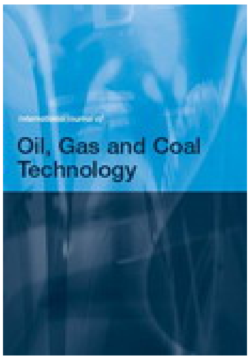

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Abstract: In the Dabei oil and gas field, addressing wax deposition in condensate gas reservoirs is crucial. By analysing field-obtained samples with varied wax contents (7%, 12%, 19%, 28%) using the HPVT-150 PVT instrument, we observed minimal changes in flash steam composition but notable enrichment in flash oil components and increased condensate oil densities. Higher wax content led to an increased flash gas-to-oil ratio, dew point pressure, and reverse condensate saturation, impacting heavy hydrocarbons. Recovery efficiency of condensate oil decreases with higher wax content and abandonment pressure at 10MPa. These findings are pivotal for developing high-wax condensate reservoirs. [Received: July 24, 2024; Accepted: March 3, 2025]

Keywords: condensate gas reservoir; wax content; dew point pressure; phase behaviour.

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1 Introduction

The exploration and exploitation of condensate gas reservoirs, nestled within the larger context of hydrocarbon resources, have long been confronted with the pervasive challenge of wax deposition (Nichita et al., 2001). This phenomenon, though fundamentally altering the flow dynamics of extraction systems, is intricately tied to the complex interplay of thermodynamic and kinetic factors – an aspect that often escapes superficial discussions (Hoteit et al., 2008). The scientific community has progressively unraveled the subtleties of wax formation mechanisms, identifying it as a critical impediment influencing operational efficiency, economic viability, and necessitating technological innovations in prevention strategies (Cao et al., 2022).

In the Tarim Basin, the Dabei oil and gas field stands as a pivotal contributor to China's West-to-East gas project, boasting abundant condensate gas resources. These reservoirs, poised at the interface of traditional oil and gas deposits, pose unique extraction hurdles, primarily due to the propensity for wax accumulation under varying thermal and pressure gradients (Wang et al., 2019). Despite advancements in predictive models for wax appearance and accumulation, the comprehensive understanding of how differing wax contents influence reservoir phase behaviour and, consequently, extraction efficiency remains an area warranting deeper investigation.

This study aims to bridge this knowledge gap by focusing on the precise impact of wax content variability on the phase behaviour of condensate gas reservoirs in the strategic Dabei area. By meticulously examining the underlying physical and chemical processes governing wax deposition, our research seeks to clarify how these dynamics shape key parameters such as dew point pressure, flash separation characteristics, and the recoverability of condensate (Yang et al., 2021). The investigation employs a rigorous experimental approach, utilising high-pressure, full-temperature PVT analyses to simulate real-world reservoir conditions and elucidate the intricate relationship between wax content and reservoir performance (Jennings and Weispfennig, 2005).

Through this meticulous inquiry, we aspire to offer a robust dataset that can inform more efficient mitigation strategies against wax-related challenges, thereby enhancing production outputs, ensuring economic profitability, and advancing the technological frontier in condensate gas management (Meray et al., 1993). The findings are poised to contribute significantly to the global discourse on optimising condensate reservoir exploitation, underscoring the practical implications of our research within the broader energy sector (Yong et al., 2021).

2 Methods

2.1 Geological characteristics of the study area

Condensate gas reservoirs are a mixture of crude oil and natural gas, which appears as a single gas phase in underground high-temperature and high-pressure conditions. As it was mined out of the ground, the liquid hydrocarbons are reversed to form gas-liquid two-phase with the decrease of the temperature and pressure (Liu et al., 2022). As the pressure and temperature decrease during production, the originally gaseous hydrocarbons undergo a phase change, or 'reverse' their state from a single gas phase to a mixture of gas and liquid phases. This is commonly known as retrograde condensation, where heavier hydrocarbon components that were in a gaseous state underground condense into liquid, leading to the formation of a gas-liquid two-phase system in the wellbore and production facilities. The primary condensate gas reservoir refers to that have been migrating and accumulating in the gas phase state after the condensate gas is formed. Tarim Basin is rich in extensive ultra-deep condensate oil and gas reservoirs resources, which are distributed in the platform basin area, paleo-uplift surrounding area and foreland basin, with burial depths generally exceeding 7 Km. In the Dabei area on the northern slope of Tazhong, the condensate oil and gas reservoirs resources are abundant, and the proven condensate oil reserves have reached 4.8×10^7t (Shen et al., 2022).

