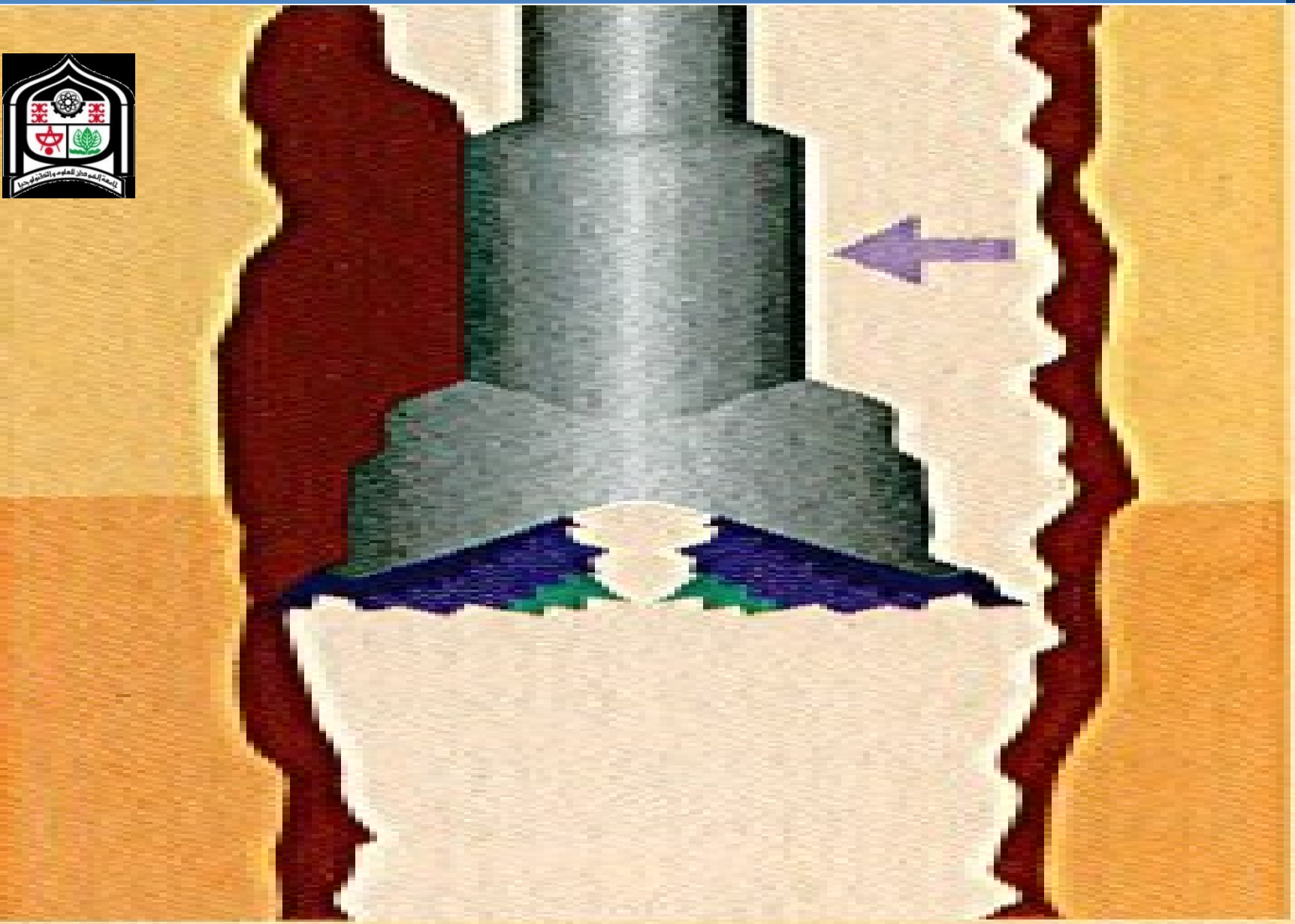


Contents

INTRODUCTION

Introduction:

- Pipe Sticking is one of the serious problems that the drillers experience during drilling process of oil and gas wells.
- When the drill string is no longer free to move up, down, or rotate as the driller wants it to, the drill pipe is stuck. Sticking can occur_while_drilling, making a connection, logging, testing, or during any kind of operation which involves leaving the equipment in the hole.
- Pipe sticking can be divided into two categories: the differential stuck and mechanical stuck (shale swelling). In this research, we will focus on mechanical stuck and the effect of implementing additives on drilling mud to prevent mechanical pipe sticking. This project will investigate the shale swelling by using_linear swell meter apparatus.

INTRODUCTION

Problem statement:

- Ghadeer C-1 wild cat well has a mechanical sticking when using drilling mud as water based mud because the formation is commonly shale, clay stone and for this reason caused hole swelling and that lead to pipe stuck. This will require treatment to the mud by adding some additives in order to prevent formation from shale swelling. In this project, Calcium Carbonate ($CaCo_3$) or KCL/Sodium Silicate are used as additives for that purpose.

INTRODUCTION

Prevent shale swelling by study the effect of calcium carbonate ($CaCo_3$) and KCl/Silicate on the sticking pipe using water based mud.

Make treatment to the mud in order to get a suitable favorable properties of mud required for prevention of pipe sticking .

Case study &Geology of area

Case study:

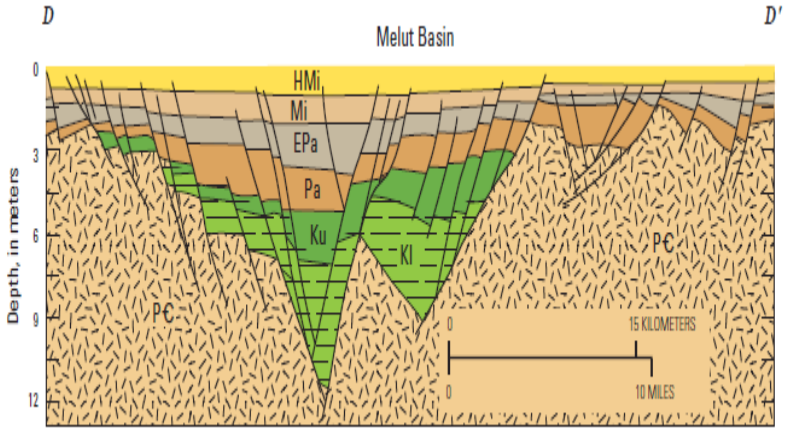
- Rig No: 4521(ZPEB)
- Well Name: Ghadeer C-1
- Well Type: Exploration well (wild cat)
- Plan Total Depth (m): 3000m
- Basin: Melut Basin
- Field/Block: PALOGUE/BLOCK 7E
- Position:16 km NW of Gumry field and
- 39 km to Adar base camp
- Offset well: Mishmish central-1 is located 5KM to East Ghadeer C-1

