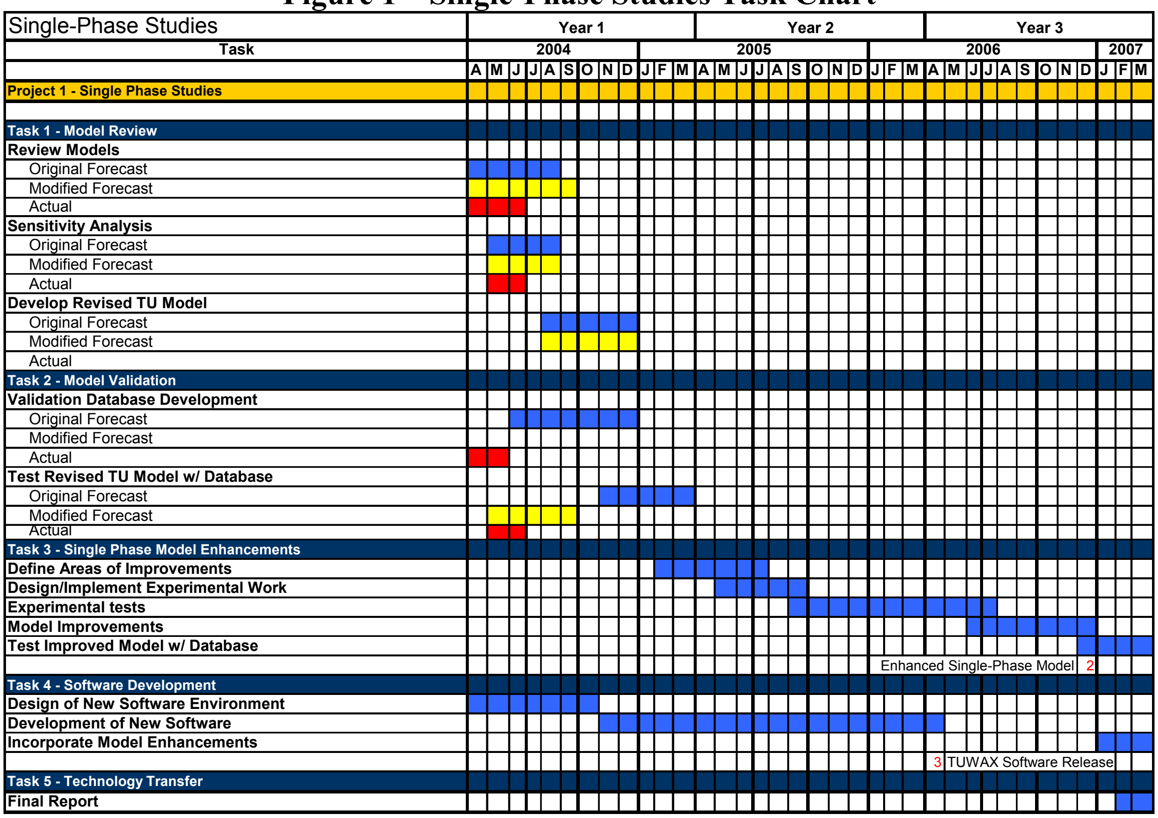
Paraffin Deposition Progress Report
April – June 2004

Activity Status

During the last quarter, the single-phase and pigging studies were started. All tasks are on or ahead of schedule with the exception of designing the new software environment. It is now projected that work on this task will not begin until October 2004 with a completion date of March 2005. The task charts showing current project status are provided in Figures 1 to 3 along with project status update details.

Figure 1 – Single-Phase Studies Task Chart



Original Forecast
Modified Forecast
Actual

Task 1: Model Review

<u>Review Models</u> - Timeline for completion: September 2004; one month past proposed timeline of August 2004.

NOTE: Research Associate has completed review of models, except "Shear Stripping".

It is taking more time than expected to code and evaluate models identified. It is not foreseen that late completion of this task will affect other tasks.

