IOP Conference Series: Earth and Environmental Science

Preface

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ICEMINE
"Accelerating the Advancements in Lower Carbon Energy for A Sustainable Environment"
2023

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Preface

Greetings and a warm welcome to the expansive compilation of research and scholarly contributions presented in the Proceedings of the ICEMINE 2023. In the spirit of intellectual exploration and collaboration, this voluminous collection encapsulates the diverse and profound discussions that unfolded during the conference. As we delve into the following pages, readers will encounter a comprehensive exploration of knowledge, innovation, and interdisciplinary collaboration within the overarching theme of ICEMINE 2023.

ICEMINE 2023 is the 6th International Conference hosted by the Faculty of Mineral Technology, Universitas Pembangunan Nasional "Veteran" Yogyakarta, Indonesia. The conference was held at Grand Keisha Hotel, Yogyakarta, Indonesia, on the 9th of November 2023. The theme of this year's program is *"Accelerating the advancements in lower carbon energy for a sustainable environment"*.

We extend our appreciation to our esteemed partner university, whose unwavering dedication and scholarly contributions have significantly enriched the contents of this conference proceedings. In collaboration with our partner universities, Trisakti University and PEM Akamigas, UPN Veteran Yogyakarta creates an academic platform that fosters diverse perspectives, innovative ideas, and interdisciplinary exchange. Their insightful research and collaborative spirit have undeniably elevated the quality of discourse within our academic community, fostering an environment conducive to intellectual growth and innovation.

Furthermore, we would like to express our profound gratitude to our sponsors, whose generous support has been pivotal in bringing this event to success. Their unwavering commitment to advancing research and cultivating intellectual exchange underscores the importance of their role in shaping the trajectory of our academic disciplines.

Reflecting on Sustainability in Indonesia

In recent years, the imperative to decrease carbon emissions and shift towards energy sources with lower carbon footprints has become exceptionally crucial. Emphasizing the importance of transitioning to cleaner energy sources is paramount for preserving our environment and addressing climate change. The significance of advancing lower carbon energy technologies cannot be overstated, as they play a vital role in mitigating the adverse impacts of climate change and ensuring a sustainable environment for future generations. As scholars and researchers, we carry a distinct responsibility to accelerate the development of these technologies, driving innovation, encouraging critical thinking, and offering the expertise and solutions needed to forge a more sustainable future.

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The chosen theme for ICEMINE 2023, *Accelerating the advancements in lower carbon energy for a sustainable environment,* resonates with the evolving landscape of academic inquiry and technological advancement. This theme has served as a catalyst for researchers to delve into various aspects, spanning the theoretical frameworks to practical applications. The rich tapestry of this proceedings volume mirrors the comprehensive exploration undertaken by the conference participants, representing a mosaic of perspectives that collectively contribute to the ongoing narrative of Sustainability.

Within this volume lies a plethora of research, articles, case studies, and theoretical explorations carefully curated from the vast pool of submissions and presentations at the conference. These contributions, emanating from a global community of earth science scholars, reflect the breadth and depth of insights shared during ICEMINE 2023. The contributions cover a wide spectrum of earth sciences, which are:

1. Geological Science and Engineering
2. Geophysics, Geomatics and Geochemistry
3. Earth Resources Project Evaluation and Valuation
4. Petroleum and Geothermal Engineering
5. Mining and Metallurgical Engineering
6. Taxation and Policy
7. Conservation, Geoheritage and Geopark
8. Disaster Management
9. Reclamation and Environmental Issues

Navigating the future: a vision for what lies ahead

As we engage with the contents of this proceedings volume, let us not only celebrate the documented achievements but also contemplate the trajectory of our respective fields. The ideas presented here have the potential to seed new research directions, innovative solutions, and transformative advancements. Readers are encouraged to interact critically with the content, fostering discussions and collaborations that transcend traditional academic silos. The interdisciplinary nature of the contributions invites us to explore the intersections of knowledge, where groundbreaking ideas often emerge from the convergence of diverse perspectives. May the knowledge shared within this volume inspire future generations, spark new avenues of inquiry, and contribute to the advancement of our collective understanding.

Cordially yours,

Dr. Widyawanto Prastistho

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KEYNOTE SPEAKERS

BEST PRESENTERS

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Andra Y Ginting	The Effectiveness of Soil Washing as a Remediation Method on Oil Spill Contaminated Soil (Case Study: Wonocolo Traditional Oil Mine)	Environmental Engineering UPNVY
Muhammad Irvingia Al Farizzi	Telomoyo Volcano Complex Geotourism: An In-Depth Analysis and Future Development	Geological Engineering UPNVY
David Michael	Optimizing the Impact of Rheological Properties on Bentonite Prehydrated- Based Drilling Mud Through the Utilization of Prehydration	Trisakti University
Muhammad Naufal Hisya Himendra	Comparative Analysis of The Use Emulsion and Watergel Explosive on Fragmentation at PT Dahana Site Kaltim Jaya Bara, East Kalimantan	Mining Engineering, Trisakti University
Nungky N. Wijayanti	Determination of Perforation to Obtain the Optimum Rate in "NKY" Well Of "MWA" Field	Petroleum Engineering, UPNVY
Kyeong Park	Geoparks and Sustainability - Korean Case	Sungshin Women's University, South Korea

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Peer Review Statement

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Conference Title

"The 6th International Conference on Earth Science, Mineral, and Energy."

Peer review statement

All papers published in this volume have been reviewed through processes administered by the Editors. Reviews were conducted by expert referees to the professional and scientific standards expected of a proceedings journal published by IOP Publishing.

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PAPER • OPEN ACCESS

Physical property comparison of polymeric KCl sludge composition and polyamine at different temperatures

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Physical property comparison of polymeric KCl sludge composition and polyamine at different temperatures

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Abstract. Drilling mud is a fluid used to assist the drilling process. The composition and physical properties of the mud greatly influence a drilling operation. Drilling operations that penetrate formations with shale content have the potential to experience drilling problems related to shale hydration. To get a good ability to prevent shale hydration, mud is added with polymeric and polyamine KCl additives (shale inhibitors) with the aim of stabilizing shale in contact with drilling fluid, as well as preventing drill cuttings from forming colloids. The results obtained in the KCl polymer mud composition at temperatures of 80°F, 250°F, and 300°F for mud weight were 9.3 ppg, 9.1 ppg, and 9 ppg, respectively. Funnel viscosity was 40 sec/qt, 36 sec/qt, and 34 sec/qt. Tap rates were 4.8 cc, 6 cc, and 6.6 cc. Mud cake remained at 1 mm and pH also remained at 9. While the results obtained on polyamine mud composition at temperatures of 80°F, 250°F, and 300°F for mud weight were 9.2 ppg, 8.9 ppg, and 8.8 ppg, respectively. Funnel viscosity was 26 sec/qt, 20 sec/qt, and 17 sec/qt. Tap rate of 10 cc, 13.8 cc, and 15 cc. Mud cake of 1 mm, 2 mm, and 2 mm. pH remains at 9. The data obtained shows that the results of the physical properties of polymeric KCl mud are better than polyamine mud.