Condensate gas reservoirs are mainly distributed in the Ordovician, and the drilling result shows that the heavy oil reservoirs, medium oil reservoirs, light oil reservoirs, volatile oil reservoirs and condensate gas reservoirs are distributed on the horizontal plane, and the density of crude oil is gradually getting smaller from northwest to southeast. The Dabei condensate oil and gas reservoir has the characteristics of large burial depth, good source-reservoir-caprock combination and late formation of primary oil and gas reservoirs. It has a hot basin in the early stage and a cold basin in the late stage. The structure is relatively stable, and the geothermal gradient is low. The study area develops marine source rocks, which are characterised by large burial depth, high pressure, and low geothermal gradient. With continuous large-scale hydrocarbon generation and expulsion capabilities, it is an effective source rock for ultra-deep condensate oil and gas reservoirs (Gambelli et al., 2021).

This article selects the condensate oil and separator gas obtained from the surface separator of Well A in the Dabei condensate gas field. The testing temperature at the sampling spot is 15°C, the pressure is 15 MPa, and the gas-oil ratio is $2.54 \times 10^3 m^3/m^3$. Table 1 outlines the composition of various gas components found in Well A of the Dabei oilfield, focusing on differing levels of wax content. The table presents data in terms of molar percentages for components like carbon dioxide (CO_2), nitrogen (N_2), methane (C_1), ethane (C_2), propane (C_3), and other hydrocarbons up to C_{11+}. As the wax content in the condensate oil rises from 7% to 28%, subtle shifts occur in these components. Notably, while CO_2 and N_2 amounts fluctuate slightly, the proportions of heavier hydrocarbons, starting from C_2 onwards, generally increase with increasing wax content. Additionally, the table reflects how the presence of more wax leads to a gradual rise in the density of condensate oil and a higher ratio of flash gas to oil.

Table 1 The condensate oil components of Dabei Well A

Component	*Molar mass (mol%)*	*Component*	*Molar mass (mol%)*	*Component*	*Molar mass (mol%)*
C_2	0.0003	C_{12}	8.2540	C_{24}	1.7147
C_3	0.0016	C_{13}	6.7210	C_{25}	1.5276
iC_4	0.0056	C_{14}	8.5290	C_{26}	1.1862
nC_4	0.0144	C_{15}	6.2654	C_{27}	1.1130
iC_5	0.0669	C_{16}	5.6442	C_{28}	0.8046
nC_5	0.0704	C_{17}	4.8326	C_{29}	0.6320
C_6	0.6271	C_{18}	4.3167	C_{30}	0.4659
C_7	3.9753	C_{19}	3.9792	C_{31}	0.3154
C_8	7.2326	C_{20}	3.2100	C_{32}	0.4599
C_9	7.2648	C_{21}	2.6767	C_{33}	0.2379
C_{10}	6.6918	C_{22}	2.3024	C_{34}	0.2357
C_{11}	6.5018	C_{23}	2.1230		

Table 2 The separator gas components of Dabei Well A

Component	*Molar mass (mol%)*	*Component*	*Molar mass (mol%)*
CO_2	0.2207	iC_4	0.1266
N_2	0.6197	nC_4	0.1549
C_1	94.5684	iC_5	0.0689
C_2	3.5162	nC_5	0.0539
C_3	0.6375	C_6	0.0331

Table 2 shows the separator gas components of Dabei Well A. The paraffin carbon number of the condensate gas reservoir is between 16 and 60, of which the coarse crystalline wax carbon is 16~30, the microcrystalline wax carbon is 31~60, and the proportion of components above C_{16} exceeds 37.98%, the separator gas group Methane accounts for approximately 95% (Chen et al., 2023). Table 3 shows the wax, resin and asphaltene contents in the Dabei condensate by using gas chromatography to test the basic properties of condensate oil. According to the crude oil wax content classification standard, the sampling condensate oil is a high wax content oil, and in the condensate oil samples obtained from the surface wellhead or separation, some wax has precipitated in the wellbore, which more likely caused wax precipitation in the wellbore with the pressure and temperature decrease (Zhang et al., 2021).