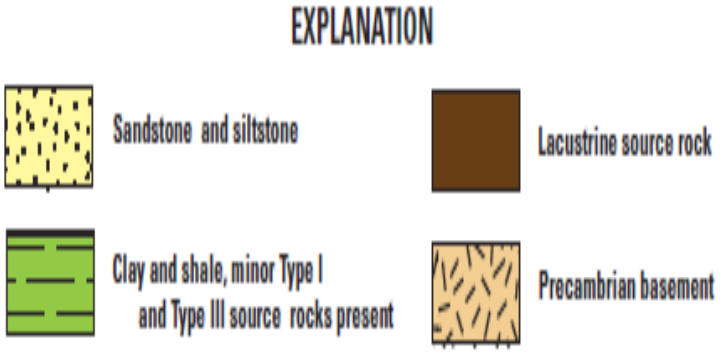
Case study &Geology of area

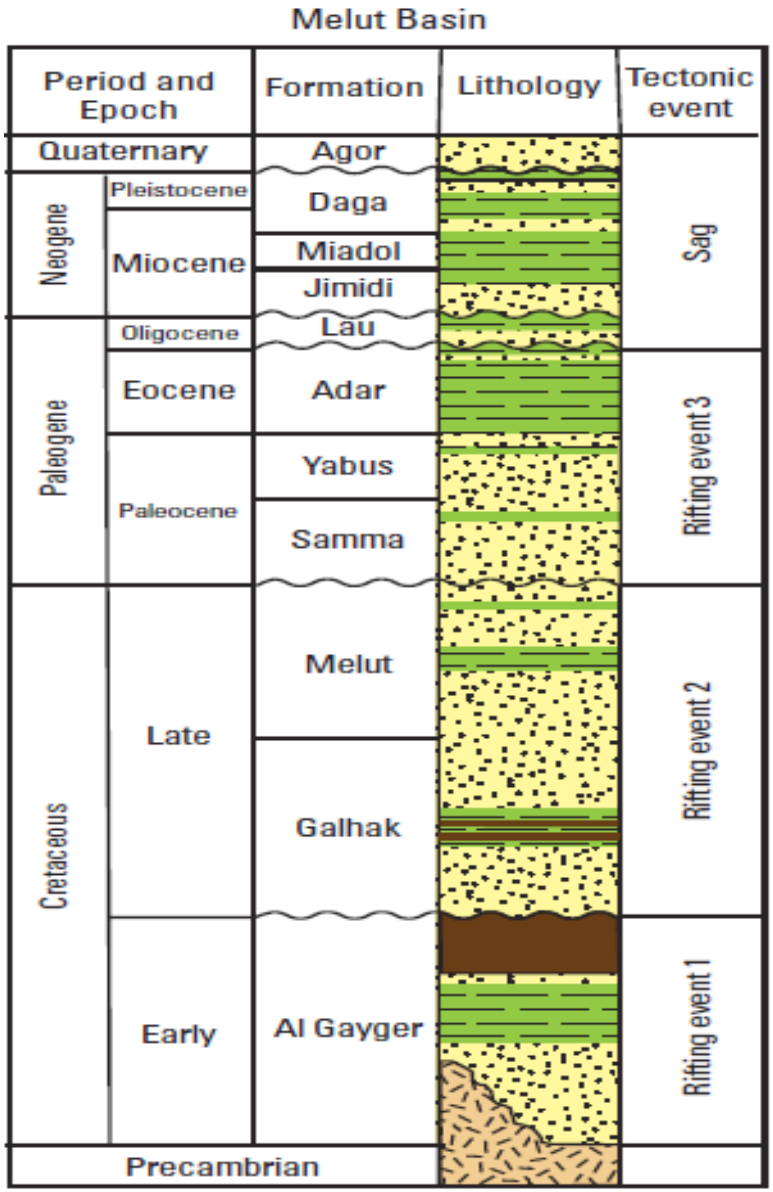
Geology of area:

- There are many basins in area these basins are all rift basins, owing their existence to the rifting activities of Western, Central and East African Rift Systems.
- Muglad, Melut, Blue Nile, Red Sea, Khartoum, and White Nile Basins.
- The formation that causes shale swelling in our case study is Lau formation (1795-1800 m) in Melut basin. That contains shale and claystone.
- The source rock in Melut basin is equivalent to the Abu Gabra Formation found in muglad basin yabous formation is the main reservior in melut basin .

Case study &Geology of area







Literature review

Martin et all (1973) using Laboratory and field studies have demonstrated that potassium cations

Van et all (1994) explain that potassium salts have been used for a long time as swelling inhibitors in WBM

Patel et all (2002) laboratory tests, a typical mud contains several additives at concentrations commonly used, including a viscosifier

Methodology

Methodology:

Conducting Experimental tests using Linear Swell meter Apparatus in order to investigate and study the following:

- Prepare KCL/polymer mud typical to that used when the problem occurred.
- Identify the effect of water on shale sample to calibrate the apparatus.
- Identify the effect of used mud typical on shale sample.
- Identify the effect of $CaCo_3$ on shale sample.
- Identify the effect of both KCL /sodium silicate on shale sample.