<u>Sensitivity Analysis</u> - Timeline for completion: August 2004; on track with proposed timeline.

<u>Develop Revised TU Model</u> - Timeline for completion: Ongoing, but most of the work will be complete by December 2004; on track with proposed timeline.

Task 2: Model Validation

<u>Validation Database Development</u> - Complete in May 2004.

<u>Test Revised TU Model w/ Database</u> - Timeline for completion:September 2004; ahead of proposed timeline of April 2005.

Task 3: Single-Phase Model Enhancements (Work to begin February 2005.)

Task 4: Software Development

<u>Design of Software Environment</u> - Timeline for completion: March 2005; behind proposed timeline of October 2004.

NOTE: Research Assistant will begin work on this project in October 2004. It is not foreseen that the late completion of this task will affect other tasks.

<u>Development of New Software</u> - Work to begin November 2004.

<u>Incorporate Model Enhancements</u> - Work to begin December 2004.

Task 5: Technology Transfer (Final Report due March 2007)

Figure 2 – Multiphase Studies Task Chart

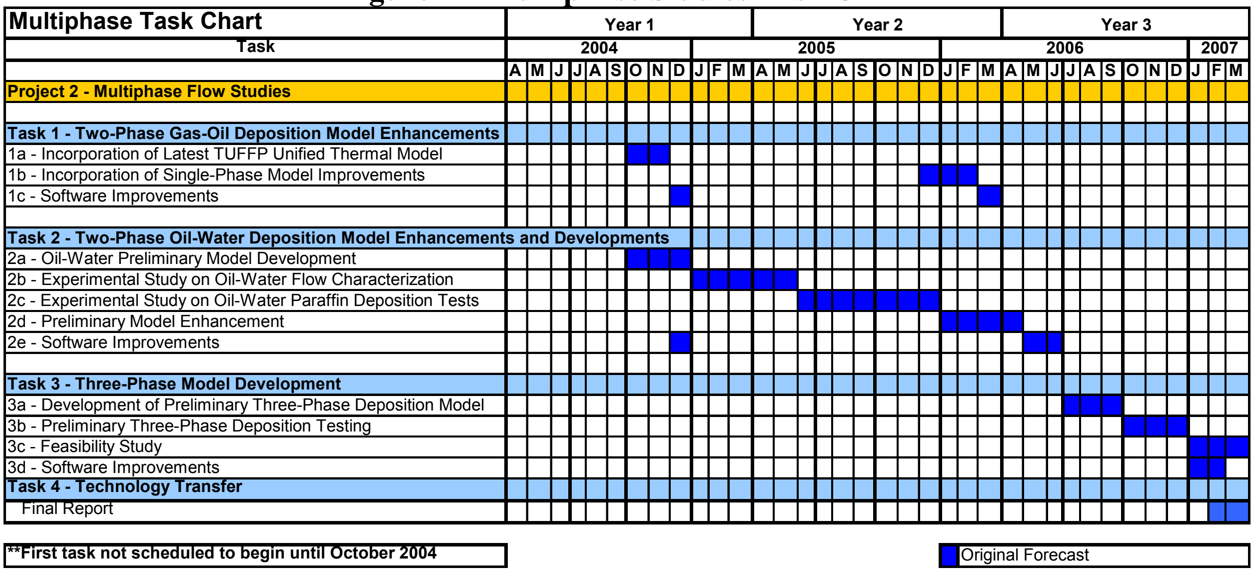
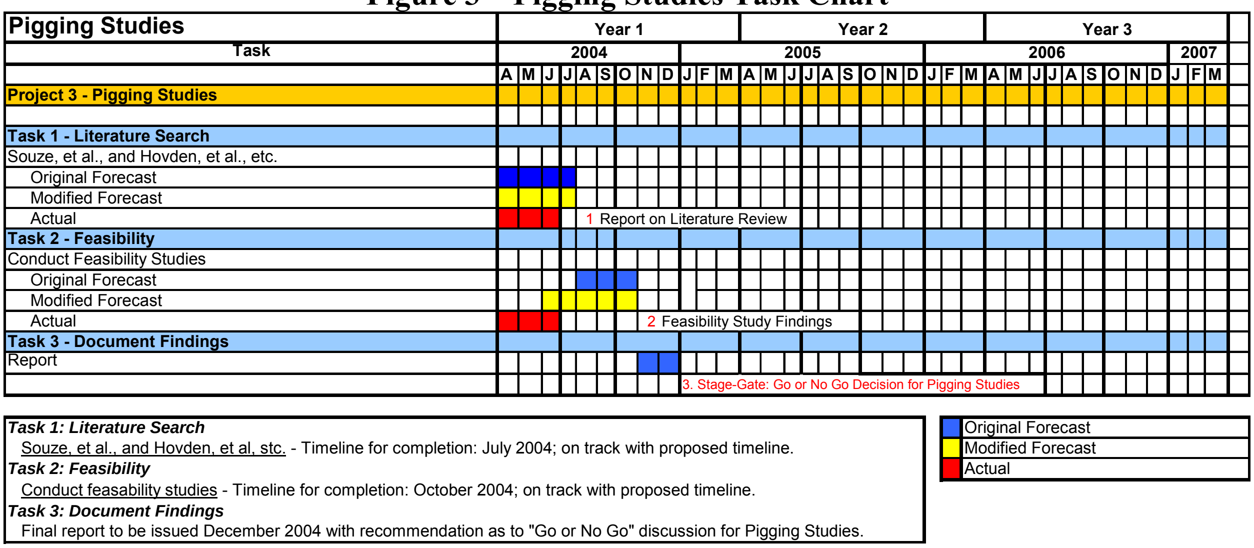


