2” height to determine the shear bond strength between cement-casing and also to measure cement casing-permeability. The specimen mold needs chamber caps when it is placed into simulator.
Cylindrical type, with 1” diameter and 2.5” height. This specimen mold contains 6 cement chambers. The cement specimens are used to determine both cement permeability and the compressive strength.
All those specimen molds are designed that could be run simultaneously in the simulator at given well condition.
Compressive strength value is calculated with the following formula:

$$CS=k.P.(A1/A2) \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

where, CS : compressive strength, psi
P : maximum load, psi
A1 : hydraulic mortar’s bearing block cross section area, in^2
A2 : cement core’s cross section area, in^2
k : correction constant, function of height (t) and diameter (d) ratio, see Table1.

Shear bond strength is calculated using the following formula:

$$SBS=P.(A1/\pi.D.h) \quad \ldots\ldots\ldots\ldots\ldots\ldots (2)$$

Where, SBS: shear bond strength, psi ;
P : strain maximum load, psi
A : cement core’s cross section area, in^2
H : cement core’s height, in
D : diameter core, in

Table 1. Relations of constanta and h/d

h/d	Konstanta (k)
2,00	1,00
1,75	0,98
1,50	0,96
1,25	0,93
1,00	0,87

3.2. Design of Laboratories Works

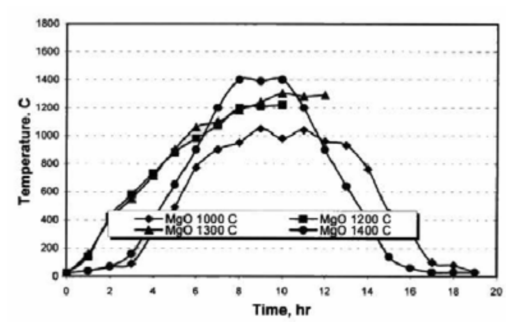


Figure 4. Based of Burning Process Raw Materials

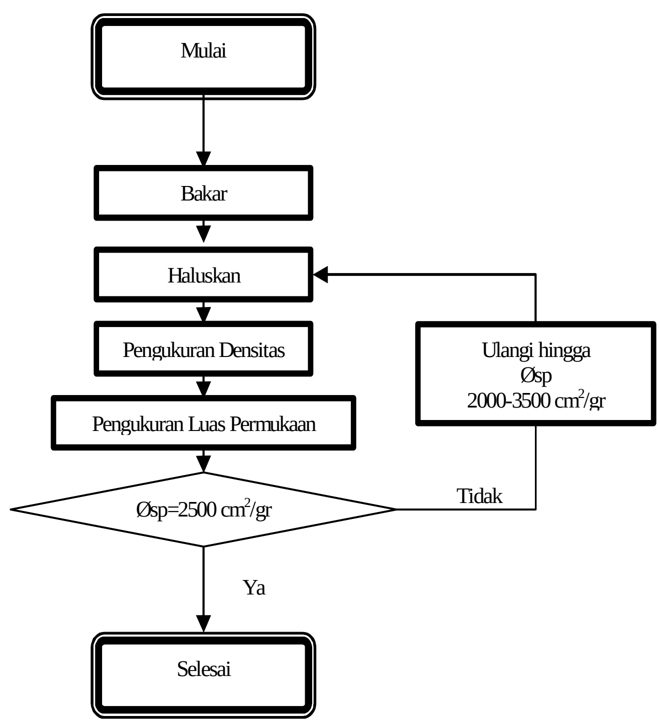


Figure 5. The Processes Activated of Raw Materials

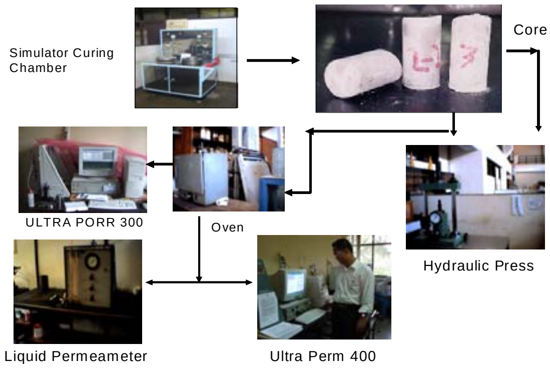


Figure 6. The processes of quality rock cement

Table 2. Composition models cement slurry

No.	Composition	Aquadest (mL)	CaO (gr)	MgO (gr)	Silica Flour (gr)	Cement (gr)	Micros-phere (gr)
1.	Based Cement (BC)	250	-	-	-	568.18	-
2.	Silica Cement(SC)	250	-	-	198.86	369.32	-
3.	SC + CaO 3% BWOS	250	16.55	-	193.07	358.56	-
4.	SC + CaO 5% BWOS	250	27.06	-	189.39	351.73	-
5.	SC + MgO 3% BWOS	250	-	16.55	193.07	358.86	-
6.	SC + MgO 5% BWOS	250	-	27.06	189.39	351.73	-
7.	SCM + CaO 3% BWOS	250	16.55	-	193.97	193.07	165.49
8.	SCM+CaO 5% BWOS	250	27.06	-	189.39	189.39	162.34