Methodology

List of Lab Martials:

a sample of Barite - SUST Lab

sample of PAC.LV - SUST Lab

sample of starch - SUST Lab

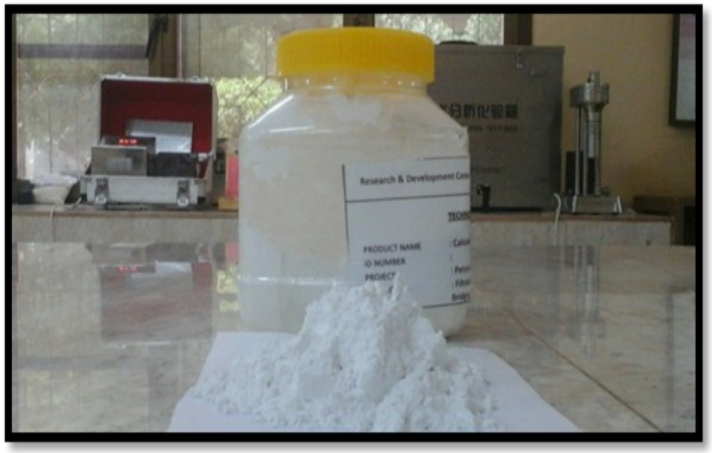
sample of Caustic soda - SUST Lab

Methodology

sample of Potassium Chlorite - SUST Lab

sample of Flowzan - SUST Lab

sample of Sodium Silicate - SUST Lab



sample of Calcium Carbonate - SUST Lab

Methodology

List of Lab Equipments:

Mud Balance Apparatus –SUST Lab

Six speed viscometer Apparatus-SUST Lab

API-filter-press Apparatus-SUST Lab

Linear swell meter Apparatus –SUST Lab

Results & Discussion

- KCL-polymer base fluid -was prepared in the laboratory, and then two additives were tested in the laboratory: calcium carbonate "$CaCo_3$"sodium –silicate(Na_2sio_3) and KCL .
- To study the effect of additives on the mud properties, especially on mechanical sticking; amount of additives in the base fluid were varied.
- Mud Weight, Rheological properties, filtration and- shale swelling of tested fluids were determined according to API recommended practice standard procedure for testing drilling fluids, API. As shown in table of properties of tested muds

Results & Discussion

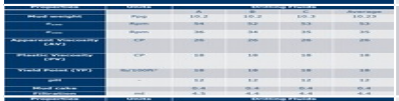
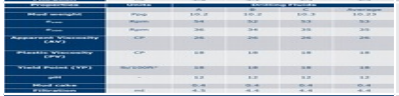
Results:

Table of Marital of tested muds:

Components	Drilling Fluids	
	Amount in lab	Amount in field
Water	600 (ml)	0.00377 (barrel)
Barite	174.6 (gm)	0.38493(pound)
Caustic Soda	1.0 (gm)	0.0022(pound)
PAC LV	1.0 (gm)	0.0022(pound)
Starch	24.3 (gm)	0.05357(pound)
KCL	2 (gm)	0.0441(pound)
Flowzan	1.0 (gm)	0.0022(pound)

Results & Discussion

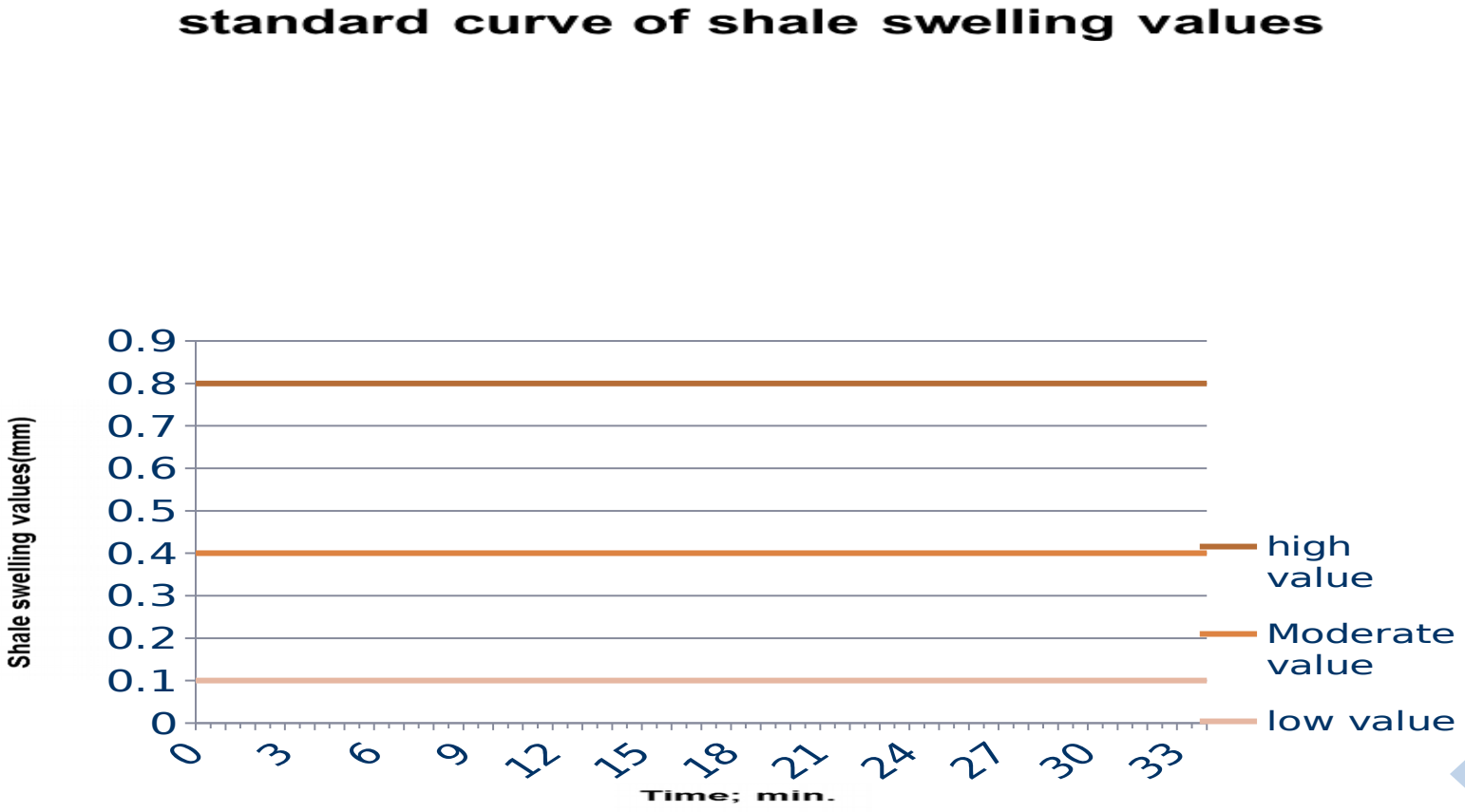
Table of properties of tested muds:

Properties	Units	Drilling Fluids			
		A	B	C	Average
Mud weight	Ppg	10.2	10.2	10.3	10.23
	Rpm	54	52	53	53
	Rpm	36	34	35	35
Apparent Viscosity (AV)	CP	26	26	26	26
Plastic Viscosity (PV)	CP	18	18	18	18
Yield Point (YP)	lb/100ft^2	18	18	18	18
pH	-	12	12	12	12
Mud cake		0.4	0.4	0.4	0.4
Filtration	ml	4.5	4.4	4.4	4.4

Results & Discussion

Discussion:

The effect of additives was investigated and the results obtained clarify whether we succeed or failed in reducing shale swelling value.