Table 3 The wax, resin and Asphaltene contents in the Dabei condensate

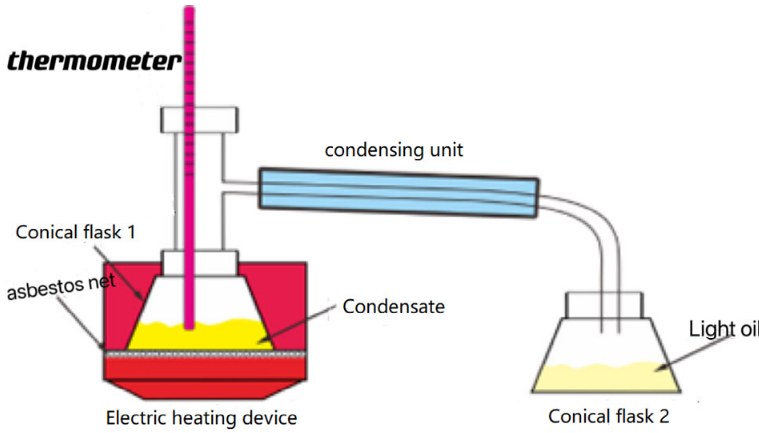
Sampling temperature (℃)	*Wax content* (%)	*Resin content* (%)	*Asphaltene content* (%)
53~55	13.7	5.86	0.06

2.2 Experimental method

This paper studied the effects of different wax contents on the phase behaviour of condensate gas reservoirs. The condensate sample taken from the separator is used to reduce and increase the wax content by adding the existing light oil or high wax condensate oil to the oil sample, while keeping the gas-oil ratio unchanged (Dong et al., 2022). Figure 1 shows the preparation process of the condensate oil sample. The condensate oil is put into the Erlenmeyer flask 1 and gives uniform heating by placing an asbestos net. Start the electric heating device and control the temperature, allowing the light oil in the condensate to enter the Erlenmeyer flask 2 through distillation, and finally leave the high-wax condensate in the Erlenmeyer flask 1; Mix the high-wax condensate oil with the condensate oil taken from the separator according to a certain proportion. According to the wax, colloid, and asphaltene contents in the condensate oil in Table 3, test the wax content of the mixed condensate oil and prepare the wax-containing condensate oil samples with contents of 7%, 12%, 19%, and 28%. Condensate oil samples with different wax contents and separator gas samples were compounded to obtain condensate gas well flow samples with different wax contents (Tian et al., 2022).

After the sample preparation, the oil and gas phase behaviour of different wax contents were tested by using the HPVT-150 high-pressure full-temperature PVT instrument. Experiments include dew point pressure, constant mass expansion, degassing and equilibrium condensate wax precipitation and so on. Using high-precision computer-controlled motors, degassed condensate oil is obtained through flash evaporation separation under high-precision conditions. The equilibrium condensate oil is separated during constant mass expansion and decompression, and the test data of condensate flash, constant mass expansion and constant volume depletion experiment can be obtained. Install a high-pixel camera on the PVT instrument to accurately test the bubble point or dew point, reverse the relationship between condensate volume and volume, automatically record the phase changes of the formation fluid under different temperatures and pressures, and test the change of infrared light intensity passing through the fluid through the change of infrared light intensity, which obtained a more accurate data on bubble point or dew point pressure (Yu et al., 2023).

Figure 1 Condensate oil preparation flow chart (see online version for colours)



Condensate oil flash test is an experimental method used to determine the flash point of condensate oil. The experimental process is as follows: prepare flash point instrument, closed cup flash point reagent, thermometer and so on, pour 100 ml of condensate oil sample into the flash point reagent cup. Keep the experimental environment safe and clean and avoid contamination from other impurities; Put the flash point reagent cup into the flash point metre, insert the thermometer into the cup, and start heating at 3°C per minute. When the sampling temperature is close to the flash point, observe whether there is flash or flame on the surface of the sample; When a flash or flame occurs in the sample, record the temperature at the moment, which is the flash point of the condensate oil. Record the flash point temperature obtained in the experiment, and based on the flash point temperature, the volatility and fire hazard of the condensate oil can be judged (Choudhary and Phirani, 2022).

