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Investigating the Impact of Achi *(Brachystegia Eurycoma)* on the Thickening Time of Cement

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ABSTRACT

In recent times, more wells are being drilled and producing in the petroleum industry. To prevent early workover resulting from casing collapse caused by corrosion, shattering of cement sheath during perforation and fracturing, and to protect the integrity of the well, it is important to use properly designed cement slurry with appropriate additives to protect the well from the formation. The development of adequate thickening time cement is a critical task in cementing operations today. Achieving suitable thickening time of oil well cement ensures both preventionof lost circulation and a long wait on cement time. With this in mind, this research work shows a comparative study of the thickening time of oil well cement with achi and without achi contamination under different temperature of 130 °F, 150 °F, 200 °F, and 250°F and pressure conditions of 1000 psi, 1500 psi, 2000 psi and 3000psi respectively for all the experimentconducted. The thickening time of cement slurry without achi content at 70 Bc were 205, 215, 202and 200 minutes respectively. The experiment was also conducted under different achi content ranging from 2 g, 4 g, 8 g, 10 g to 12g. The results and analysis were compared. The result with 2g achi content were 164, 147, 146, and 141 minutes. The results with 4g achi content were 127, 131, 130, and 124 minutes. The results with 8g achi content were 71, 69, 75, and 65 minutes, while the results at 10g achi content were 67, 62, 63, and 60 minutes. The results with 12g achi content were 63, 62, 60, and 56 minutes under the temperature and pressure respectively. The data obtained from the experiment signifies that introducing achi and altering the temperature and pressure to the cement slurry has a significant effect on the properties of the cement by accelerating the thickening time.

KEY WORDS*:* Achi, Cement, Thickening time, Brachystagia eurycoma, and Additives

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1 | INTRODUCTION

In the oil and gas business, well cementing refers to the procedure of applying a cement slurry to the annular area between the well casing and the exposed formation (Nelson et al., 2006). The main goal is to create a cement sheath that would offer zonal isolation and prevent the transfer of gas from one zone to another, either to avoid product loss into the annulus or to a second zone that contains production oil or ground water. The cement sheath also has to adhere to and support the casing, shield it from torsion and vibration pressures during pressure evaluation and deeper drilling, and shield it from thermal shocks during deeper zone production. The transfer of gas from one zone to another, either to avoid product loss into the annulus or to a second zone that contains production oil or ground water. The cement sheath also has to adhere to and support the casing, shield it from torsion and vibration pressures during pressure evaluation and deeper drilling, and shield it from thermal shocks during deeper zone production.

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2 | MATERIALS AND METHODOLOGY

To determine how brachystagia eurycoma affected how quickly cement slurry thickened, a number of tests were run at various concentrations, pressure and temperatures. According to the requirements for materials and testing for Well Cements, all tests were carried out (Anon, 2014). The thickening time test determines how long the cement slurry may remain fluid before hardening or becoming unpumpable (Heinold et al, 2002). In other words, the period of time following first mixing when cement cannot be pumped. Bearden units of consistency (Bc) are used to measure the cement slurry's consistency.

Figure 1 shows the sensitive electronic weighing balance that was used for the experiments to weigh substances at scale uncertainty of only 0.01g.

Figure 1: *Electronic weighing Balance*

Figure 2 is chandler atmospheric consistometer which was used to measure the consistency or the time it takes cement to remain in fluid state before it reaches a certain consistency that it will no longer be pumpable.

Figure 2: *Chandler atmospheric consistometer*

Figure 3 is electronic motor mixer, the device that was used in mixing the cement slurry using an agitator or mixing blade.

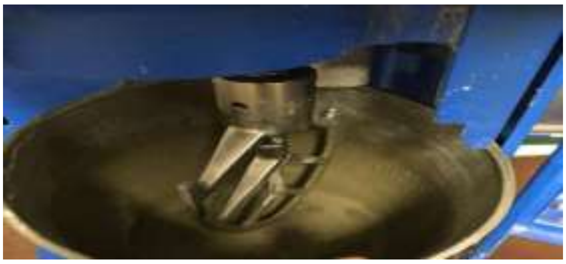

Figure 3: *Electric Motor mixer*

Cleaning

The seeds were then cleaned to remove any remaining debris or foreign materials. This was done by sieving or winnowing. The sorting steps precedes this and then debris, such as dirt, broken seeds or other impurities are removed. The seeds were then washed in clean water to remove any remaining dirt or impurities.

Drying

The drying process for achi seeds typically involves spreading the seeds out in a single layer on a clean surface, such as a tray or a tarp, and exposing them to direct sunlight for several days. The seeds should be turned regularly to ensure that all sides are exposed to the sun and to prevent mold or mildew from forming. Once the seeds were dried and brittle, they were stored in a sealed container in a cool, dry place.