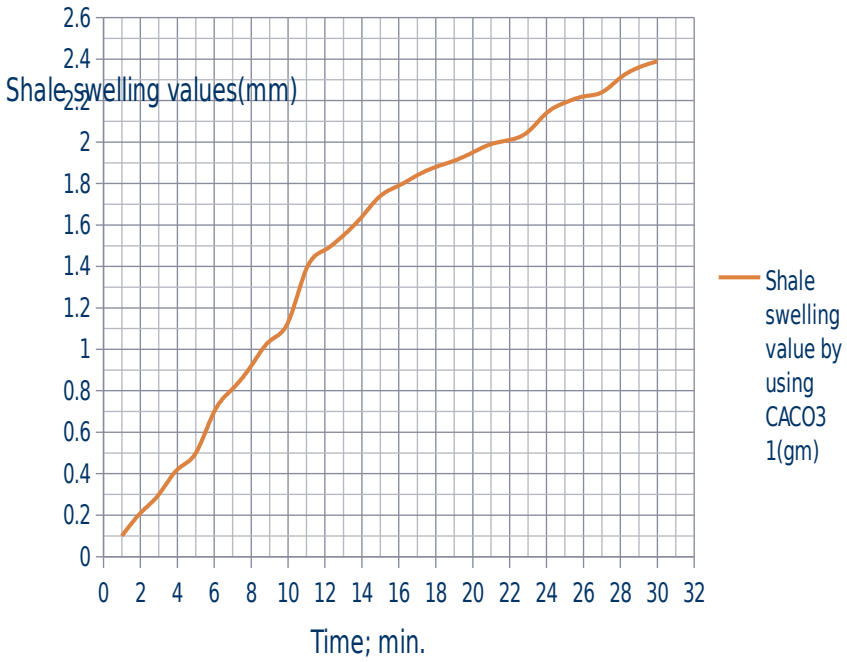


Results & Discussion

- The effect of different quantities of ($CaCo_3$) on the shale sample:

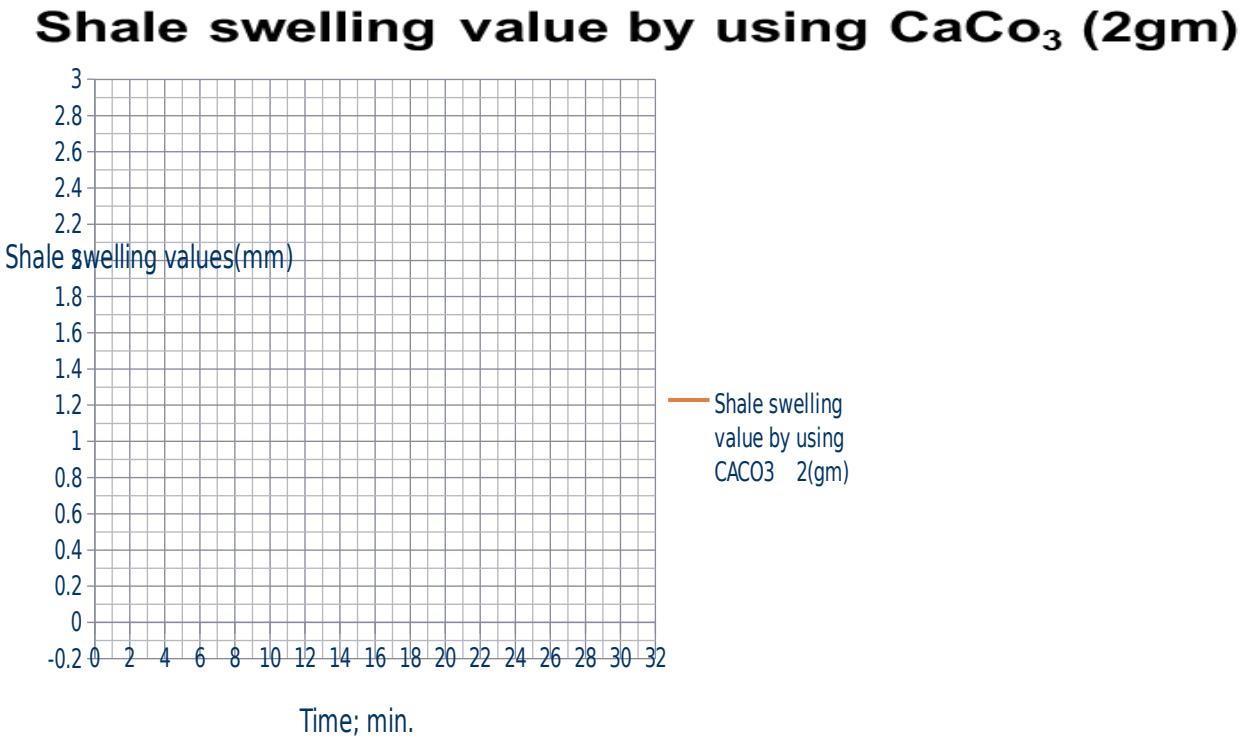
(1) when we added small weight of $CaCo_3$ (1gm), the results shows a very high values of swelling as shown in fig. below which mean that this quantity added is not succeed in preventing swell propagation.