The condensate oil constant expansion experiment is used to determine the volume expansion coefficient of condensate oil under certain temperature and pressure conditions. The experimental process is as follows: prepare thermostatic water bath device, sampling container, thermometer, pressure gauge, pour 50ml of prepared condensate sample into the sampling container, put the sampling container into thermostatic water bath, and set the required temperature and pressure conditions. The temperature is set in the range of 30–200°C, and the pressure is regulated by the air pressure in the water bath or the pressure control device; When the sample reaches a constant temperature and pressure after standing for a period of time, use a thermometer to measure the temperature of the sample, and use a volumeter or others measuring equipment to measure the volume of the sample under constant conditions, use a pressure gauge to measure the pressure of the sample; Based on the sample volume and temperature data obtained from the experiment, the volume expansion coefficient of the condensate oil is calculated. The volume expansion coefficient can be the ratio of the volume change of the sample to the temperature change (Sun et al., 2022).

The condensate oil constant volume depletion experiment is an experiment used to simulate the oil production process in the reservoir development. The experimental process is as follow: prepare thermostatic water bath device, sampling container, pressure gauge, products liquid collector, pour 50 ml condensate oil sample into the sampling container, put the sampling container into the thermostatic water bath, and set the required temperature and pressure conditions; When the sample reaches a constant temperature and pressure, use a pressure gauge to measure the initial pressure of the sample. After the experiment starts, control the switch of the liquid collector to gradually reduce the pressure in the sampling container and measure the pressure of the sample regularly. When the pressure of the sample drops to the setting minimum pressure, stop the experiment, and record the pressure and liquid production at the moment; according to the liquid production rate and pressure data obtained in the experiment, the liquid production rate and output of condensate oil were calculated (Chen et al., 2022).

3 Results

Through single flash evaporation, dew point test, equal composition expansion, constant volume depletion and other PVT phase state tests, the gas recovery rate, condensate oil recovery rate, condensate oil saturation, volume coefficient and other parameters under different pressures are tested. Perform a single flash evaporation test on the formation condensate gas sample under the original formation conditions at constant pressure, measure the single degassing and single deoiling, and perform chromatographic analysis on the single deoiling and single degassing to obtain the formation well flow material composition (Chen et al., 2021).

3.1 Single flash experiment results

Through a single flash experiment on condensate oil samples with different wax contents, the components of flash gas, flash oil and well fluid were obtained (Tables 4–6). It can be seen from the table that as the wax content increases, the contents of C_1 and C_2 in the flash gas component are the highest, but each component has minimal changes; The content of C_{10} and C_{11+} in the flash oil component is the highest, and the content of each component is increasing; The contents of C_1 and C_2 in the well fluid components are the highest, and the contents of each component are increasing. In the flash gas, C_1 and C_2 maintain their dominance, with minimal variations in their respective mol% as wax content rises. Meanwhile, in the flash oil (Table 5), the mol% of heavier components (C_{10}, C_{11+}) do show an increase with increasing wax content, reflecting a shift in the composition towards heavier fractions. Figure 2 shows the condensate density and flash oil ratio for different wax contents. It can be seen from Figure 2 that as the wax content increases, the density of condensate oil gradually increases, and the ratio of flash gas to oil also increases, which is mainly due to the fact that in the flash evaporation experiment, as the wax content in the condensate oil increases, the probability of wax precipitation increases, resulting in an increase in the density of the condensate oil. At the same time, due to the increased temperature, the volatilisation of the condensate oil increases the components will evaporate out, resulting in an increase in the flash oil ratio (Sun et al., 2023).

Table 4 Flash gas components of Well Dabei A with different wax contents (mol%)

Component	*Wax content (%)*			
	7	*12*	*19*	*28*
CO_2	0.2314	0.2227	0.2096	0.2207
N_2	0.6664	0.6750	0.5407	0.6522
C_1	94.4076	94.3394	94.9195	94.4707
C_2	3.5832	3.6553	3.3263	3.5828
C_3	0.6503	0.6591	0.6004	0.6428
iC_4	0.1330	0.1297	0.1188	0.1265
nC_4	0.1636	0.1573	0.1443	0.1534
iC_5	0.0741	0.0678	0.0628	0.0661
nC_5	0.0559	0.0517	0.0479	0.0505
C_6	0.0345	0.0421	0.0298	0.0342

Table 5 Composition of flash oil at different wax contents in Well Dabei A (mol%)