1. Introduction

People could not understand the term drilling mud in ancient times. Water was the only means of lifting drill shale or cutting. Then, as time went on, drilling technology has progressed. Drilling mud was first used to increase the success rate of a drilling operation. Determining the type and content of mud is critical for increasing the success and smoothness of a drilling operation. In this scenario, the appropriateness of the mud type and composition with the formation conditions to be drilled can reduce drilling costs . [1]–[3]

Drilling mud is crucial in a drilling process. Drilling that is fast, safe, and affordable is heavily determined by the circumstances and mud systems used. The condition under question here is how the mud's characteristics or rheology [4]. While the mud system referred to here is a specific sort of mud that must be used while taking into account formation and borehole conditions. Non-disperse KCl polymer muds must sustain or preserve the hydration and dispersion process of the drilled shale formation as much as feasible. The most typical method is to limit the quantity of water that reacts with the shale by blanketing the cutting formed by the shale with polymer as quickly as possible to avoid additional reactivity with water.[4], [5] It is possible to conclude that KCl polymer mud is a mud used to control chemical reactions in shale strata. Because the primary element is water, this mud is a sort of water base mud. This mud is most suited for use in formations with laminar shale, clay, and limestone rock types, as well as rocks with a high amount of sloughing shale and clay swelling. The most common mud system utilized in drilling is polymeric KCl mud. The technology is built around an anionic encapsulating polymer fluid, which encapsulates drill cuttings during hole cleaning. In water, KCl degrades into K^+ and Cl^- ions. K^+ ions will replace Na^+ ions in the stabilization of shale minerals. As a result, in plate shale, K^+ ions are bound much stronger than Na^+ ions with plate clay between clay and water, reducing the repulsion force between plate clay particles in water. The stronger the attraction between clay, the more water is released from the system. This is due to the fact that K^+ ions have a large atomic radius, which can close the shale microfracture and prevent water from entering the microfracture, reducing shale drying (hydration). [6]–[8]

The polyamine used is a quarternary ammonium salt that inhibits water absorption in shales and clays (water absorption) while also preventing dispersion (non dispersion). Polyamine is a shale inhibitor material that has many advantages over KCl, including its environmentally friendly nature. Since 1980, various polyamine research and development has been conducted, but it has not been able to completely replace the function of KCl as a shale inhibitor. [9], [10]

Because of its ability to stabilize clay when drilling through water-sensitive shale, polyamine is used in high-performance water-based drilling fluids. Wellbore stability has historically been a major concern during drilling operations due to the possibility of water-sensitive shale formations hydrating when in contact with aqueous drilling fluids. Clay hydration in water-sensitive formations causes wellbore degradation via two mechanisms: swelling and clay dispersion. Swelling of clay from the formation frequently results in hole tightening and increased pipe sticking, whereas dispersion frequently results in hole washout and shale weakening. [11], [12]

The purpose of this study was to compare the results of physical properties between KCl Polymer Mud Composition with Polyamine at Various Temperatures.

2. Method

This study was carried out at Universitas Trisakti's Laboratory of Drilling and Production Engineering. The first step was to collect six mud samples. The first three samples are polymeric KCl mud compositions with the same material that will be tested at 80°F, 250°F, and 300°F. While the fourth through sixth samples are polyamine mud compositions containing the same materials that will be tested at temperatures of 80°F, 250°F, and 300°F, respectively. Fresh water is used in the polymer KCl mud composition. KOH is used to control the pH. As viscosifiers and water loss controllers, bentonite and pac-LV are used. It can also be used to make mud cakes because it controls water loss. As biopolymers and rheology modifiers, XCD and PHPA are used. [13], [14]

The main ingredient of mud, KCl polymer, is a shale inhibitor that can replace Ca^{2+} ions with K^+ ions. K-Soltex was developed as a shale inhibitor and to strengthen K^+ ions derived from KCl polymer. Barite can be used as a weighting agent or to increase density, thinner, fluid loss control, and dispersant with lignosulfonate. Finally, defoamer is used to reduce foaming. The ingredients in the polyamine mud composition are the same as those in the polymer KCl composition, except that the polymer KCl and K-Soltex ingredients are replaced with polyamine, which acts as a shale inhibitor. With the same ingredients, it will then be heated in the oven for 1 hour at temperatures of 80°F, 250°F, and 300°F, with a comparison of the results between the KCl polymer mud composition and polyamine. [15]–[17]

3. Result and Discussion

Laboratory research on the physical and rheological properties of drilling mud necessitates standardization of drilling mud properties that have become standard provisions of the research. This mud is produced in two systems: KCL and Polyamine. Table 1 shows the standard specification data for KCl and Polyamine mud at 80 ^{0}F, 250 ^{0}F, and 300 ^{0}F temperatures.

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Table 1. Composition Comparison Results of Polymeric KCl Sludge with Polyamine.

Physical properties of mud	KCl Polimer			Polyamine			Unit
	80°F	250°F	300°F	80°F	250°F	300°F	
Mud Weight	9.3	9.1	9	9.2	8.9	8.8	ppg
Funnel Viscosity	40	36	34	26	20	17	sec/qt
Plastic Viscosity	20	17	15	14	10	8	cp
Yield Point	24	19	17	17	12	10	lbs/100 ft²
Apparent Viscosity	32	26.5	23.5	22.5	16	13	cp
600 RPM	64	53	47	45	32	26	-
300 RPM	44	36	32	31	22	18	-
200 RPM	40	33	28	27	18	15	-
100 RPM	35	29	24	23	13	11	-
6 RPM	20	14	11	10	7	5	-
3 RPM	16	11	8	7	5	3	-
Gel strength 10 seconds	16	11	8	7	5	3	lbs/100 ft²
Gel strength 10 minutes	26	20	16	14	10	6	lbs/100 ft²
Screening rate	4.8	6	6.6	10	13.8	15	cc
Mud cake	1	1	1	1	2	2	mm
pH	9	9	9	9	9	9	-

The density of mud is the mass per unit volume of mud that influences the buoyant effect on a solid particle; the higher the density of an object, the greater the mass per volume. A Mud Balance tool is used in laboratory research to determine density of mud. Figure 1 shows the results of measuring the density of KCL and Polyamine muds at various temperatures.

