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Wax Deposition Study

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Abstract

Wax deposition is a serious field problem encountered during crude oil production that causes plugging of pipeline, well tubing and process equipment. Wax crystals lead to oil high viscosity and decreased pumping capacity. This work aims to investigate wax deposition in flow lines. This may include; effect of oil ambient temperature, insulation thickness and time duration on wax deposition rate in pipelines. Two computer software HYSYS and PVTSIM were used to estimate wax deposition. The obtained results show that wax deposition can be predicted with good accuracy with computer software.

Keywords: Wax deposition; pipe wax build-up; pipeline problems.

1. Introduction

Wax deposition is mainly a problem in pipelines, production equipment and in wells. Deposited wax in pipelines may cause increased pressure drop, decreased production and clogged pipes. It may also damage production equipment or make it less efficient. When oil is cooled below a certain temperature, wax will start to precipitate. This temperature is called the wax appearance temperature (WAT), and is normally found around 30 - 40°C [1].

2. Estimation of Wax Deposition

Two waxy crude composition were selected [2] to estimate wax deposition rate in pipelines at different ambient temperature, insulation thickness and time duration By using Two software (HYSYS and PVTSIM).

3. Pipe line conditions

Table 3.1 below shows conditions of oils and pipe lines used in this work to investigate wax deposition in flow lines. Tables 3.2 and 3.3 show the composition of oil.

Table 3.1: Conditions of oils and pipe lines

Oil Number	1	2
Pipe Length (Km)	100	100
Pipe Diameter (Inch)	16	16
Inlet Pressure (Bar)	25	25
Inlet Temp. (°C)	31	31
Flow Rate Barrel/Day	30000	30000

4. Results

4.1. Effect Ambient Temperature on Wax Deposition

4.1.1. Using Hysys Software

Figure4.1 shows the wax deposition at different ambient temperature (10 °C, 15°C and 20°C) .

Table 3.2: Composition of oil

Com	mol%	Mwt	Com	mol%	Mwt
C_4	0.03	58	C_{26}	1.107	366
C_5	3.221	72	C_{27}	0.967	380
C_6	5.205	86	C_{28}	0.588	394
C_7	1.745	100	C_{29}	0.658	408
C_8	1.516	114	C_{30}	0.359	422
C_9	1.356	128	C_{31}	0.359	436
C_{10}	2.353	142	C_{32}	0.249	450
C_{11}	17.561	156	C_{33}	0.289	464
C_{12}	10.491	170	C_{34}	0.269	478
C_{13}	8.885	184	C_{35}	0.219	492
C_{14}	6.99	198	C_{36}	0.17	506
C_{15}	6.452	212	C_{37}	0.12	520
C_{16}	4.876	226	C_{38}	0.07	534
C_{17}	3.919	240	C_{39}	0.06	548
C_{18}	3.52	254	C_{40}	0.15	562
C_{19}	3.5	268	C_{41}	0.05	576
C_{20}	2.722	282	C_{42}	0.02	590
C_{21}	2.214	296	C_{43}	0.01	604
C_{22}	2.134	310	C_{44}	0.0239	618
C_{23}	1.964	324	C_{45}	0.02	632
C_{24}	1.416	338	C_{50}	0.027	702
C_{25}	1.416	352	C_{60}	0.289	842

Table 3.3: Composition of oil

Com	mol%	Mwt	Com	mol%	Mwt
C_5	0.168	72	C_{28}	0.871	394
C_6	2.742	86	C_{29}	0.564	408
C_7	1.752	100	C_{30}	0.455	422
C_8	2.564	114	C_{31}	0.337	436
C_9	2.534	128	C_{32}	0.346	450
C_{10}	9.185	142	C_{33}	0.257	464
C_{11}	10.571	156	C_{34}	0.406	478
C_{12}	13.729	170	C_{35}	0.287	492
C_{13}	7.701	184	C_{36}	0.346	506
C_{14}	8.008	198	C_{37}	0.297	520
C_{15}	5.206	212	C_{38}	0.475	534
C_{16}	4.207	226	C_{39}	0.228	548
C_{17}	3.009	240	C_{40}	0.475	562
C_{18}	3.207	254	C_{41}	0.228	576
C_{19}	3.247	268	C_{42}	0.257	590
C_{20}	2.722	282	C_{43}	0.238	604
C_{21}	2.059	296	C_{44}	0.287	618
C_{22}	2.366	310	C_{45}	0.228	632
C_{23}	1.742	324	C_{46}	0.168	646
C_{24}	1.94	338	C_{47}	0.257	660
C_{25}	1.356	352	C_{48}	0.148	674
C_{26}	1.811	366	C_{49}	0.188	688
C_{27}	0.732	380	C_{50}	0.099	702

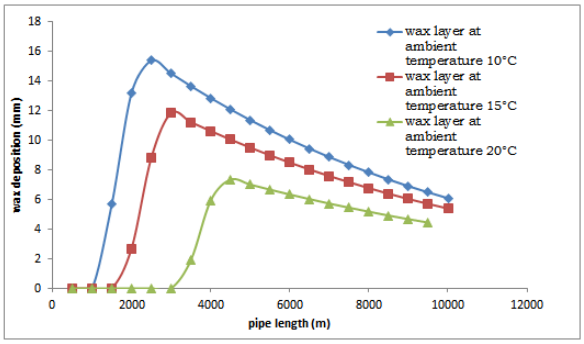

Figure 4.1: Effect of ambient temperature on wax deposition for oil

4.1.2. Using PVTSIM software

Figure 4.2 shows the wax deposition at different ambient temperature (10 °C, 15°C and 20°C) by using PVTSIM software.