Component	*Wax content (%)*			
	7	*12*	*19*	*28*
C_2	0.0072	0.0080	0.0134	0.0088
C_3	0.0032	0.0048	0.0053	0.0032
iC_4	0.0041	0.0047	0.0062	0.0056
nC_4	0.0092	0.0087	0.0108	0.0088
iC_5	0.0112	0.0108	0.0121	0.0119
nC_5	0.0121	0.0108	0.0116	0.0148
C_6	0.0809	0.1067	0.1011	0.2183
C_7	0.3776	0.5640	0.5221	0.6792
C_8	1.3855	1.7853	1.4719	1.3776
C_9	3.0436	2.8757	2.3652	2.1537
C_{10}	5.2637	4.1490	3.4563	3.4169
C_{11+}	89.8018	90.4715	92.0240	92.1012

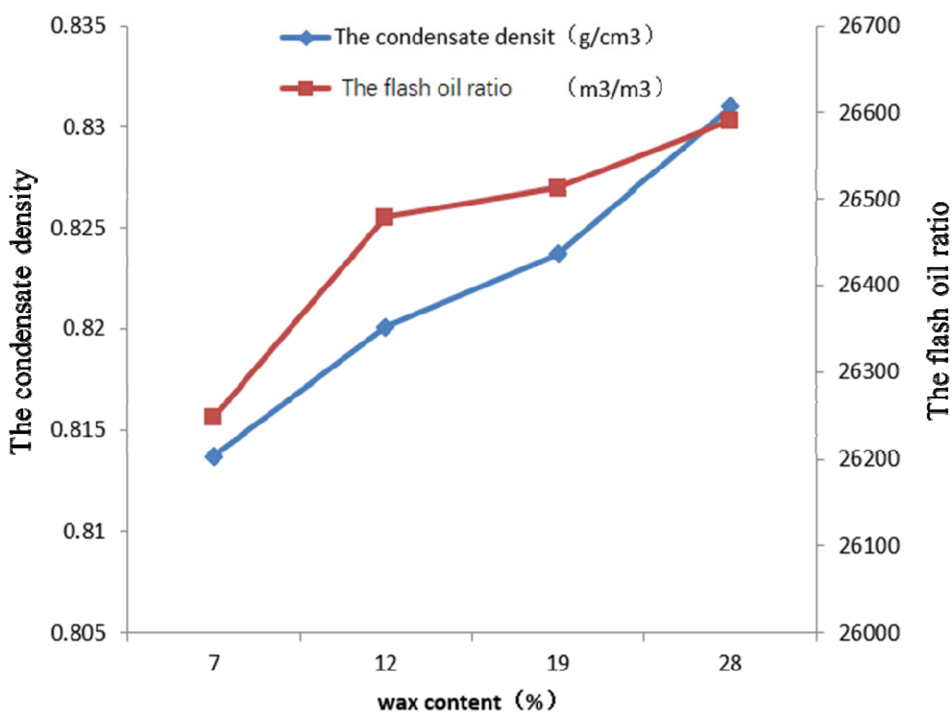
Table 6 Well flow components with different wax contents in Dabei Well A (mol%)

Component	*Wax content (%)*			
	7	*12*	*19*	*28*
CO_2	0.2306	0.2219	0.2089	0.2200
N_2	0.6638	0.6726	0.5388	0.6500
C_1	94.0508	94.0049	94.5930	94.1515
C_2	3.5698	3.6425	3.3152	3.5710
C_3	0.6479	0.6568	0.5984	0.6407
iC_4	0.1325	0.1293	0.1185	0.1261
nC_4	0.1631	0.1568	0.1439	0.1530

Table 6 Well flow components with different wax contents in Dabei Well A (mol%) (continued)

Component	*Wax content (%)*			
	7	*12*	*19*	*28*
iC_5	0.0739	0.0677	0.0627	0.0660
nC_5	0.0558	0.0516	0.0478	0.0505
C_6	0.0351	0.0428	0.0305	0.0360
C_7	0.0029	0.0044	0.0041	0.0053
C_8	0.0096	0.0124	0.0102	0.0096
C_9	0.0187	0.0176	0.0146	0.0133
C_{10}	0.0292	0.0230	0.0192	0.0191
C_{11+}	0.3162	0.2956	0.2942	0.2878
$\rho(C_{11+})$	0.8390	0.8477	0.8506	0.8540
$M(C_{11+})$	210.99	227.22	232.99	239.75