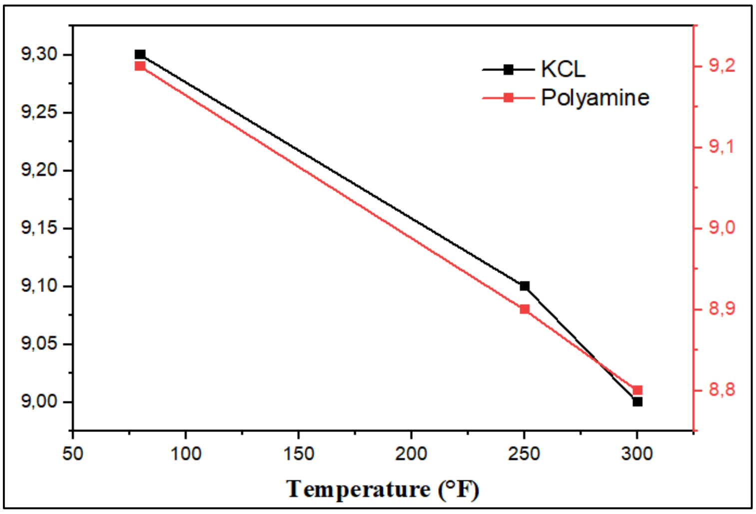

Figure 1. Mud weight of KCl and Polyamine.

The viscosity of the mud is critical in raising a drill shale (cutting) to the surface. The higher the viscosity in a mud, the easier it is to lift the drill flakes; however, as the viscosity decreases, the drill flakes become more difficult to separate from the cuttings. Viscosity is the resistance to mud flow during circulation, which can occur due to a shift between drill mud particles.

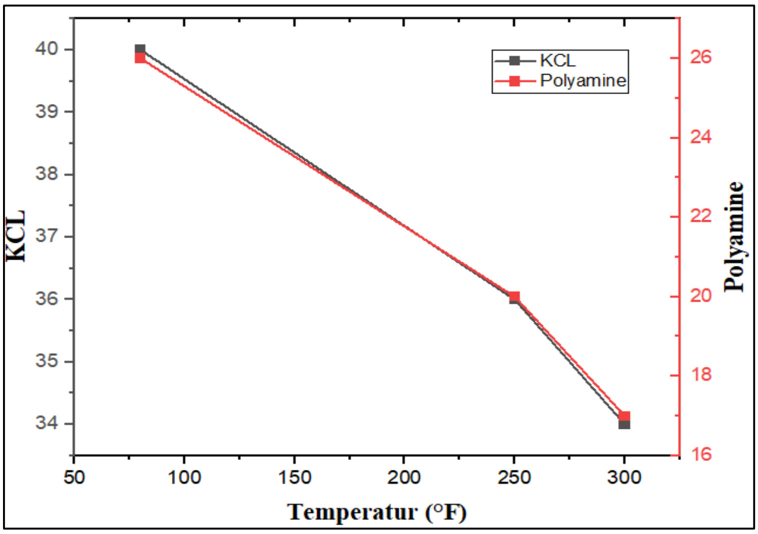

Figure 2. Funnel Viscosity of KCL and Polyamine.

Plastic viscosity is a flow resistance caused by friction between solids in mud, liquid solids, and friction between liquid layers. The following is the result of reading the Plastic Viscosity value with the Fann VG meter tool in Figure 3.

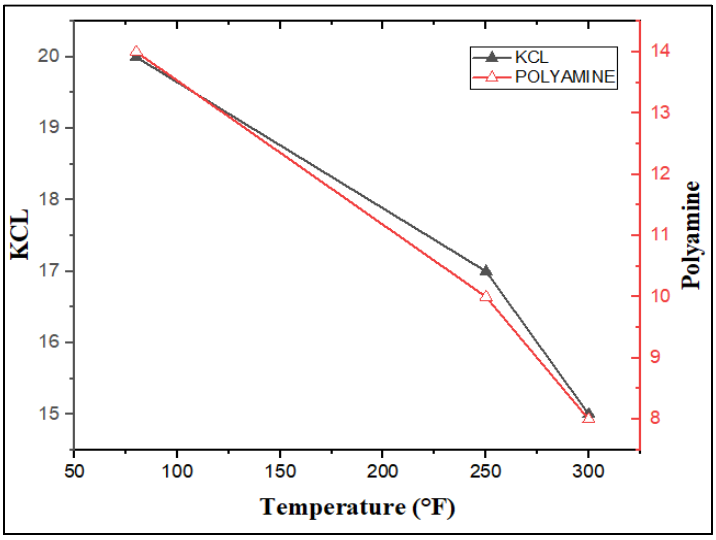

Figure 3. Plastic Viscosity of KCL and Polyamine.

Yield Point measures the attraction of solid particles in mud. Low yield points can lead to barite precipitation and poor hole cleaning. A high Yield Point, on the other hand, can result in increased circulation pressure, is difficult to stir in the tank, and has a tendency to retain gas in the mud. Figure 4 depicts the results of the Yield Point measurements of KCl and Polyamine muds at various temperatures.

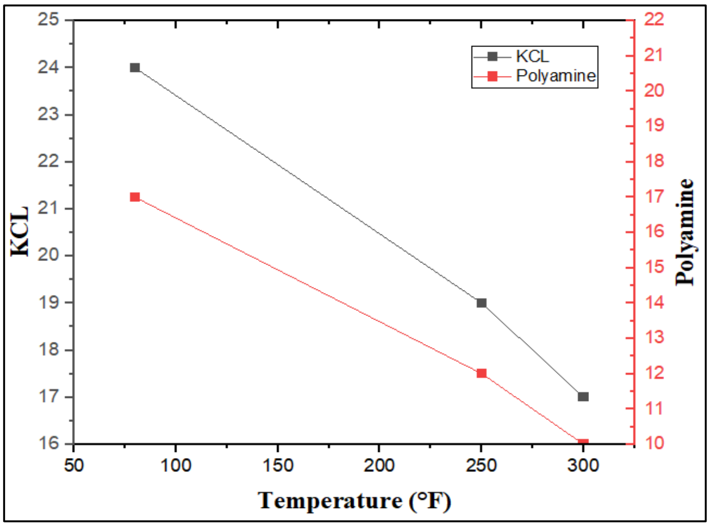

Figure 4. Yield point of KCL and Polyamine.