Milling

The seeds were then milled to produce flour. This was done using a pestle and mortar. Finally, the powder was sifted to remove any larger pieces or impurities, resulting in a smooth, fine flour.

Experimental procedure

A micro sieve was used to sieve enough quantity of cement and transferred into a plastic bag and sealed properly to avoid exposure to air which could have effect on the cement properties. 230ml of portable water was measured using a measuring cylinder and transferred into one of the plastics containers. 2g of Achi was measured out using an electrical weighing balance and poured into the already measured portable water and allowed to dissolve completely. The plastic container with the solution was now placed under the cement mixer. 500g of cement was measured out from the sieved cement using a triple beam balance. The cement mixer was powered on and adjusted to a speed of 4000 RPM. The cement was then poured gradually into the plastic container containing 2g of Achi solution while simultaneously stirring the slurry with the cement mixer for about 10 secs. The prepared slurry was then poured into the consistometer slurry container and installed on the consistometer. The consistometer calibration settings is being adjusted to match the desired parametersfor the test such as temperature and pressure. The consistometer displayed the results of the test, typically in the form of a graph that showed how the consistency of the slurry changed over time. The data was then analyzed to determine the slurry's final consistency. Steps 2-10 were repeated to prepare the cement slurry for 4g, 8g, 10g and 12g of achi respectively.

3 | RESULTS AND DISCUSSION

3.1 Results of thickening time test

The consistometer reading were obtained at various achi content and tested at varying temperatures and pressures are presented below. The thickening time test was carried out for slurries for both achi contamination and without achi contain and the thickening time for each slurry sample was measured at 30Bc, 50Bc and 70Bc respectively.

Table 1: Results of thickening time test for each achi concentration tested at 130°F andpressure 1,000 psi

Achi Concentration	Thickening Time	(mins)	
(g)	@30Bc	@50Bc	@70Bc
0	160	180	205
2	140	149	167
4	93	118	127
8	57	64	71
10	53	59	67
12	50	55	63

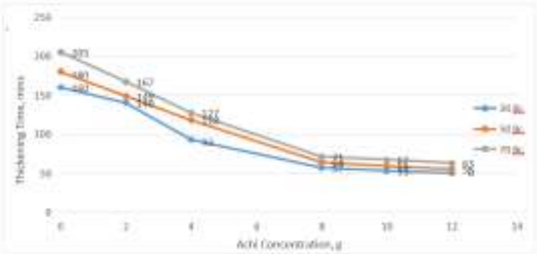

Figure 4: Thickening time recorded at 130°F and 1000psi.

The results of the thickening time experiment conducted under experimental condition oftemperature at 130°F and pressure at 1500psi is presented in figure 4. This results in Figure 4 clearly illustrates that, thickening time at the consistency of 30 Bc, 50 Bc and 70 Bc, respectively decreases at the rate of about -1hour 30 minutes, -2hours 5minutes and-2hours 22 minutes; It was also observed from these results that the achi that was used as an additive has a significant effect on the thickening time of the cement slurry

Table 2: Results of thickening time test for each achi concentration tested at 150°F and 1500 psi.

Concentration (g)	Achi Thickening Time (mins)		
	@30Bc	@50Bc	@70Bc
0	163	179	215
2	133	139	147
4	97	120	131
8	51	62	69
10	54	57	62
12	50	55	62

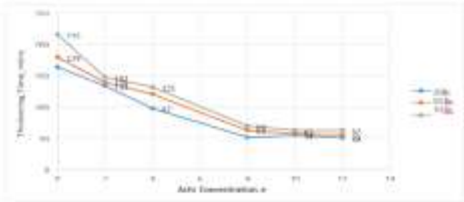

Figure 5: Thickening time recorded at 150 °F and 1500 psi.

The results are quite similar to that of the results obtained in figure 4 above. Figure 5 illustrates the outcome of the thickening time test investigated under experimental conditions of 150°F and 1500psi. An increased temperature and achi content acceleratedthe thickening time and there was a rate decrease of about 1hour 53 minutes, 2hours 4 minutes and 2hours 33 minutes respectively at 30 Bc, 50 Bc and 70 Bc.

Table 3: Results of thickening time test for each achi concentration tested at 180°F andpressure 1500 psi.

Concentration	Achi Thickening Time (mins)		
(g)	@30Bc	@50Bc	@70Bc
0	153	178	202
2	128	141	146
4	95	115	130
8	59	64	75
10	53	55	63
12	50	54	60

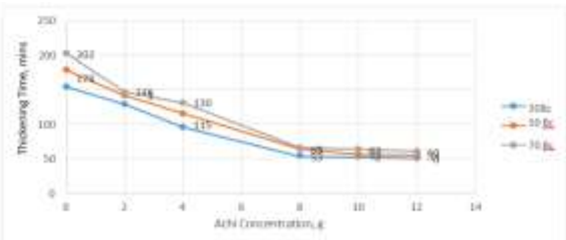

Figure 6: Thickening time recorded at 180 °F and 2000 psi.