9.	SCM+MgO 3% BWOS	250	-	16.55	193.07	193.07	165.49
10.	SCM+ MgO 5% BWOS	250	-	27.06	189.39	189.39	162.34

4. Results and Discussions

4.1. Results

Table 3. The finneness of powder additives

Powder of Materials	Finnenes (cm^2/gr)
Based Cement	2517
Silica Flour	3150
Lime Local	3763
Periclase Local	2881

Table 4. The Density of composition models cement

No.	Composition Models	Density (ppg)
01.	Based Cement Powder	24.99
02.	Silica Flour Powder	22.24
03.	Lime Powder Local (CaO)	21.32
04.	Periclase Powder Local (MgO)	29.16
05.	Based of Cement Slurry (BC)	15.9
06.	Silica Cement Slurry (SC)	15.3
07.	SC + Periclase Local 3%	15.60
08.	SC + Periclase Local 5%	15.61
09.	SC + Lime Local 3%	15.55
10.	SC + Lime Local 5%	15.55
11.	SC Microsphere + Periclase Local 3%	11.75
12.	SC Microsphere + Periclase Local 5%	11.75
13.	SC Microsphere + Lime Local 3%	11.70
14.	SC Microsphere + Lime Local 5%	11.75

Table 5. Viscosity of cement slurry

Composition Models	Φ600 (dial)	Φ300 (dial)	Plastic Viscosity (cp)
Based Cemen (BC)	166	134	32
Silica Cement (SC)	219	168	51
SC + Periclase 3% BWOS	130	90	40
SC + Periclase 5% BWOS	125	88	37
SC + Lime 3% BWOS	217	155	62
SC + Lime 5% BWOS	240	165	75
Microsphere Cement (MC)	300	200	100
MC + Periclase 3% BWOS	260	140	120
MC+ Periclase 5% BWOS	300	205	95
MC + Lime 3% BWOS	300	185	115
MC + Lime 5% BWOS	300	175	125
SMC + Periclase 3% BWOS	300	157	143
SMC + Periclase 5% BWOS	300	163	137
SMC + Lime 3% BWOS	300	159	141
SMC + Lime 5% BWOS	300	155	145

Table 6. Thickening Time of Composition Models

SC + Expanding Additive 3% BWOS

Lime 3%					Periclase 3%			
Time (minutes)	Uc	waktu (minutes)	Uc		Time (minutes)	Uc	Time (minutes)	Uc
5	13	100	38		5	10	100	23
10	13	105	44		10	10	105	26
15	13	110	50		15	10	110	31
20	13	115	57		20	10	115	35
25	13	120	63		25	10	120	40
30	15	125	68		30	10	125	44
35	15	130	73		35	10	130	47
40	16	135	77		40	11	135	50
45	17	140	79		45	11	140	52
50	18	145	82		50	12	145	54
55	19	150	87		55	12	150	56
60	20	155	88		60	13	155	58
65	21	160	88		65	14	160	60
70	22	165	80		70	14	165	62
75	23	170	78		75	16	170	64
80	26	175	78		80	17	175	66
85	28	180	78		85	18	180	68
90	31	185	78		90	19	185	71
95	34				95	21		

