CHAPTER VI

CONCLUSION AND SUGGESTION

6.1. Conclusion

From the result of this research, it can be concluded that:

1. The compressive strength of the cement will be reduced if the calcium carbonate is added to the cement. This is caused by the excessive amount of calcium carbonate that forms a group calcium carbonate that still in a powder state makes the cement has pores.
2. By adding silica fume as an additive to combine with calcium carbonate, it can reduce the loss of compressive strength that is caused by calcium carbonate. This can be seen in the comparison between the result in this research and Paramatatya's (2014) research. In this research, with 5% BWOC calcium carbonate and 5% BWOC silica fume, the compressive strength is 19.80 MPa in 28 days, but in Paramatatya's (2014) research, by adding 2.285% BWOC calcium carbonate to the cement without silica fume, the compressive strength is 19.36 MPa in 28 days. The strength of the cement should be decreased when calcium carbonate is added to the cement, but in this research, cement with 5% BWOC calcium carbonate and 5 % BWOC silica fume has higher compressive strength compare to specimen with 2.285% BWOC calcium carbonate without silica fume. Then it could be concluded that silica fume can reduce the loss of compressive strength caused by calcium carbonate.

3. The shear bond strength of the cement will increase when the calcium carbonate is added, but will decrease when the calcium carbonate is too much so it cannot reacts properly with cement and creates a layer of calcium carbonate in the surface of the cement and also creates pores to the cement that will disturb the bond between cement and steel casing. This can be seen in the comparison between the result in this research and Paramatatya's (2014) research. In this research, the result of shear bond strength of the cement with the calcium carbonate and silica fume in 28 days are 3.14 MPa (0% BWOC), 6.85 MPa (5% BWOC), 3.69 MPa (10% BWOC), 3.06 MPa (15% BWOC), and 2.59 MPa (20% BWOC). In Paramatatya's (2014) research, the result of shear bond strength of the cement with the calcium carbonate in 28 days are 2.16 MPa (0% BWOC), 3.95 MPa (0.011% BWOC), 4.48 MPa (0.045% BWOC), 10.56 MPa (1.174% BWOC), and 13.07 MPa (2.285% BWOC).
4. Based on the result from this research, the optimum amount of calcium carbonate and silica fume that can be use is 5% BWOC because with 5% BOWC of calcium carbonate and 5% BWOC of silica fume, the loss of compressive strength is the smallest and the shear bond strength is increased compare to the specimen with 10%, 15%, and 20% BWOC calcium carbonate and silica fume

6.2. Suggestion

Based on the research that has been done, there are some suggestion for further research about oil well cement with combination of calcium carbonate and silica fume as the additive:

1. To find the optimum amount of calcium carbonate that can be used as the additive, a research can be done by using calcium carbonate with the range of percentage 2.285% up to 5% BWOC, since with 2.285% BWOC calcium carbonate, the shear bond strength is still increasing and in 5% BWOC calcium carbonate, the shear bond strength is already decreasing.
2. After the optimum amount of calcium carbonate that can be used as the additive is found, the silica fume can be added with several amount of variant to get the optimum effect from silica fume to increase the compressive strength of the cement.

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ATTACHMENT

ATTACHMENT A

Oil Well Cement Slurry Mix Design

Vc = (W/1000)+(C/1000Sc)

where:
Vc = volume of concrete
C = mass of cement
M = mass of water
Sc = specific gravity of cement

Sc	=	3.15	
Water Cement Ratio	=	0.46	
1 Sack of Cement	=	50	kg
Vc	=	0.038873	m^3
Quantity of Cement for 1 m3	=	**25.72479**	**Sack of Cement**

Cylinder Mold Volume Calculation

Cylinder Mold Dimension:

For Compressive Test:

d	=	7.5	cm
h	=	15	cm

For Shear Bond Test

d	=	2.54	cm
h	=	5.08	cm

Mold Volume for Compressive	=	210.9375	cm^3	=	**0.000210938**	**m^3**
Per 1 batch (9 Specimens)	=	1898.438	cm^3	=	**0.001898438**	**m^3**
Total 5 Batches	=	9492.188	cm^3	=	**0.009492188**	**m^3**
Mold Volume fo Shear Bond	=	8.193532	cm^3	=	**8.19353E-06**	**m^3**
Per 1 batch (2 Specimens)	=	16.38706	cm^3	=	**1.63871E-05**	**m^3**
Total 5 Batches	=	81.93532	cm^3	=	**8.19353E-05**	**m^3**