The gel strength of mud is a measure of its resistance to flow from a stationary state. When the mud is at rest or not circulating, the gel strength should be high enough to prevent cuttings from moving downward. Gel strength measurements are usually taken twice for standardization, once at the beginning of 10 seconds or right after sludge circulation is stopped and again after 10 minutes or right when circulation resumes. Figure 5: Gel strength value results after 10 seconds of calculation

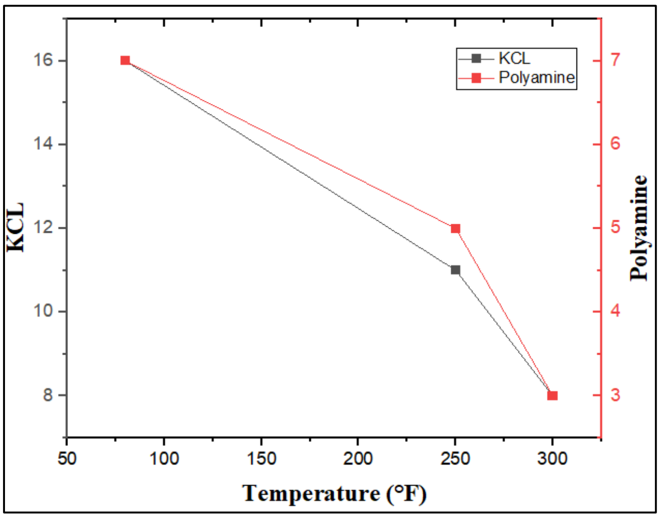

Figure 5. Gel Strenght 10 sekon of KCL and Polyamine.

Figure 6 depicts the results of the 10-minute gel strength calculation for the KCL and Polyamine sludge systems:

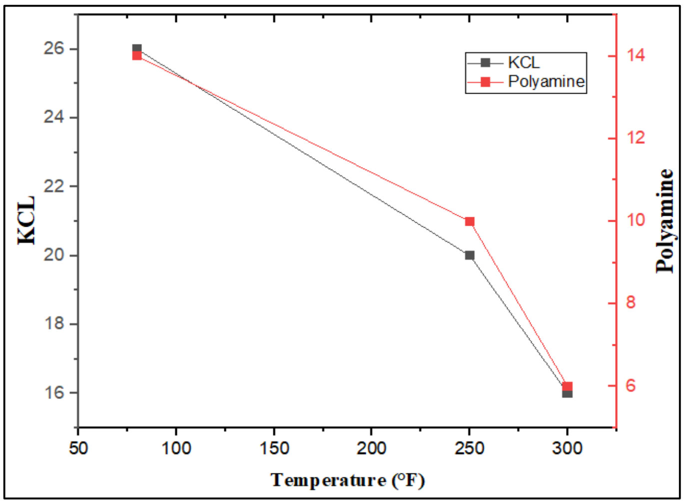

Figure 6. Gel Strenght 10 minute of KCL and Polyamine.

The rate of drilling mud filtering is made up of both solid and liquid components. Because the wellbore wall has pores in general, the mud's liquid component will enter the borehole wall. The sieve rate is an indication of the amount of liquid entering the formation that is affected by temperature, pressure, and solids. The invaded zone is the area infiltrated by mud, while the incoming liquid is known as the filtrate.

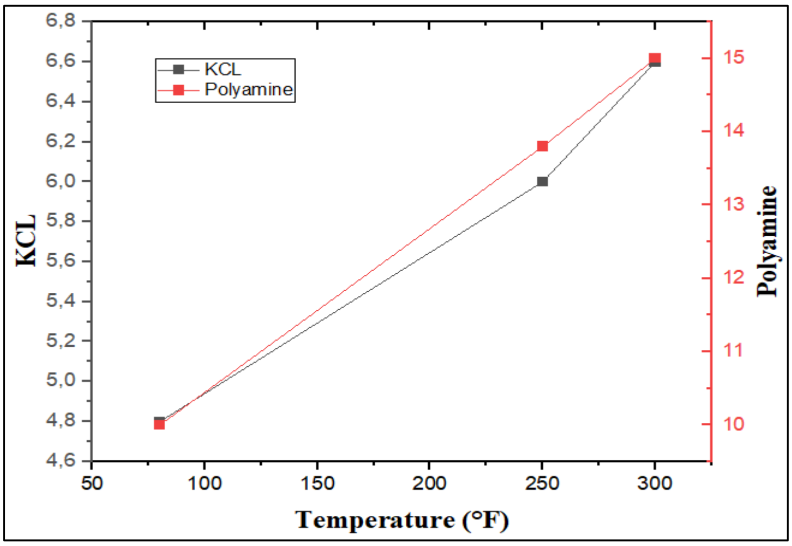

Figure 7. Water loss of KCL and Polyamine.

The sieve rate's goal is to form a mud cake on the borehole wall. A good mud cake is thin to reduce the possibility of pinching the drill pipe, strong to help stabilize the borehole, and solid to ensure that the filtrate that enters the formation is not excessive. A good mud cake is thin to reduce the possibility of pinching the drill pipe, strong to help stabilize the borehole, and dense to ensure that the filtrate that enters the formation is not excessive. Thick mud cake will clamp the drilling pipe, making it difficult to lift and rotate, while the filtrate that enters the formation will damage the formation and can cause damage to the formation.

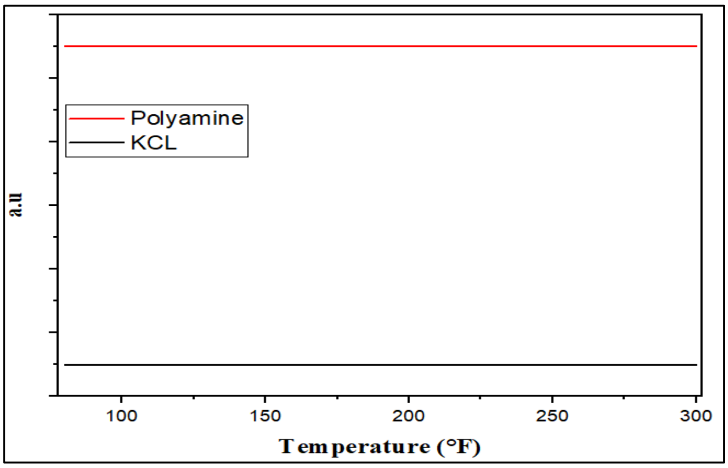

Figure 8. Mud cake of KCL and Polyamine.