Table 7. Thickening time of composition models silica cement + Expanding 5% BWOS

Model komposisi semen silika + ekspanding

CaO 5%					MgO 5%			
waktu (menit)	Uc	waktu (menit)	Uc		waktu (menit)	Uc	waktu (menit)	Uc
5	23	100	56		5	21	100	43
10	23	105	62		10	21	105	49
15	23	110	66		15	21	110	58
20	23	115	70		20	21	115	65
25	23	120	74		25	23	120	71
30	24	125	77		30	23	125	76
35	24	130	79		35	24	130	81
40	26	135	81		40	24	135	84
45	27	140	83		45	24	140	85
50	28	145	86		50	25	145	85
55	30	150	87		55	26	150	85
60	31	155	88		60	27	155	85
65	32	160	89		65	28	160	83
70	34	165	89		70	30	165	83
75	36	170	89		75	31	170	83
80	38	175	89		80	32	175	82
85	42	180	85		85	34	180	82
90	45	185	80		90	37	185	82
95	50				95	40		

Table 8. Thickening time of composition models silica Cement microsphere+ Expanding additive local 3% BWOS

Model komposisi semen microsphere + silika + ekspanding

CaO 3%					MgO 3%			
waktu (menit)	Uc	waktu (menit)	Uc		waktu (menit)	Uc	waktu (menit)	Uc
5	29	60	45		5	28	70	47
10	32	65	50		10	30	75	50
15	32	70	58		15	30	80	52
20	32	75	69		20	33	85	56
25	32	80	81		25	33	90	62
30	32	85	85		30	35	95	71
35	32	90	90		35	35	100	75
40	35	95	94		40	36	105	80
45	35	100	98		45	36	110	84
50	38	105	104		50	40	115	94
55	41				55	40	120	97
					60	43	125	99
					65	43	130	102

Table 9. Thickening time of composition models silica cement microspher +expanding additive local 5% BWOS

Model komposisi semen microsphere + silika + ekspanding

CaO 5%					MgO 5%			
waktu (menit)	Uc	waktu (menit)	Uc		waktu (menit)	Uc	waktu (menit)	Uc
5	35	50	45		5	28	75	45
10	35	55	49		10	28	80	46
15	35	60	53		15	28	85	48
20	35	65	58		20	28	90	52
25	35	70	65		25	28	95	56
30	36	75	76		30	28	100	62
35	38	80	87		35	28	105	71
40	40	85	94		40	29	110	75
45	43	90	101		45	30	115	80
					50	32	120	86
					55	34	125	90
					60	36	130	94
					65	39	135	97
					70	42	140	101

Composition Models	Conditioning Time (hours)	*Compresssive strength (psi)*	*Shearbo[illegible] strengt[illegible] (psi)*
Silica Microsphere Cement (SMC) + Periclase 3% BWOS	24	2615	1087
	72	3050	1027
	168	3627	1294
Silica Microsphere Cement (SMC)+ Periclase 5% BWOS	24	2744	1179
	72	3020	992
	168	3506	1236
Silica Microsphere Cement (SMC) +Lime 3% BWOS	24	689	873
	72	891	427
	168	3796	1216
Silica Microsphere Cement SMC) + Lime 5% BWOS	24	3506	402
	72	3541	665
	168	3595	1038

Table 10. Optimation of composition models expanding cement, silica cement, and based cement.

Sistem Semen	Temperatur					Komposisi				
	100 ℃	135 ℃	150 ℃	200 ℃	250 ℃	1.50%	3%	5%	7.50%	10%
Semen Dasar	***	**	*	*	*	-	-	-	-	-
Semen Silika	*	*	**	***	****	-	-	-	-	-
SD+CaO	***	***	****	**	*	**	***	****	***	**
SS+CaO	*	**	***	****	****	**	***	****	***	**
SD+MgO	****	****	***	*	*	**	***	***	****	***
SS+MgO	**	**	***	****	***	***	***	***	***	****

Table 11. Porosity of composition models cement by ultra porr 300 test

Data Ultra Permeabilitas Test

Core Lab Instruments (www.coreinst.com)

Note: This report can be opened in Microsoft Excel for editing.

