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Lightweight Cement Slurry Made From Local Raw Materials for Cementing Wells in the Ustyurt Region

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ABSTRACT: As an example shows, the absorption of cement slurry is observed while cementing producing pay zones with low reservoirs pressure, thus, to prevent which the low specific weight cement slurry is widely used.

KEY WORDS: cement absorption, development, the method of cement slurry, oil, borehole (oil well), carboxymethylcellulose (CMC), casing strings.

I.INTRODUCTION

A decrease in the cement slurry density is obtained by replacing part of the cement with a lower than cement density filler and a higher specific surface area, also by increasing the water content of the slurry. Special lightweight cements produced by factories make it possible to obtain a slurry density in the range of 1490-1550 kg / m^3. The use of diatomite as a filler allows reducing the density of the cement mixture to 1400-1500 kg / m^3. Also, lightweight cement mixtures with a density of 1250-1350 kg / m^3 are obtained by adding gas-filled micro-cylinders made from polymer resins, but they are expensive and hard- to- get imported materials.

In the conditions of the Ustyurt oil and gas region when cementing technical and production columns according to the regulations, the density of the cement slurry should be in the range of 1400-1500 kg / m^3. To ensure such a density of cement slurry, studies were held on the use of readily available and inexpensive lightening additives available in our Republic. Based on studies conducted on the preparation of lightweight cement slurry formulations, we have proposed as a lightening additive, brown coal powder, which is used in drilling enterprises for the preparation of coal-alkaline reagentpaste. For adjusting the thickening time of cement slurry, NTPh, ferrochrome lignosulfate, CMC-500 were used. As a result of replacing part of the cement with brown coal powder, the cement slurry density decreased to 1400-1500 kg / m^3. Besides, experimental studies were conducted to identify the effect of brown coal powder on the properties of cement slurries and cement stone formed from them. Studies were carried out at a temperature of from 20 to 100 0C. The results of the study to determine the optimal composition and effect of the content of brown coal on the strength parameters are shown in table 1.

Table 1. The effect of the brown coal powder on the strength parameters of the cement slurry (T=20^0C)

№	The content of the cement slurry, in wt.%					The indicators of the cement slurry			
	cement	dolomite	Brown coal	CMC	Water/cement	γ, gr/cm^3	d., cm	G_{prd} Mpa	G_{liqfd} Mpa
1	100	-	-	-	0,7	1,65	25	1,4	3,8
2	80	-	20	-	0,6	1,57	25	1,4	3,8
3	70	-	30	-	0,6	1,53	25	1,3	3,5
4	60	-	40	-	0,6	1,49	25	1,2	3,6
5	60	-	40	-	0,7	1,40	26	1,2	3,6
6	60	20	20	-	1,0	1,35	23	0,5	1,6
7	60	15	25	-	0,9	1,40	25	0,6	1,9
8	60	10	30	-	0,9	1,45	25	0,7	2,2
9	100	-	-	0,5	0,7	1,65	23	2,0	4,5

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10	80	-	20	0,5	0,6	1,57	23	2,0	4,5
11	70	-	30	0,5	0,6	1,53	23	1,8	4,2
12	60	-	40	0,5	0,6	1,49	23	1,6	3,9
13	60	-	40	0,5	0,7	1,40	24	1,6	3,9
14	60	20	20	0,5	1,0	1,35	21	0,7	2,2
15	60	15	25	0,5	0,9	1,40	23	0,9	2,4
16	60	10	30	0,5	0,9	1,45	23	1,1	2,7

From the data given in Table 1 with an increase brown coal in the content the specific gravity of the lightweight cement slurry increases to 1.57 g / cm^3. However, the strength of the cement slurry decreases slightly compared to the strength of cement stone obtained from pure cement. With the help of CMC, the thickening time of cement slurries are regulated, in addition, CMC contributes to an increase in the strength of cement stone, as shown in Table 1 (paragraphs 9-16). Based on our studies, we obtained the following composition of lightweight cement slurry:

1) For cementing production casing:
   Cement slurry mass. % - 60-50%
   Brown coal mass. % - 20-50%
   Dolomite mass. % - 10-15%
   Water/cement ratio - 0.6-0.7
2) for cementing technical columns:
   Cement slurry mass. % - 60-50%
   Brown coal mass. % - 20-30%
   Dolomite mass. % - 10-20%
   Water/cement ratio - 0.9-1.0

The testing of the lightweight cement slurry with the brown coal in the composition under 100^0 C and 40^0 C was held in the labs of Ustyurt URBCITC. The results of the testing were given in the Table 2.

Table 2. The composition and properties of lightweight cement slurry with brown coal

№	The content of the cement slurry, in wt.%					The indicators of the cement slurry				T^0C
	cement	dolomite	Brown coal	CMC	Water/cement	G, gr/cm^3	$d_{.strt}$	T Hour-min	D_{con} cm	
1	100	-	-	0,1	0,7	1,65	25	6-05	15	100
2	80	20	-	0,1	0,8	1,57	25	5-20	11	100
3	70	-	30	0,08	0,6	1,53	22	5-30	13	100
4	60	-	40	0,08	0,6	1,49	22,5	5-50	12	100
5	60	-	40	0,08	0,7	1,40	22,5	6-10	15	100
6	100	-	-	0,02	0,7	1,65	25	5-30	14	40
7	70	-	30	0,02	0,7	1,52	25	5-30	12	40
8	60	15	25	0,02	0,7	1,45	25	5-30	13	40

From the data given in the Table 2 it is seen that in the result of adding the brown coal into the cement it is possible to get the lightweight cement slurry with the density from 1400 to 1530 kg/m^3. By the strength parameters and its density this composition meets the cementing regulations demand for Ustyurt oil and gas region. The usage of the brown coal makes possible to save cement slurry for 30-40% and bentonite clay up to 20%. The proposed composition of the lightweight cement slurry with the brown coal passed the industrial testing when cementing the conductor launched 910 m deep into the well N 2 the Notrhern Berdakh.

According to the project, the casing string with a diameter of 299 mm was to be launched to a depth of 1600 m, a clean cement slurry was used to cement the well.

Considering the drilling conditions, it was decided to launch the conductor to a depth of 910 m. The reason for this decision is to accompany the drilling process with partial absorption of the drilling fluid on sandy deposits and to show off sea sand from the upper gap in the wellbore.

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For cementing the casing string, a lightweight cement slurry with a specific gravity of = 1.45 g / cm3 was used. The composition of the cement slurry is cement, brown coal, bentonite in a ratio of 3: 1: 1.

According to the paper, it was considered to use cement slurry prepared from 89.7 tons of cement slurry at W/C= 0.7 for cementing the column. For the preparation of lightweight cement slurry in the amount of 78.4 m^3, the following was used:

- Cement – 50 t
- Brown coal – 15 t
- Bentonite – 15t

The use of lightweight cement slurry formulations during cementing conductor ensured the rise of the cement slurry behind the column to the wellhead. The rise of the cement slurry behind the column was accompanied without absorption into the strata consisting of porous and fractured rocks, although during cementing with gel cement and Portland cement based solutions. Cement solution absorption was observed; as a result, the cement solution was not raised to the design height behind the column.

The testing of the lightweight cement slurry in the well N 2 of the Northern Berdakh area showed that the given composition ensures the effective cementing of the conductor along with the saving of cement slurry and prevents the complications related to the cement solution absorption.

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