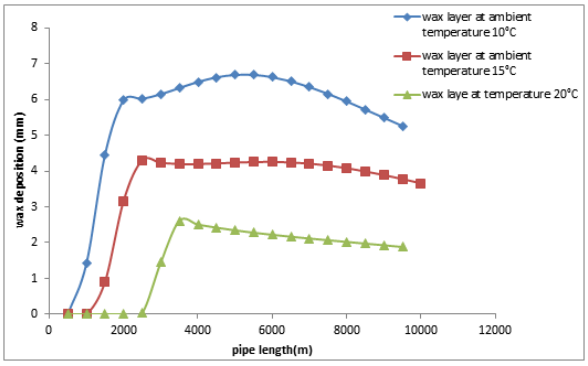

Figure 4.2: Effect of ambient temperature on wax deposition for oil

4.2. Effect of insulation thickness on wax deposition

4.2.1. Using Hysys Software

Figure 4.3 shows the wax deposition at different insulation thickness 5mm, 10mm and 15mm by using HYSYS software.

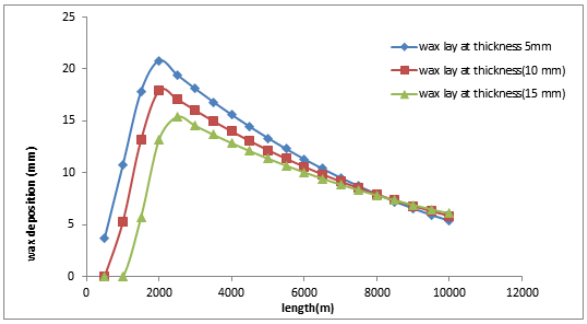

Figure 4.3: Effect of insulation thickness on wax deposition for oil

4.2.2. Using PVTSIM software

Figure 4.4 shows the wax deposition at different insulation thickness 5mm, 10mm and 15mm by using PVTSIM software.

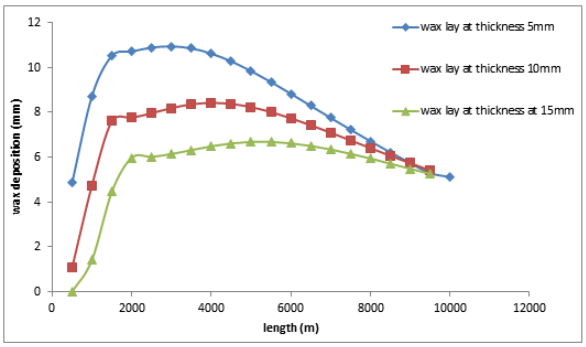

Figure 4.4: Effect of insulation thickness on wax deposition of oil

4.3. Effect time duration on wax deposition

4.3.1. Using Hysys Software

Figure 4.5 shows the wax deposition at different time duration (720 hr1440 hr, and 2160 hr) by using HYSYS software.

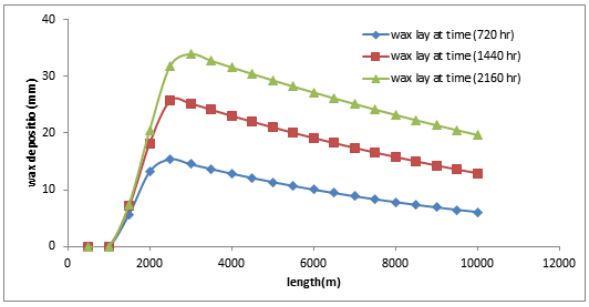

Figure 4.5: Effect of time duration on wax deposition of oil

4.3.2. Using PVTSIM software

Figure 4.6 shows the wax deposition at different time duration (720 hr1440 hr, and 2160 hr) by using PVTSIM software.

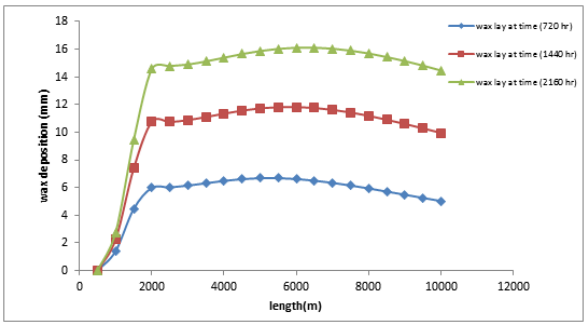

Figure 4.6: Effect of time duration on wax deposition of oil

5. Conclusion

Based on the results obtained from the simulation of pipelines carrying different waxy crude composition. There is a good match of results of wax deposition when utilizing two software programs (HYSYS and PVTSIM). The rate of wax deposition on pipe wall is direct proportional to the following:

- Temperature difference between the bulk oil and the pipeline.
- Time duration.

Increasing of insulation thickness is one of the methods that can use to decreasing wax through a pipe line.

References

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