Ultraperm Report			
Company	ITB	**Operator**	P.Yos
Job	P.Nurs	**Details**	Disertasi

ID	Length (cm)	Diam. (cm)	Temp ©	Baro Pres (mmHg)	Conf Pres.	DP (Psid)	Upstr Pres (Psig)	P1 (Psia)	P2 (Psia)	Q (cc/sec)	Ka (md)	Pm (Psia)
scm.c5%	3.610	2.535	24.5	693.0	300	1.46	1.32	14.72	13.26	0.023	0.207	13.990
scm.m5%	3.725	2.505	24.5	693.0	300	1.46	1.32	14.72	13.26	0.024	0.237	13.990
scm.c3%	3.600	2.530	24.5	693.0	300	1.47	1.32	14.72	13.26	0.022	0.204	13.990
scm.m3%	3.500	2.425	24.5	693.0	300	1.46	1.32	14.72	13.26	0.021	0.196	13.990
sc	3.275	2.537	24.5	693.0	300	1.46	1.32	14.72	13.26	0.023	0.195	13.990

Table 12. Permeability of composition models expanding cement by liquid permeameter test

pengkondisian 72 jam (3 hari) 200oC										
core	d(inch)	davg(inch)	h(inch)	havg(inch)	A(1/4D^2*pi)inch^2	OP(psi)	FP(psi)	Time(sec)	Fluid(mL)	k(md)
semen silika	2.31	2.33	3.24	3.2367	4.2656	350	200	11400	6.35	4.14 E-05
(SC)	2.33		3.23							
	2.35		3.24							
SC+CaO	2.42	2.4067	3.52	3.4633	4.5509	300	200	72000	0	0
3%BWOS	2.4		3.45							
	2.4		3.42							
SC+MgO	2.59	2.5933	3.2	3.2267	5.2841	300	200	18900	0	0
3% BWOS	2.59		3.24							
	2.6		3.24							
SC+MgO	2.55	2.4967	3.55	3.59533	4.8977	300	200	68400	2	3.15 E-06
5%BWOS	2.51		3.6							
	2.43		3.63							
SC+CaO	2.49	2.49	3.69	3.6967	4.8715	350	200	90000	28	2.31 E-05
5%BWOS	2.48		3.7							
	2.5		3.7							
SCM+MgO	2.6	2.5667	3.61	3.5833	5.1762	300	200	86400	0	0
3%BWOS	2.55		3.62							
	2.55		3.52							
SCM+CaO	2.5	2.53	3.96	3.9633	5.0293	400	200	13800	0	0
3%BWOS	2.53		3.97							
	2.56		3.96							
SCM+MgO	2.5	2.5033	3.48	3.48	4.9237	400	200	26100	0.4	7.96E-07
5%BWOS	2.5		3.42							
	2.51		3.54							
SCM+CaO	2.5	2.5133	1.98	1.9833	4.9631	400	200	5400	0	0
5%BWOS	2.52		1.99							
	2.52		1.98							

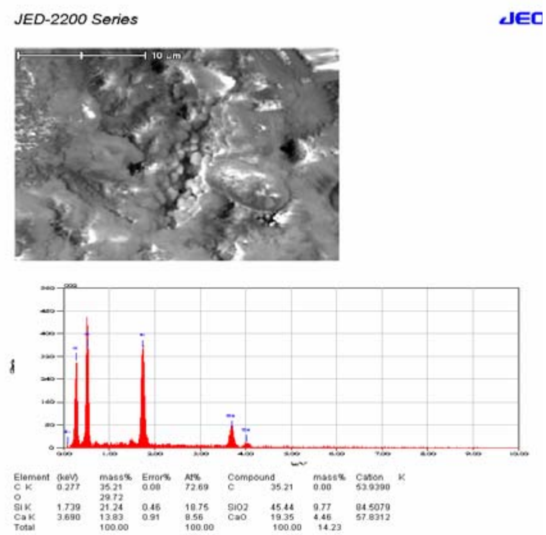
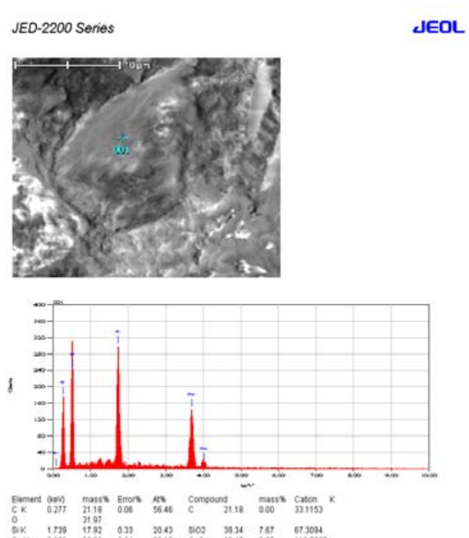