Figure 2 The condensate density and flash oil ratio for different wax contents (see online version for colours)



3.2 Dew point pressure test results

The formation temperature of the condensate gas reservoir in Well Dabei A is 117°C, and the formation pressure is 91 MPa. The dew point pressure test was carried out on the well fluid samples with different wax contents, and the pressure and temperature of the dew point at the wax contents were obtained by using the step-by-step depressurisation approximation method (Table 7). Based on the experimental data, Figure 3 shows the dew point pressure of well flow with different wax contents at 117°C. It can be seen from Table 7 and Figure 3 that as the wax content of the gas condensate reservoir increases, the pressure of the dew point also increases, which is mainly because the solidification of the overall gas condensate increases with the increase of the wax content. When the pressure decreases to a certain level, the wax in the condensate gas begins to solidify to form a solid phase, causing the dew point pressure of the condensate gas to increase (Liu et al., 2023). Subsequently, other analysis methods can be used to optimise the results, and the improved Grey Wolf optimisation algorithm (MGWO) with multi-objective constraints can calculate the optimal QP with the minimum substitution value and the shortest time (Bansal et al., 2020). Many optimisation problems have been solved using a meta-heuristic technique (Kumar et al., 2018). It generates query plans to better balance latency and cost (Kumar et al., 2019; Mishra et al., 2024).

The relationship between the dew point pressure (Pd) and the wax content (wt) was obtained by linear fitting equations (1)~(3), when the wax content increased by 1%, the dew point pressure increased by about 0.2305~0.2868°C.

$$pd = 0.2305wt + 51.262(106.78°C) \tag{1}$$

$$pd = 0.2586wt + 50.172(116.78°C) \tag{2}$$

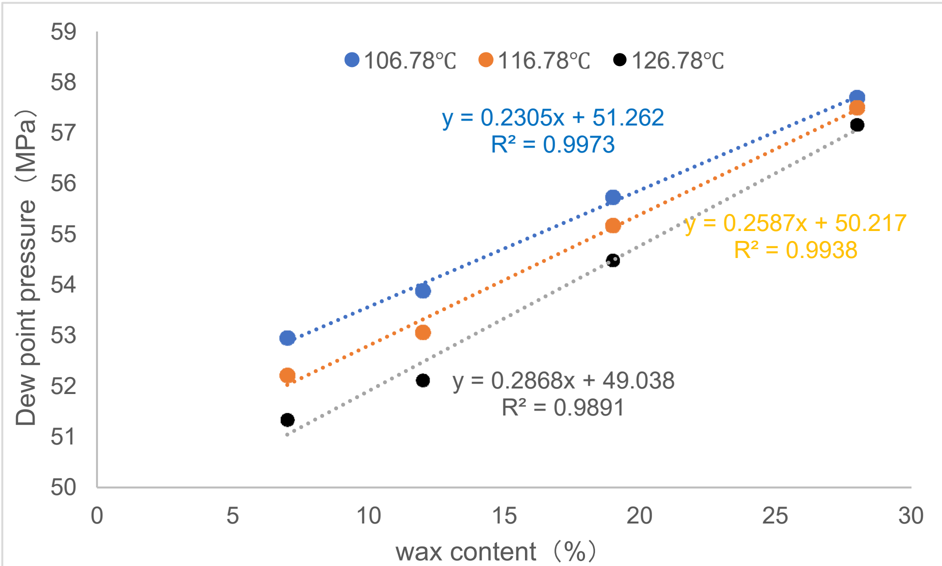
$$pd = 0.2868wt + 49.038(126.78°C) \tag{3}$$

The changes of wax content and dew point pressure at different temperatures are linear.

Table 7 Dew point pressure and temperature under different wax contents

Sample number	*Wax content (%)*			
	7		*12*	
	Temperature (℃)	*Measured dew point (MPa)*	*Temperature (℃)*	*Measured dew point (MPa)*
1	106.78	52.95	106.78	53.88
2	116.78	52.21	116.78	53.06
3	126.78	51.33	126.78	52.11
Sample number	*Wax content (%)*			
	19		*28*	
	Temperature (℃)	*Measured dew point (MPa)*	*Temperature (℃)*	*Measured dew point (MPa)*
1	106.78	55.73	106.78	57.70
2	116.78	55.17	116.78	57.50
3	126.78	54.48	126.78	57.16