The decreasing trend still follows from the result being illustrated in fig 6 for thickening time test investigated at a temperature of 180°F and 2000psi. There was a rate decrease of about 1 hour 43 minutes, 2 hours 4 minutes and 2hours 22 minutes respectively across all tested 30Bc, 50Bc and 70Bc respectively.

Table 4: Results of thickening time test for each achi concentration tested at 250°F andpressure 3,000 psi

Achi	Thickening Time (mins)		
Concentration			
(g)	@30Bc	@50Bc	@70Bc
0	154	180	200
2	124	136	141
4	88	113	124
8	52	59	65
10	50	56	60
12	49	53	56

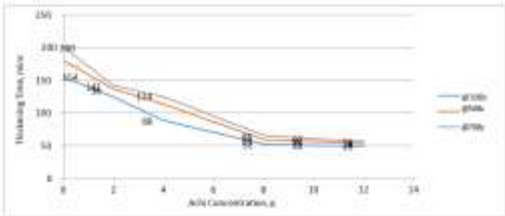

Figure 7: Thickening time recorded at 250°F and 3000psi.

The results are quite similar to that of the results obtained in fig 6 above. Figure 7 illustrates the outcome of the thickening time test investigated under experimental conditions of 250°F and 2500psi. An increased temperature and achi content acceleratedthe thickening time and there was a rate decrease of about -1 hour 45 minutes, -2hours 5 minutes and -2 hours 22 minutes respectively at 30 Bc, 50 Bc and 70 Bc.

3.2 Discussion of Results

Based on the results in figure 4 to 7, the experimental values obtained for the thickening time of cement slurry at different temperatures and pressures are as follows: Forthe first test from figure 4, the experiment conducted at 130°F and 1000psi with varying concentrations of the additive achi, the thickening times at 30 Bearden unit of consistency were 160, 140, 93, 57, 53, and 50 minutes for 0g, 2g, 4g, 8g, 10g, and 12g achi content, respectively. At 50 Bearden unit of consistency, the results were 180, 149, 118, 64, 59, and 55 minutes, and for 70Bc, the results were 205, 167, 127, 71, 67, and 63 minutes. For the second test from figure 5, the temperature and pressure were increased to 150°F and 1500psi, respectively. The thickening times at 30Bc were 163, 133, 97, 51, 52, and 50 minutes for 0g, 2g, 4g, 8g, 10g, and 12g achi content respectively. At 50Bc, the results were 178, 139, 120, 62, 57, and 53 minutes, and for 70Bc, the results were 215, 147, 131, 69, 62, and 62 minutes. For the third test from figure 6, the temperature and pressure were further increased to 180°F and 2000psi, respectively. The thickening times at 30Bc were 153, 128, 95, 53, 52, and 50 minutes for 0g, 2g, 4g, 8g, 10g, and 12g achi content, respectively. At 50 Bearden unit of consistency, the results were 178, 140, 115, 63, 55, and 54 minutes, and for 70Bc, the results were 202, 146, 130, 65, 63, and 60 minutes. Figure 7 data at 250°F and 3000psi, the thickening times at 30Bc were 151, 124, 88, 50, 50, and 49 minutes for 0g, 2g, 4g, 8g, 10g, and 12g achi content, respectively. At 50Bc, theresults were 176, 112, 96, 60, 53, and 51 minutes, and at 70Bc, the results were 200, 144, 127, 64, 60, and 57 minutes.

These results show that when cement slurries are replicated under increased temperature and pressure and increased in achi content, they accelerate more, as observed in the previous test. According to the API standard, oil field cement should have a pumping time ranging from 2 hours 30 minutes to 5 hours. The results obtained figure 4 to 7 show significant effects when achi was added to the cement slurry mixture. In the first case, where no achi was added, the thickening time at 30Bc was 2.40 hours, slightly below the API standard.At 50Bc, the thickening time was 3 hours, meeting the API standard, and at 70Bc, it was 3.25 hours, falling within the range specified by API.

4 | CONCLUSION

The major aim of investigating the impact of Achi on the thickening time of cement was achieved whereby a detailed explanation presenting facts, figures and graphical analysis was derived for the process as well. Further, relevant results were obtained in form of graphs and also in addition tables were generated having a comparative analysis of the various cases.

5 | RECOMMENDATION

A concise investigation on the impact of achi on the thickening time of cement was developed; however, subsequent addition to the research could be subsequential in understanding the whole process. In view to this, subsequent research in the modelling process and an overall feasibility should be of great interest to the researcher. It is also recommended that further studies should also explore new additives to better improve the thickening time.

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