CC = Calcium Carbonate
SF = Silica Fume

Amount of Cement per 1 Batch (1 Varian)

Amount of Cement per 1 Batch for Compressive	=	0.048837	sack of cement			
	=	2.441845	kg			
For Each Variant:						
0% Additive (CC+SF)	=	2.441845	kg	=	**2441.845**	**gr**
5% Additive (CC+SF)	=	2.19766	kg	=	**2197.66**	**gr**
10% Additive (CC+SF)	=	1.953476	kg	=	**1953.476**	**gr**
15% Additive (CC+SF)	=	1.709291	kg	=	**1709.291**	**gr**
20% Additive (CC+SF)	=	1.465107	kg	=	**1465.107**	**gr**
Amount of Cement per 1 Batch for Shear Bond	=	0.000422	sack of cement			
	=	0.021078	kg			
For Each Variant:						
0% Additive (CC+SF)	=	0.021078	kg	=	**21.07769**	**gr**
5% Additive (CC+SF)	=	0.01897	kg	=	**18.96992**	**gr**
10% Additive (CC+SF)	=	0.016862	kg	=	**16.86215**	**gr**
15% Additive (CC+SF)	=	0.014754	kg	=	**14.75438**	**gr**
20% Additive (CC+SF)	=	0.012647	kg	=	**12.64661**	**gr**

Amount of Calcium Carbonate per 1 Batch (1 Varian)

Amount of Cement per 1 Batch for Compressive	=	0.048837	sack of cement			
	=	2.441845	kg			
Amount of Calcium Carbonate for Each Variant:						
0% Additive (CC)	=	0	kg	=	**0**	**gr**
5% Additive (CC)	=	0.122092	kg	=	**122.0922**	**gr**
10% Additive (CC)	=	0.244184	kg	=	**244.1845**	**gr**
15% Additive (CC)	=	0.366277	kg	=	**366.2767**	**gr**
20% Additive (CC)	=	0.488369	kg	=	**488.369**	**gr**

Amount of Cement per 1 Batch for Shear Bond = 0.000422 sack of cement
= 0.021078 kg

Amount of Calcium Carbonate for Each Variant:

0% Additive (CC)	=	0	kg	=	**0** **gr**
5% Additive (CC)	=	0.001054	kg	=	**1.053884** **gr**
10% Additive (CC)	=	0.002108	kg	=	**2.107769** **gr**
15% Additive (CC)	=	0.003162	kg	=	**3.161653** **gr**
20% Additive (CC)	=	0.004216	kg	=	**4.215537** **gr**

Amount of Silica Fume per 1 Batch (1 Varian)

Amount of Cement per 1 Batch for Compressive = 0.048837 sack of cement
= 2.441845 kg

Amount of Silica Fume for Each Variant:

0% Additive (SF)	=	0	kg	=	**0** **gr**
5% Additive (SF)	=	0.122092	kg	=	**122.0922** **gr**
10% Additive (SF)	=	0.244184	kg	=	**244.1845** **gr**
15% Additive (SF)	=	0.366277	kg	=	**366.2767** **gr**
20% Additive (SF)	=	0.488369	kg	=	**488.369** **gr**

Amount of Cement per 1 Batch for Shear Bond = 0.000422 sack of cement
= 0.021078 kg

Amount of Silica Fume for Each Variant:

0% Additive (SF)	=	0	kg	=	**0** **gr**
5% Additive (SF)	=	0.001054	kg	=	**1.053884** **gr**
10% Additive (SF)	=	0.002108	kg	=	**2.107769** **gr**
15% Additive (SF)	=	0.003162	kg	=	**3.161653** **gr**
20% Additive (SF)	=	0.004216	kg	=	**4.215537** **gr**

Amount of Cement, SF, CC (Compressive)

Total Cement	=	**9.76738**	**kg**
Total Calcium Carbonate	=	**1.220922**	**kg**
Total Silica Fume	=	**1.220922**	**kg**

Amount of Cement, SF, CC (Shear Bond)

Total Cement	=	**0.084311**	**kg**
Total Calcium Carbonate	=	**0.010539**	**kg**
Total Silica Fume	=	**0.010539**	**kg**

Total Amount of Cement, SF, CC (Compressive + Shear Bond)

Total Cement	=	**9.85169**	**kg**
Total Calcium Carbonate	=	**1.231461**	**kg**
Total Silica Fume	=	**1.231461**	**kg**