Figure 3 Dew point pressure of well fluid with different wax content (see online version for colours)



3.3 Constant mass expansion experiment

By conducting constant mass expansion experiments on well fluid samples with different wax contents at 117°C, the constant mass expansion experimental results of the samples were obtained. It can be concluded that the as the wax content increases, the relative volume of the well fluid has minimal changes. At the same time, the expansion capacity of the formation condensate gas fluid is close to that of the formation condensate gas fluid, and the deviation coefficient and volume coefficient also have minimal changes. Figure 4 shows the amount of reverse condensate for fluids with different wax contents. It can be seen that as the wax content increases, the saturation of the formation fluid reverse condensate continues to increase, which indicates that the increase of wax content intensifies the reverse condensate of heavy hydrocarbon components. This is mainly because with the increase of wax content, the light hydrocarbon components in the formation fluid decrease, leading to the increase in the saturation of reverse condensate.

3.4 Experimental results of constant volume depletion

By conducting constant volume depletion experiments on well flow samples with different wax contents, the constant volume depletion results under formation temperature were obtained. Table 7 shows the saturation of reverse condensate fluids with different wax contents. It can be seen that as the wax content of the sample increases, the pressure gradually increases, the saturation of the reverse condensate liquid increases, and the reverse condensation effect of the heavy hydrocarbon components becomes stronger. The condensate saturation is generally less than 1.25%, which has a certain impact on seepage. At the same time, the equilibrium gas phase deviation coefficient in the production well flow material with little change.

Figure 4 Reverse condensate volume of fluids with different wax content (see online version for colours)

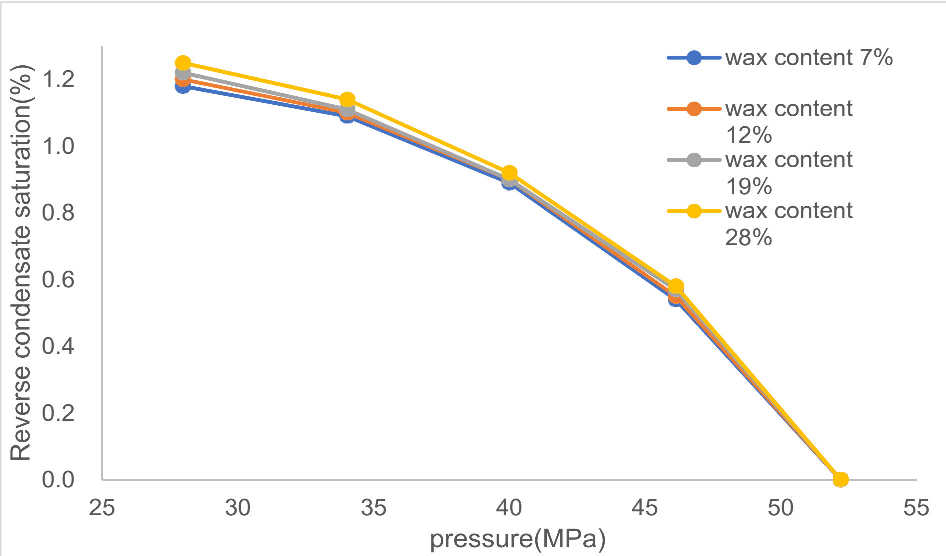
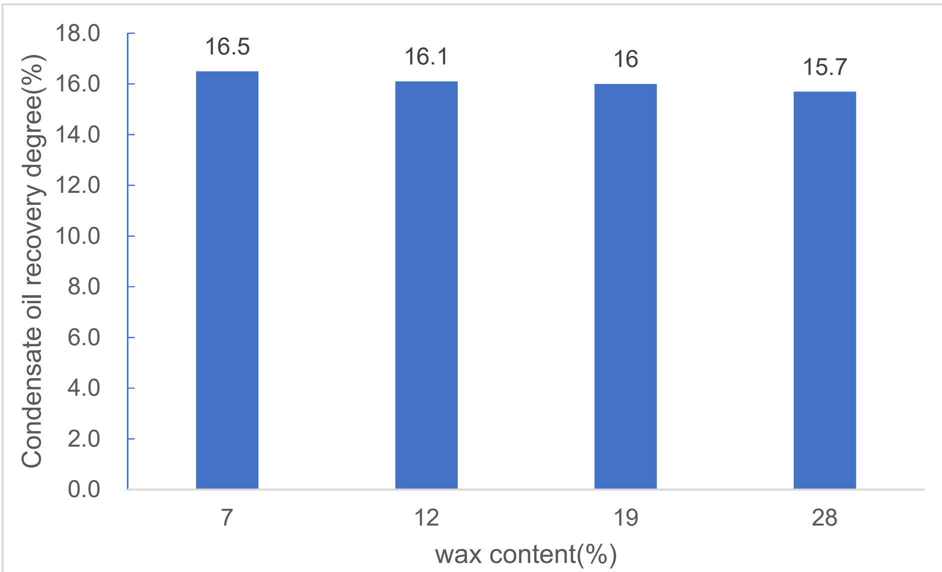