Table 13. Results of composition models light weight Cement for CS and SBS

Core Semen	Panjang (cm)	Diameter (cm)	Bulk Vol (cc)	Grain Vol (cc)	Pore Vol (cc)	Porositas (%)
SD	2.585	2.54	13.098	6.1991	6.899	52.2635
SC	2.86	2.502	14.061	9.4445	4.6165	32.832
SCM	3.875	2.54	19.635	8.8905	10.7445	54.721
SCM+CaO 3%	4.4	2.54	22.295	9.95405	12.341	55.353
SCM+CaO 5%	3.34	2.55	17.058	7.6768	9.381	54.995
SCM+MgO 3%	2.82	2.53	14.177	6.64695	7.5305	53.1175
SCM+MgO 5%	3.865	2.54	19.584	8.7324	10.852	55.4125

Table 14. Porosity of composition models light weight Cement by ultra porr 300 test

Figure 7. SEM of based cement



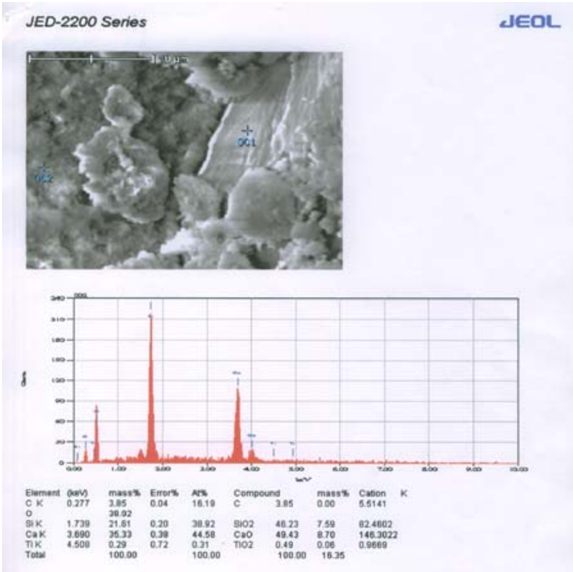


Figure 8. SEM of Expanding Silica Cement

Figure 9. SEM of expanding silica microsphere cement

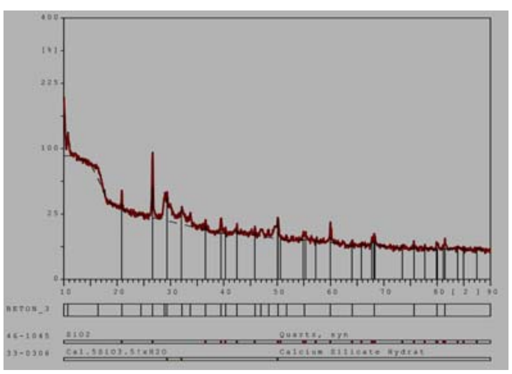


Figure 10. X- Ray of based cement

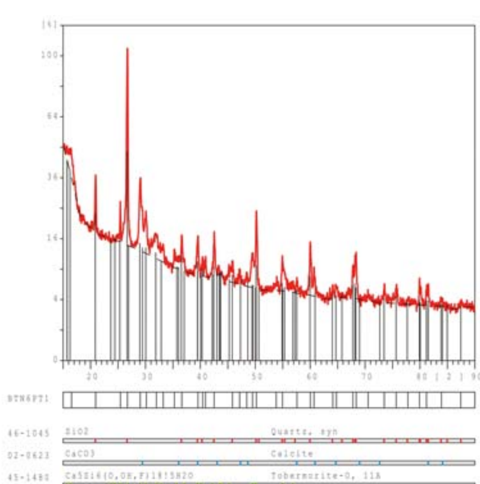


Figure 11. X-Ray of silica cement +expanding additive

X-Ray Difractometry SCM + Expanding

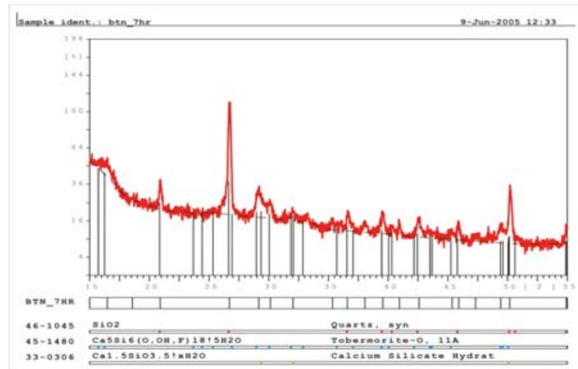


Figure 12. X-Ray of silica cement microsphere+ Expanding additive.