4. Conclusion

The following conclusions can be drawn based on the findings of the research data:

1. When the composition of polymeric KCl sludge and polyamine is compared, the physical properties of polymeric KCl sludge are better than polyamine because, on the one hand, KCl is a polymer. However, if you want to use a more environmentally friendly mud, polyamine can be used.
2. The mud weight results for the KCl polymer mud composition at temperatures of 80°F, 250°F, and 300°F were 9.3 ppg, 9.1 ppg, and 9 ppg, respectively. The funnel viscosity was 40 sec/qt, 36 sec/qt,

and 34 sec/qt. Plastic viscosities of 20 cp, 17 cp, and 15 cp. Yield points of 24 lbs/100 ft^2, 19 lbs/100 ft^2, and 17 lbs/100 ft^2. Gel strength 10 seconds of 16 lbs/100 ft^2, 11 lbs/100 ft^2, and 8 lbs/100 ft^2. Gel strength after 10 minutes was 26 lbs/100 ft^2, 20 lbs/100 ft^2, and 16 lbs/100 ft^2. The slick rates were 4.8 cc, 6 cc, and 6.6 cc. The mud cake remained at 1 mm, and the pH remained at 9.

3. For mud weight, the results for polyamine mud composition at 80°F, 250 °F, and 300 °F were 9.2 ppg, 8.9 ppg, and 8.8 ppg, respectively. The funnel viscosity was 26 sec/qt, 20 sec/qt, and 17 sec/qt, respectively. 14 cp, 10 cp, and 8 cp plastic viscosity. Yield points of 17 lbs/100 ft^2, 12 lbs/100 ft^2, and 10 lbs/100 ft^2 are available. Where the yield point must be greater than the plastic viscosity in order for the mud to lift the cutting to the surface. 10 seconds of gel strength of 7 lbs/100 ft^2, 5 lbs/100 ft^2, and 3 lbs/100 ft^2. 10 minutes of gel strength of 14 lbs/100 ft^2, 10 lbs/100 ft^2, and 6 lbs/100 ft^2.

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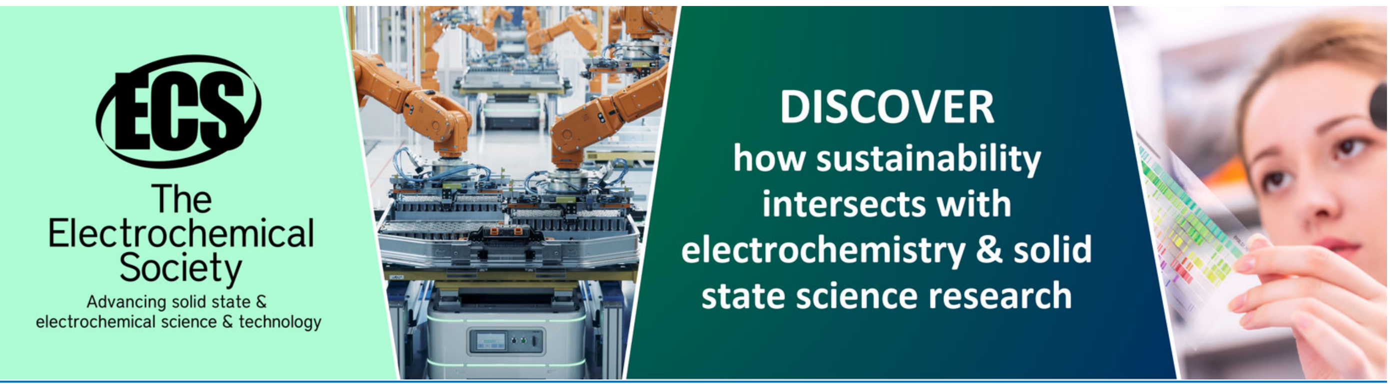

Physical property comparison of polymeric KCl sludge composition and polyamine at different temperatures

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Abstract. Drilling mud is a fluid used to assist the drilling process. The composition and physical properties of the mud greatly influence a drilling operation. Drilling operations that penetrate formations with shale content have the potential to experience drilling problems related to shale hydration. To get a good ability to prevent shale hydration, mud is added with polymeric and polyamine KCl additives (shale inhibitors) with the aim of stabilizing shale in contact with drilling fluid, as well as preventing drill cuttings from forming colloids. The results obtained in the KCl polymer mud composition at temperatures of 80°F, 250°F, and 300°F for mud weight were 9.3 ppg, 9.1 ppg, and 9 ppg, respectively. Funnel viscosity was 40 sec/qt, 36 sec/qt, and 34 sec/qt. Tap rates were 4.8 cc, 6 cc, and 6.6 cc. Mud cake remained at 1 mm and pH also remained at 9. While the results obtained on polyamine mud composition at temperatures of 80°F, 250°F, and 300°F for mud weight were 9.2 ppg, 8.9 ppg, and 8.8 ppg, respectively. Funnel viscosity was 26 sec/qt, 20 sec/qt, and 17 sec/qt. Tap rate of 10 cc, 13.8 cc, and 15 cc. Mud cake of 1 mm, 2 mm, and 2 mm. pH remains at 9. The data obtained shows that the results of the physical properties of polymeric KCl mud are better than polyamine mud.

1. Introduction

People could not understand the term drilling mud in ancient times. Water was the only means of lifting drill shale or cutting. Then, as time went on, drilling technology has progressed. Drilling mud was first used to increase the success rate of a drilling operation. Determining the type and content of mud is critical for increasing the success and smoothness of a drilling operation. In this scenario, the appropriateness of the mud type and composition with the formation conditions to be drilled can reduce drilling costs . [1]–[3]

Drilling mud is crucial in a drilling process. Drilling that is fast, safe, and affordable is heavily determined by the circumstances and mud systems used. The condition under question here is how the mud's characteristics or rheology [4]. While the mud system referred to here is a specific sort of mud that must be used while taking into account formation and borehole conditions. Non-disperse KCl polymer muds must sustain or preserve the hydration and dispersion process of the drilled shale formation as much as feasible. The most typical method is to limit the quantity of water that reacts with the shale by blanketing the cutting formed by the shale with polymer as quickly as possible to avoid additional reactivity with water.[4], [5] It is possible to conclude that KCl polymer mud is a mud used to control chemical reactions in shale strata. Because the primary element is water, this mud is a sort of water base mud. This mud is most suited for use in formations with laminar shale, clay, and limestone rock types, as well as rocks with a high amount of sloughing shale and clay swelling. The most common mud system utilized in drilling is polymeric KCl mud. The technology is built around an anionic encapsulating polymer fluid, which encapsulates drill cuttings during hole cleaning. In water, KCl degrades into K^+ and Cl^- ions. K^+ ions will replace Na^+ ions in the stabilization of shale minerals. As a result, in plate shale, K^+ ions are bound much stronger than Na^+ ions with plate clay between clay and water, reducing the repulsion force between plate clay particles in water. The stronger the attraction between clay, the more water is released from the system. This is due to the fact that K^+ ions have a large atomic radius, which can close the shale microfracture and prevent water from entering the microfracture, reducing shale drying (hydration). [6]–[8]