Shale swelling value by using $CaCo_3$ (1gm)



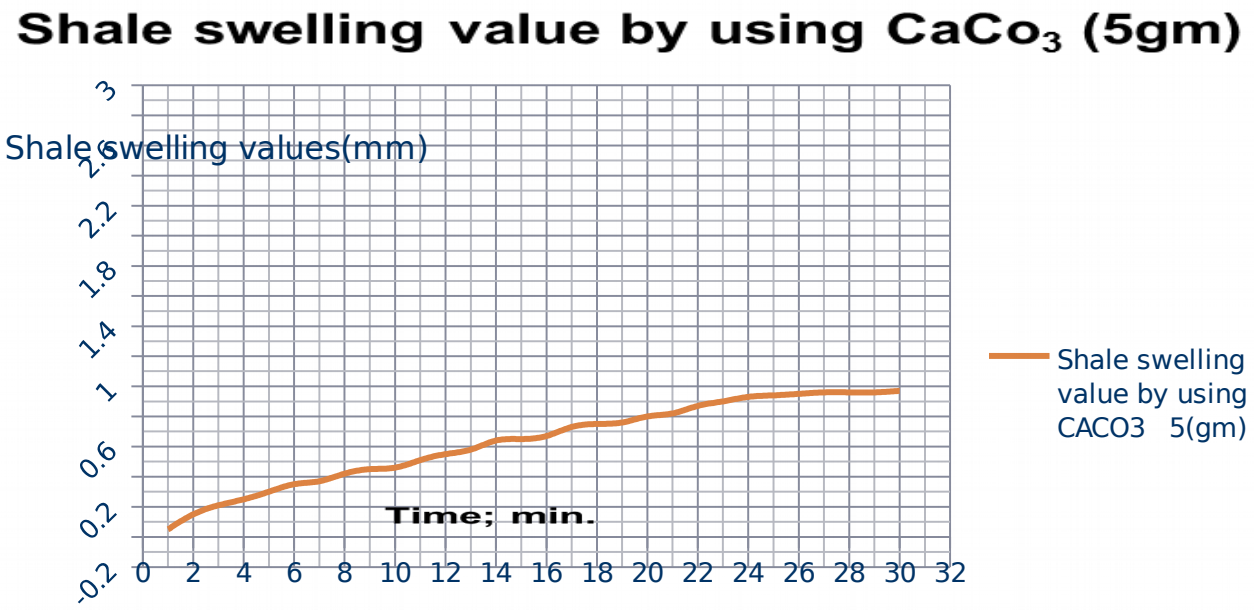
Results & Discussion

(2) When we added more of $CaCo_3$ (2gm),it reduced the values of swelling comparing with previous weight (1gm) as shown in fig. below but the results is not succeed in preventing swelling.



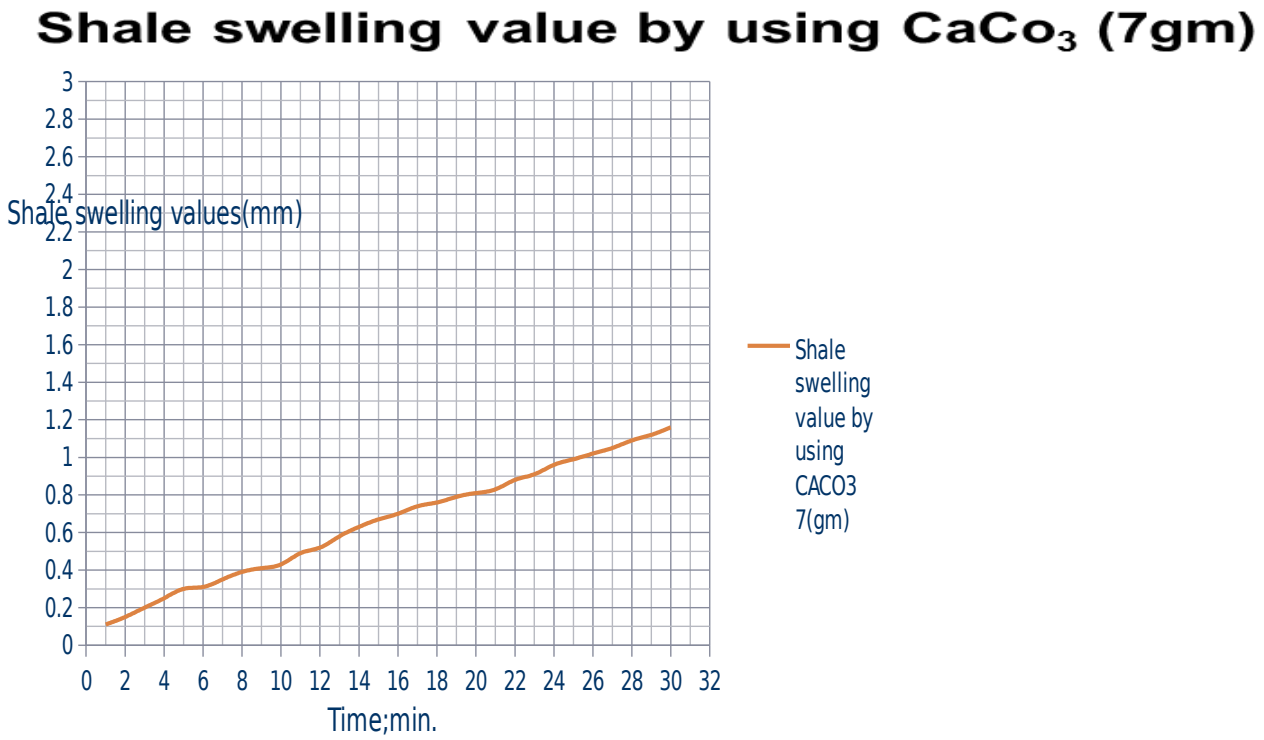
Results & Discussion

(3) Then we continue added weight of $CaCo_3$ (5gm), the values of swelling continues reducing , as shown in fig. below , best result is obtained here as we can notice no more shale swelling after 24 min. However , it does not give optimum value.