Table 7 Reverse condensate saturation of fluids with different wax contents

Number	*Wax content (%)*			
	7		*12*	
	Pressure (MPa)	*Anti-condensate liquid volume (%)*	*Pressure (MPa)*	*Anti-condensate liquid volume (%)*
1	52.21	0.00	53.06	0.00
2	46.14	0.54	47.08	0.55
3	40.00	0.89	41.00	0.90
4	34.02	1.09	35.02	1.10
5	27.96	1.18	28.95	1.20
Number	*Wax content (%)*			
	19		*28*	
	Pressure (MPa)	*Anti-condensate liquid volume (%)*	*Pressure (MPa)*	*Anti-condensate liquid volume (%)*
1	55.17	0.00	57.50	0.00
2	48.88	0.57	51.00	0.58
3	43.18	0.90	45.01	0.92
4	37.26	1.11	39.00	1.14
5	31.00	1.22	33.02	1.25

Figure 5 shows the degree of condensate oil recovery with different wax contents. When the abandonment pressure is 10 MPa, the degree of condensate oil recovery gradually decreases as the wax content increases. The reason is that the pressure decreases during the constant volume depletion process, more heavy hydrocarbon components in the condensate gas with high wax content are reversely condensed, which aggravates the loss of formation reverse condensate oil, leading to condensate oil loss leading to a reduction in the degree of condensate oil recovery. The wax content has little effect on the recovery rate of condensate oil.

Figure 5 Condensate oil recovery degree with different wax content (see online version for colours)



4 Conclusions

The study aimed to investigate the impact of different wax contents on the phase behaviour of the condensate gas reservoir in the Dabei oil and gas area, with a particular focus on addressing wax deposition issues crucial for effective wellbore and pipeline management. Our findings provide a comprehensive understanding of the underlying mechanisms governing wax behaviour and its implications for reservoir exploitation. Key conclusions, derived from extensive experimental analyses, can be summarised as follows:

Condensate samples with different wax content (7%, 12%, 19% and 28%) were prepared and PVT phase experiments were carried out. The increase of wax content has little effect on flash components, but will increase the content of heavier hydrocarbons in flash oil. With the increase of wax content, the reverse condensate saturation is still very low (generally $<$ 1.25%). During the constant volume depletion process, with the decrease of pressure, the higher wax content aggravates the reverse condensation of heavy hydrocarbons and decreases the recovery rate of condensate. A linear correlation was established between dew point pressure and wax content, indicating that the dew point pressure would increase about 0.2305–0.2868 MPa for every 1% increase in wax content. In the development of high wax condensate gas reservoirs, accurate wax content prediction and control strategies are needed. Future research should focus on developing advanced wax precipitation prediction models and exploring new approaches to mitigate wax-related flow assurance challenges; The results have not yet been applied. It is suggested that the intervention of wax behaviour should be included in the production management strategy. Examples include optimising depletion rates and the use of wax inhibitors to increase oil recovery and reduce operational downtime.

In conclusion, this study contributes to a deeper understanding of wax behaviour in condensate gas reservoirs, laying a foundation for more efficient and sustainable resource exploitation. Recognising the limitations in fully elucidating the complex interplay between wax content and reservoir dynamics, we propose that future studies delve into the micro-scale mechanisms of wax deposition and explore innovative mitigation technologies, aligning with industry needs for enhanced oil recovery and pipeline integrity.

Declarations

The datasets used during the current study available from the corresponding author on reasonable request. The authors declare that they have no conflicts of interest. This work was not supported by any funds.

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