4.2. Discussions

From Table 3, the fineness of powder materials are better to used cement slurry, because for morethan finnesness of powder material can caused of surface areas is high and the interactive of particles is strong, so that strength of rock cement is best. API give specification of fineness ranges 2000-3500 cm^2/gr, if about after test by Blain permeameter result lowerthan 2000 cm^2/gr, will must be can fineness by grinding mill and so to used screen vibrator, see Figure 5. On Table 3, the fineness of lime more than other materials because it is very weakness and brittle or hygroscopic material.

The rheology of cement are on Table 4, 5, and 6. On Table 4, consist about density of additive powder periclase is high between powder cemenr and silica flor, because the molecul weight is different. The effect of expanding additive local on density cement slurry not significant, but additive extender ceramic microspheres is significantly, because the specific gravity of ceramic is very low about 0.4 - 0.6, Nelson 93. Ceramic microspheres is rounded and inset that contain mixtures gas CO_2 and N_2 so the maximum bottom hole pressure is 4500 psi.

On Table 5, effect of expanding additive local on plastic viscosity are increasing that, because the characteristic it is inert reactive solids and lime or ceramic using some water can cause suspension condition. The shear rate of suspension cement expanding is lower that based cement but the water system is fixed 44% BWOS although added some additives. But now, the value of plastic viscosity of cement sluury after added some additive is lessthan 200 centipoise (Based of API Spec.)

The thickening time of cement expanding after mixing is exact on based cement (120-150 minutes) on 70 Uc, see Table 6. The composition models can used to applicated on HTHP condition to long time setting on between casing and borehole cause to consider to ultradeep/offshore well and geothermal well. After added ceramics the thickening time is decrease because the shear rate is low value and lightweight cement, see. The composition models will to applicated on HTHP condition must be added by retarder additive for increasing setting time or may be ceramic is not accept on ultradeep well.

The strength of composition models expanding cement is accept on concentration 3% BWOS and 5% BWOS on temperature conditioning 200^0C and pressure 2000 psi, Nur S et.all. 2004, see Table 10. The effect of ceramic on composition models expanding cement was increased of strength cement on conditioning time is increasing to. (24, 72, and 168 hours) but effect of concentration expanding on ceramic cement on strength is caused decrease value for 5% BWOS, see Table 12.

The effect of expanding additive local on permeability cement ceramic is decreased on concentration 3% BWOS but on concentration 5% BWOS is a great, Table 11 and 12. Strength accurs on mixing that is decreased after concentration mixing is increasing by ceramic extender fill it, see Table 13. Porosity of composition models cement after added expanding and ceramic additive is great between silica cement or based cement, because the surface area of suspension cement is develop after ceramic mixing, see Table 14.

The changes of mineral C-S-H under temperature 110^oC, is formed shape gel on temperature great than it gel C-S-H change alpha di C-S-H with critalization calcium hydroxide on based cement on C/S ratio nearest 2.0, see Figure 7 and 10. After silica flour and expanding additive local to added the gel C-S-H change to critalization tobermorite 11^oA and any lime too formed, and so strength of cement is increased on C/S ratio nearest 1.0 see Figure 8 and 11. And the effect of ceramic extender on composition models expanding silica cement is formed minerals tobermorite 11^oA and clino tobermorite on C/S ratio 0.72, see Figure 9 and 12. That's minerals can be effect on increasing strength of composition models silica cement (SC) and silica cement microsphere + expanding additive local.

CONCLUSIONS

1. The effect of expanding additive local can used on HTHP conditions on concentration optimum are 3% BWOS and 5% BWOS before ceramics is added, but after added ceramics concentration optimum is 3% BWOS.
2. The mineralization of hard cement after mixing ceramic found new mineral is clino tobermorite and silica cement model is tobermorite 11 ^oA, but they are cause the porosity is great than before fill ceramics.
3. We can be make the characteristics of suspension cement and rock cement are better on 200^oC and 2000 psi conditions.
4. If ceramic to be used for ultradeep well or geothermal well we must be recomposition models by retarder additive for long time waiting on cement and preparing of thickening time and rheology agains.

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