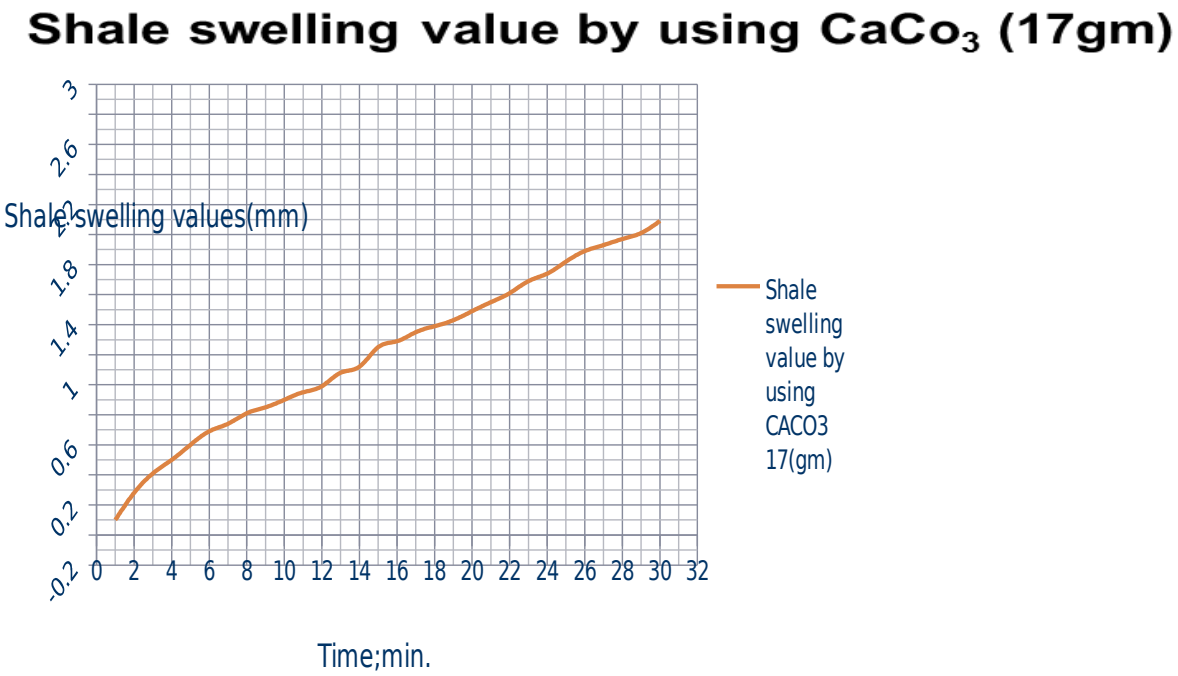
Results & Discussion

(4) Then we added more of $CaCo_3$ (7gm), but unfortunately the values of swelling increased , as shown in fig. below and also this value not accepted to prevent shale from swelling.



Results & Discussion

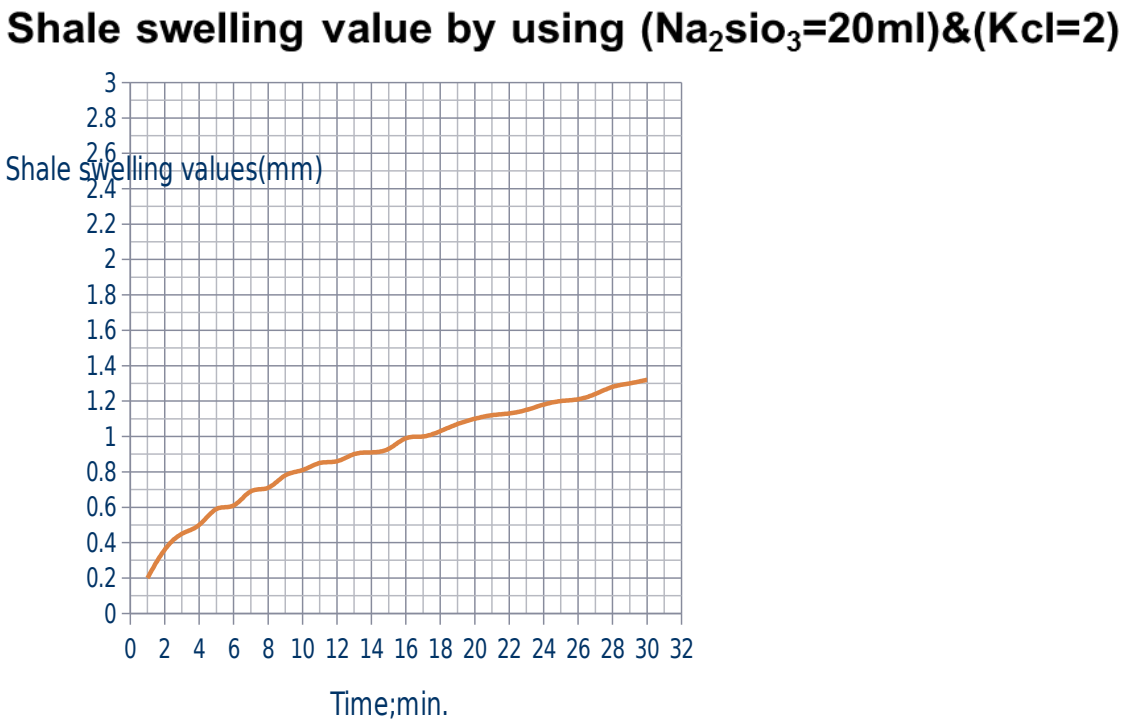
(5) By adding more of $CaCo_3$ (17gm) , we noticed that more swelling tendency, as shown in fig. below this indicate that adding more of $CaCo_3$ will not succeed in preventing swell propagation.