The polyamine used is a quarternary ammonium salt that inhibits water absorption in shales and clays (water absorption) while also preventing dispersion (non dispersion). Polyamine is a shale inhibitor material that has many advantages over KCl, including its environmentally friendly nature. Since 1980, various polyamine research and development has been conducted, but it has not been able to completely replace the function of KCl as a shale inhibitor. [9], [10]

Because of its ability to stabilize clay when drilling through water-sensitive shale, polyamine is used in high-performance water-based drilling fluids. Wellbore stability has historically been a major concern during drilling operations due to the possibility of water-sensitive shale formations hydrating when in contact with aqueous drilling fluids. Clay hydration in water-sensitive formations causes wellbore degradation via two mechanisms: swelling and clay dispersion. Swelling of clay from the formation frequently results in hole tightening and increased pipe sticking, whereas dispersion frequently results in hole washout and shale weakening. [11], [12]

The purpose of this study was to compare the results of physical properties between KCl Polymer Mud Composition with Polyamine at Various Temperatures.

2. Method

This study was carried out at Universitas Trisakti’s Laboratory of Drilling and Production Engineering. The first step was to collect six mud samples. The first three samples are polymeric KCl mud compositions with the same material that will be tested at 80°F, 250°F, and 300°F. While the fourth through sixth samples are polyamine mud compositions containing the same materials that will be tested at temperatures of 80°F, 250°F, and 300°F, respectively. Fresh water is used in the polymer KCl mud composition. KOH is used to control the pH. As viscosifiers and water loss controllers, bentonite and pac-LV are used. It can also be used to make mud cakes because it controls water loss. As biopolymers and rheology modifiers, XCD and PHPA are used. [13], [14]

The main ingredient of mud, KCl polymer, is a shale inhibitor that can replace Ca^{2+} ions with K^+ ions. K-Soltex was developed as a shale inhibitor and to strengthen K^+ ions derived from KCl polymer. Barite can be used as a weighting agent or to increase density, thinner, fluid loss control, and dispersant with lignosulfonate. Finally, defoamer is used to reduce foaming. The ingredients in the polyamine mud composition are the same as those in the polymer KCl composition, except that the polymer KCl and K-Soltex ingredients are replaced with polyamine, which acts as a shale inhibitor. With the same ingredients, it will then be heated in the oven for 1 hour at temperatures of 80°F, 250°F, and 300°F, with a comparison of the results between the KCl polymer mud composition and polyamine. [15]–[17]

3. Result and Discussion

Laboratory research on the physical and rheological properties of drilling mud necessitates standardization of drilling mud properties that have become standard provisions of the research. This mud is produced in two systems: KCL and Polyamine. Table 1 shows the standard specification data for KCl and Polyamine mud at 80 ^{0}F, 250 ^{0}F, and 300 ^{0}F temperatures.

Table 1. Composition Comparison Results of Polymeric KCl Sludge with Polyamine.

Physical properties of mud	KCl Polimer			Polyamine			Unit
	80°F	250°F	300°F	80°F	250°F	300°F	
Mud Weight	9.3	9.1	9	9.2	8.9	8.8	ppg
Funnel Viscosity	40	36	34	26	20	17	sec/qt
Plastic Viscosity	20	17	15	14	10	8	cp
Yield Point	24	19	17	17	12	10	lbs/100 ft²
Apparent Viscosity	32	26.5	23.5	22.5	16	13	cp
600 RPM	64	53	47	45	32	26	-
300 RPM	44	36	32	31	22	18	-
200 RPM	40	33	28	27	18	15	-
100 RPM	35	29	24	23	13	11	-
6 RPM	20	14	11	10	7	5	-
3 RPM	16	11	8	7	5	3	-
Gel strength 10 seconds	16	11	8	7	5	3	lbs/100 ft²
Gel strength 10 minutes	26	20	16	14	10	6	lbs/100 ft²
Screening rate	4.8	6	6.6	10	13.8	15	cc
Mud cake	1	1	1	1	2	2	mm
pH	9	9	9	9	9	9	-

The density of mud is the mass per unit volume of mud that influences the buoyant effect on a solid particle; the higher the density of an object, the greater the mass per volume. A Mud Balance tool is used in laboratory research to determine density of mud. Figure 1 shows the results of measuring the density of KCL and Polyamine muds at various temperatures.

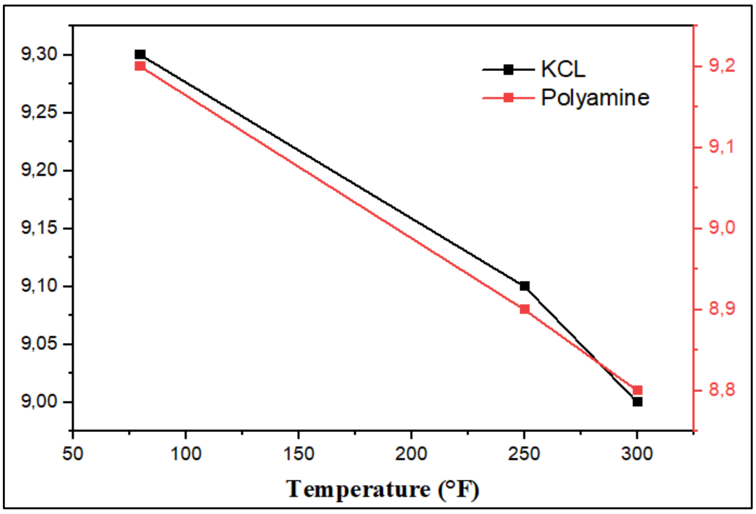

Figure 1. Mud weight of KCl and Polyamine.

The viscosity of the mud is critical in raising a drill shale (cutting) to the surface. The higher the viscosity in a mud, the easier it is to lift the drill flakes; however, as the viscosity decreases, the drill flakes become more difficult to separate from the cuttings. Viscosity is the resistance to mud flow during circulation, which can occur due to a shift between drill mud particles.