Results & Discussion

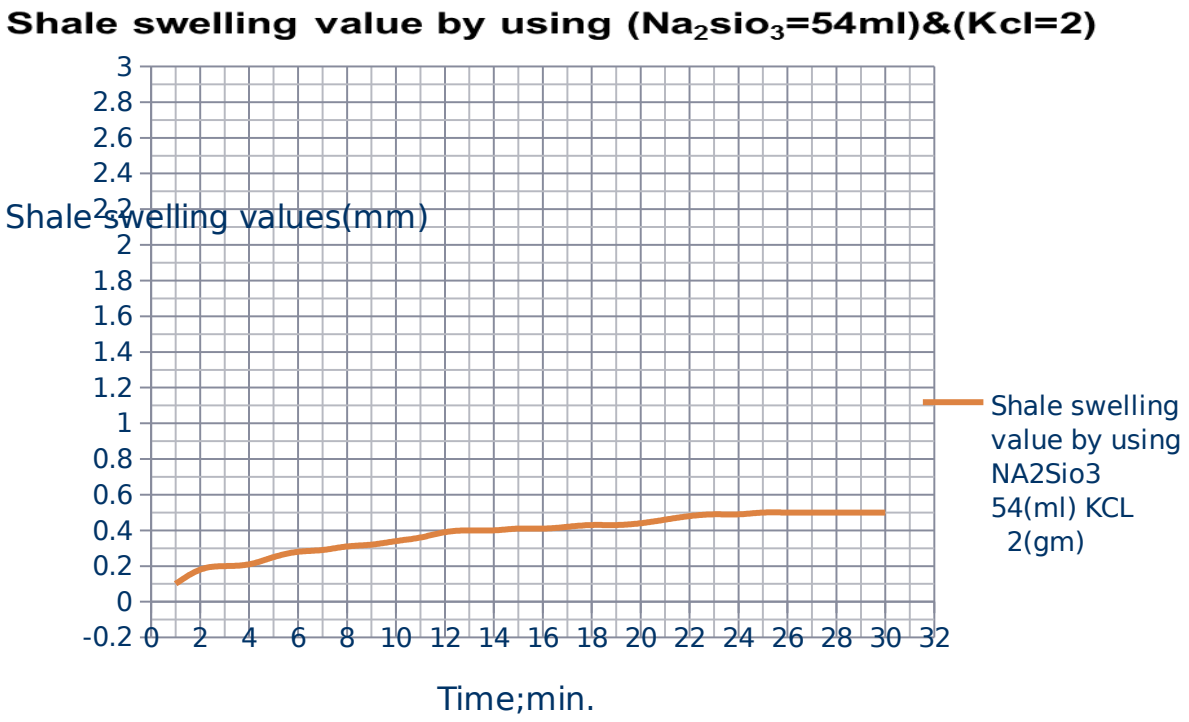
- **The effect of adding different quantities of (Na_2Sio_3) and (KCl) on the shale sample:**

(1) when we added (20 ml) of Na_2Sio_3 and(2 gm) of KCl ,gave high values of swelling as shown in fig. is not succeed in decrease shale swelling .



Results & Discussion

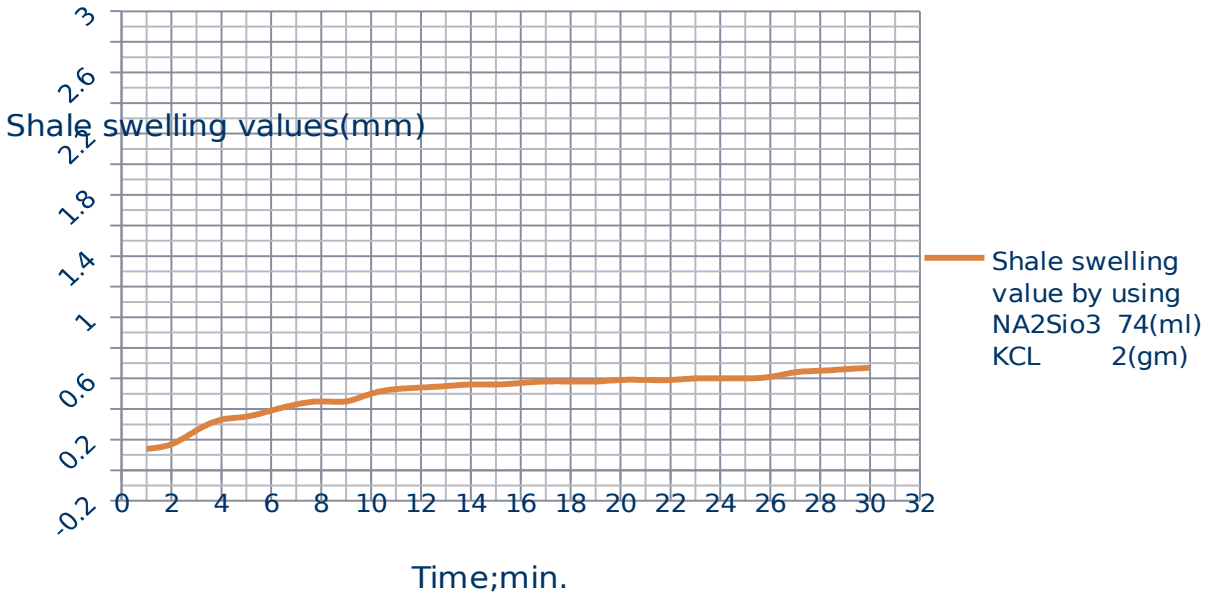
(2) when we added (54 ml) of Na_2Sio_3 and(2 gm) of KCl , it reduced the values of swelling comparing with previous test as shown in below fig. , a good results is noticed here because a small shale swelling value and after 22 min. no more shale swelling.



Results & Discussion

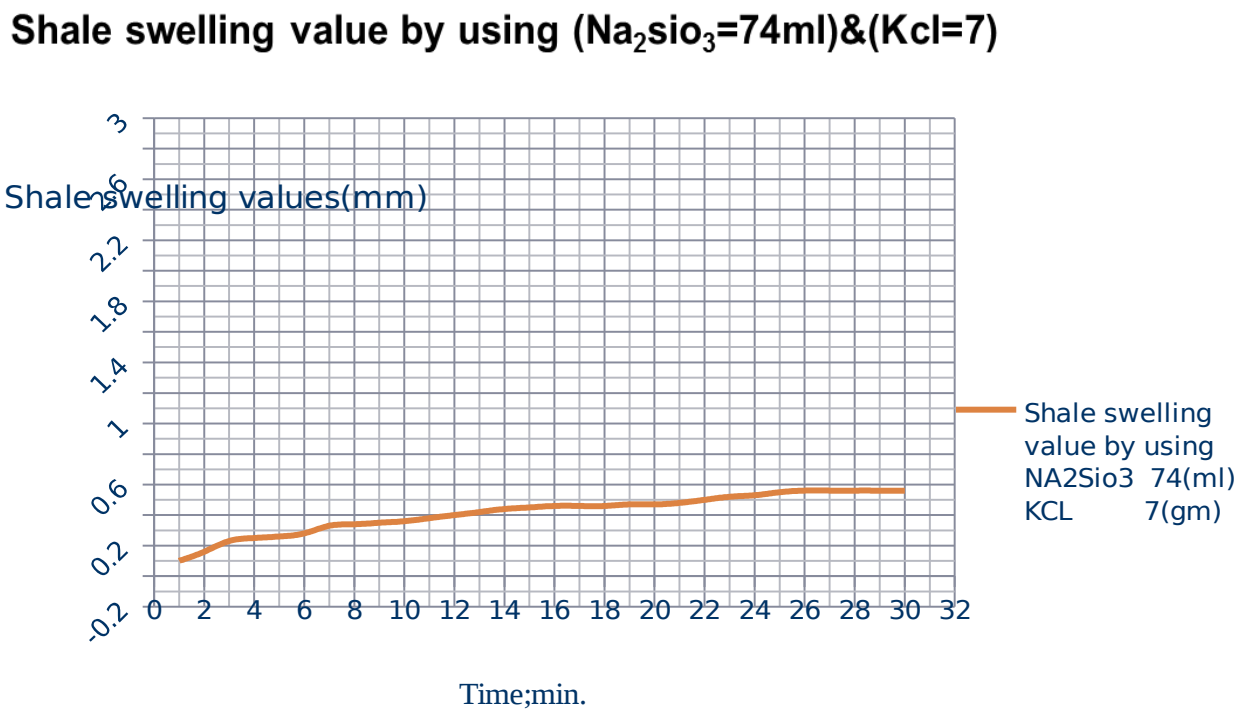
(3) when we add (74 ml) of Na_2Sio_3 and(2 gm) of KCl , gives little increase in swelling volume as shown in fig. below. We consider this to be a good results since there is no change in swelling value after 12 min

Shale swelling value by using (Na_2sio_3=74ml)&(Kcl=2)



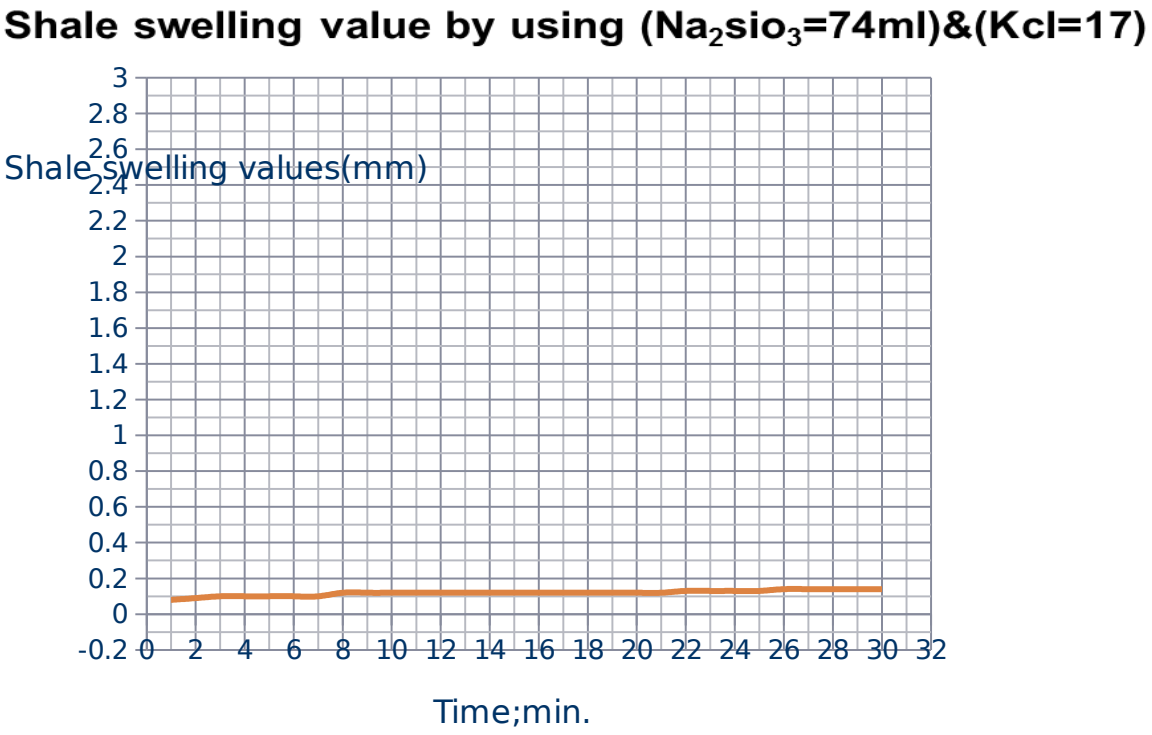
Results & Discussion

(4) when we added (74 ml) of Na_2Sio_3 and(7 gm) of KCl ,the value of shale swelling start reducing again as shown in fig.below ,also a good results since there is no change in swelling value after 12 min .



Results & Discussion

(5) when we added (74 ml) of Na_2Sio_3 and(17 gm) of KCl ,the value of shale gave optimum value of shale swelling as shown in fig. this results shows entirely prevention of shale swelling.



Conclusion & Recommendations

Conclusion:

- Quantity of $CaCo_3$ less than (5 gm) show a high value of swelling thus is not succeed in preventing swell propagation.
- Adding 5 gm of $CaCo_3$ show low values of reducing swelling. But also not succeed in preventing shale swelling.
- Concentration of $CaCo_3$ above (5 gm) show a high value of swelling thus is failed in preventing shale swelling values.
- Finally that calcium carbonate failed in reducing shale swelling value as we noticed above.
- Adding (20 ml) of Na_2Sio_3 and(2 gm) of kcl ,results high values of swelling is not succeed in preventing shale swelling values .

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- Adding (54 ml &74 ml) of Na_2Sio_3 and(2 gm,5 gm) of kcl ,the result shows a good values of swelling) succeed in preventing shale swelling values but is not optimum values.

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- The proper combination of Sodium silicate Na_2Soi_3 (74 ml) and potassium chloride KCl (17gm) can reduce the shale swelling value. Thus that is essential for the development of optimum drilling fluid systems to prevent the mechanical pipe sticking problems.

Conclusion & Recommendations

Recommendations:

- It is recommended to conduct the laboratory tests under high pressure and high temperature.
- Effect of other additives can be identified such as (polymer, potassium saults, and Quaternary ammonium compounds).
- For further studies in shale swelling we recommend using digital shale swelling measurement apparatus.
- It is recommended to add quantities 12% of (Na_2Sio_3) and 2.8% of (KCl) of drilling mud if we faced formation caused shale swelling to prevent mechanical sticking.

LOGO

Thank You!