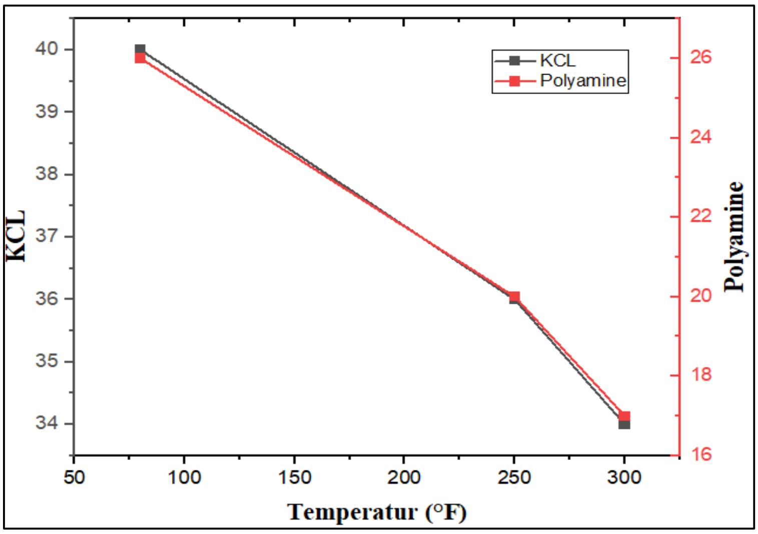

Figure 2. Funnel Viscosity of KCL and Polyamine.

Plastic viscosity is a flow resistance caused by friction between solids in mud, liquid solids, and friction between liquid layers. The following is the result of reading the Plastic Viscosity value with the Fann VG meter tool in Figure 3.

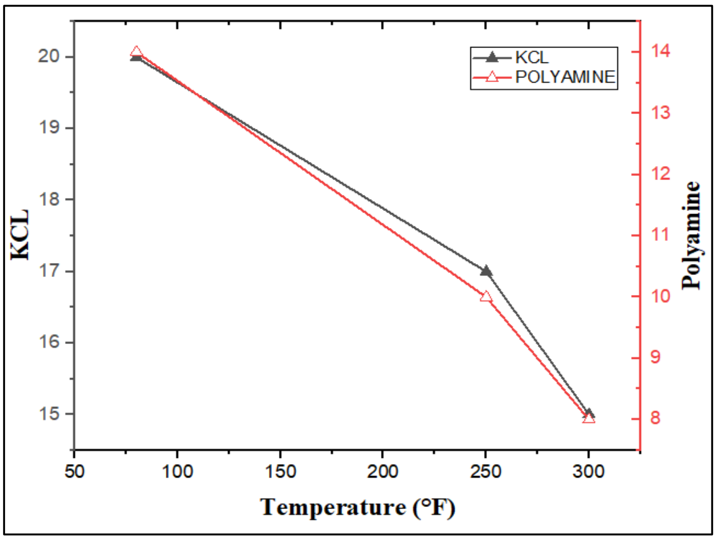

Figure 3. Plastic Viscosity of KCL and Polyamine.

Yield Point measures the attraction of solid particles in mud. Low yield points can lead to barite precipitation and poor hole cleaning. A high Yield Point, on the other hand, can result in increased circulation pressure, is difficult to stir in the tank, and has a tendency to retain gas in the mud. Figure 4 depicts the results of the Yield Point measurements of KCl and Polyamine muds at various temperatures.

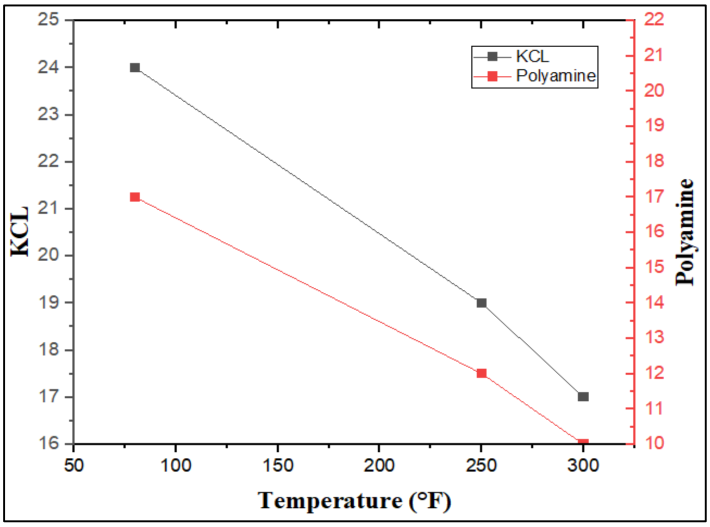

Figure 4. Yield point of KCL and Polyamine.

The gel strength of mud is a measure of its resistance to flow from a stationary state. When the mud is at rest or not circulating, the gel strength should be high enough to prevent cuttings from moving downward. Gel strength measurements are usually taken twice for standardization, once at the beginning of 10 seconds or right after sludge circulation is stopped and again after 10 minutes or right when circulation resumes. Figure 5: Gel strength value results after 10 seconds of calculation

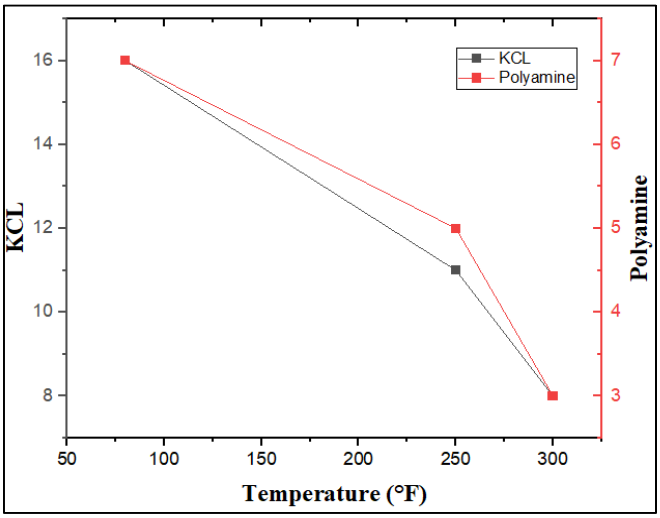

Figure 5. Gel Strenght 10 sekon of KCL and Polyamine.

Figure 6 depicts the results of the 10-minute gel strength calculation for the KCL and Polyamine sludge systems:

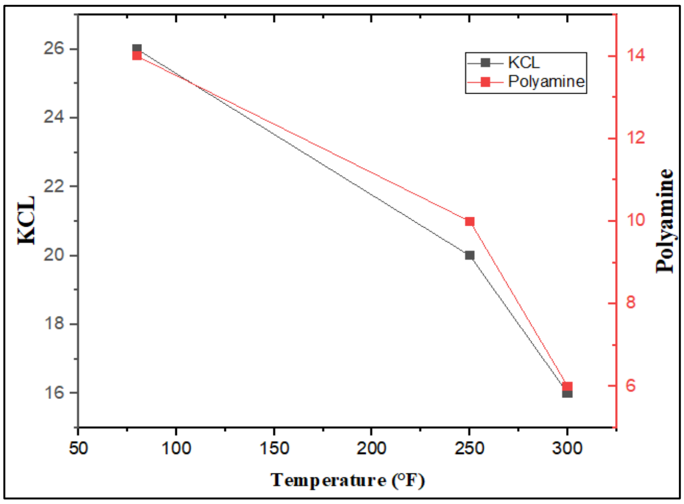

Figure 6. Gel Strenght 10 minute of KCL and Polyamine.

The rate of drilling mud filtering is made up of both solid and liquid components. Because the wellbore wall has pores in general, the mud's liquid component will enter the borehole wall. The sieve rate is an indication of the amount of liquid entering the formation that is affected by temperature, pressure, and solids. The invaded zone is the area infiltrated by mud, while the incoming liquid is known as the filtrate.

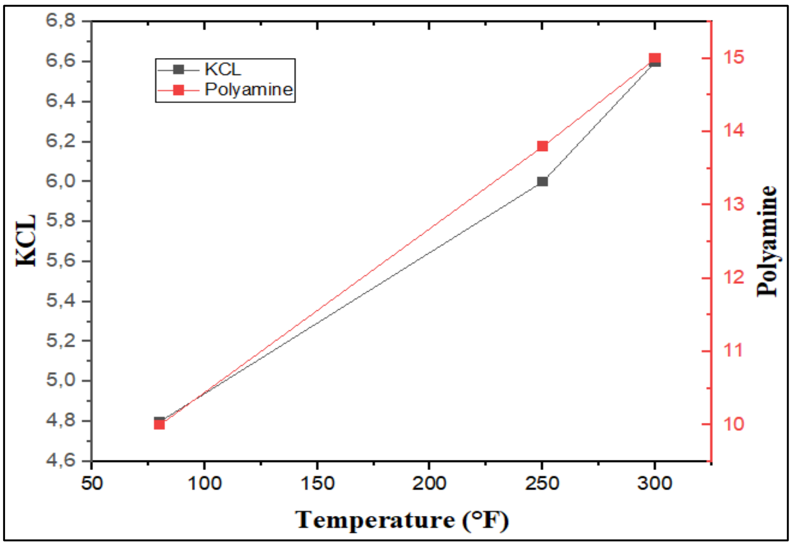

Figure 7. Water loss of KCL and Polyamine.

The sieve rate's goal is to form a mud cake on the borehole wall. A good mud cake is thin to reduce the possibility of pinching the drill pipe, strong to help stabilize the borehole, and solid to ensure that the filtrate that enters the formation is not excessive. A good mud cake is thin to reduce the possibility of pinching the drill pipe, strong to help stabilize the borehole, and dense to ensure that the filtrate that enters the formation is not excessive. Thick mud cake will clamp the drilling pipe, making it difficult to lift and rotate, while the filtrate that enters the formation will damage the formation and can cause damage to the formation.

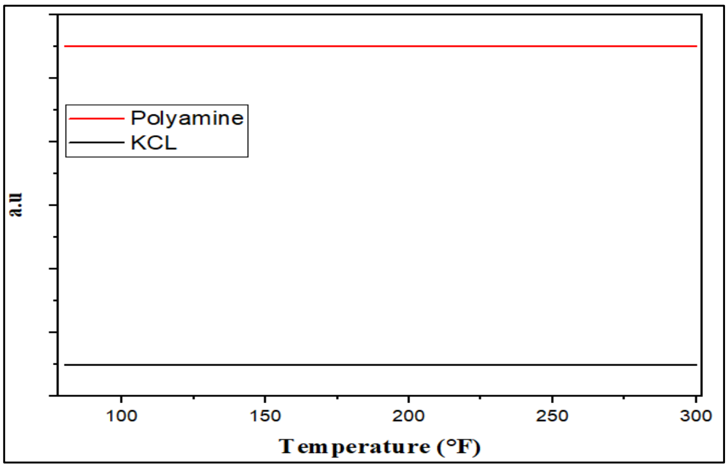

Figure 8. Mud cake of KCL and Polyamine.

4. Conclusion

The following conclusions can be drawn based on the findings of the research data:

1. When the composition of polymeric KCl sludge and polyamine is compared, the physical properties of polymeric KCl sludge are better than polyamine because, on the one hand, KCl is a polymer. However, if you want to use a more environmentally friendly mud, polyamine can be used.
2. The mud weight results for the KCl polymer mud composition at temperatures of 80°F, 250°F, and 300°F were 9.3 ppg, 9.1 ppg, and 9 ppg, respectively. The funnel viscosity was 40 sec/qt, 36 sec/qt,

and 34 sec/qt. Plastic viscosities of 20 cp, 17 cp, and 15 cp. Yield points of 24 lbs/100 ft^2, 19 lbs/100 ft^2, and 17 lbs/100 ft^2. Gel strength 10 seconds of 16 lbs/100 ft^2, 11 lbs/100 ft^2, and 8 lbs/100 ft^2. Gel strength after 10 minutes was 26 lbs/100 ft^2, 20 lbs/100 ft^2, and 16 lbs/100 ft^2. The slick rates were 4.8 cc, 6 cc, and 6.6 cc. The mud cake remained at 1 mm, and the pH remained at 9.

3. For mud weight, the results for polyamine mud composition at 80°F, 250 °F, and 300 °F were 9.2 ppg, 8.9 ppg, and 8.8 ppg, respectively. The funnel viscosity was 26 sec/qt, 20 sec/qt, and 17 sec/qt, respectively. 14 cp, 10 cp, and 8 cp plastic viscosity. Yield points of 17 lbs/100 ft^2, 12 lbs/100 ft^2, and 10 lbs/100 ft^2 are available. Where the yield point must be greater than the plastic viscosity in order for the mud to lift the cutting to the surface. 10 seconds of gel strength of 7 lbs/100 ft^2, 5 lbs/100 ft^2, and 3 lbs/100 ft^2. 10 minutes of gel strength of 14 lbs/100 ft^2, 10 lbs/100 ft^2, and 6 lbs/100 ft^2.

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