Figure 3 – Pigging Studies Task Chart



Single-Phase Studies

Model Review

Software Improvement

The current source code for simulating single-phase wax deposition in TUWAX has been thoroughly reviewed. Several bugs have been identified and corrected which include: 1) For heat transfer calculation of a pipe, the heat transfer area should be calculated by using the outside diameter of the pipe while the current program uses the inside diameter; 2) The pressure unit used in the look-up table of thermal dynamic properties is atm while the pressure unit used by current program to find thermal dynamic properties from the look-up table is pa. The pressure unit should be converted from pa to atm before using the property look-up table. Since properties are generally not sensitive to the pressure change so that errors caused by this bug are not large for stock tank oil. Some remarks have been added into the program to make the source code more readable. A new version of TUWAX will be posted on the website for download.

Model Review and Development

One of the main limitations in the current TU single-phase paraffin deposition model is the assumption of constant oil fraction in the deposit without considering aging effect on the deposition process. The Singh et al. thin layer model has been reviewed and is believed to be the best model for predicting the aging process of wax deposition. This model has been coded into a program for an ongoing validation and sensitivity study against a TU single-phase wax deposition experimental database. A time dependent wax content (or oil fraction) of wax deposit will be predicted. A typical comparison between the Singh's model and TU experimental data for a turbulent flow case is shown in the Figs. 4 - 5.

Singh et al. showed good agreement between simulation results and their experimental data in the laminar flow regimes. In this study, Singh et al. model has been tested against TU's turbulent flow data. The preliminary results indicate that the original Singh et al. model generally overestimates the wax deposit thickness and underestimates the wax content of the deposit. Their model will be tested against TU's laminar flow data.

It is believed that discrepancies between experimental data and Singh et al. model for turbulent flow are because of two reasons: 1) The original Singh's model used a film mass transfer model to calculate the mass transfer from the bulk to the deposit surface for laminar flow. The film mass transfer model is based on the analogy between heat and mass transfer, and may not be applicable for turbulent flow; 2) Absence of a shear stripping/prevention term in the model.

Venkatesan et al. (2004) pointed out that the heat-mass transfer analogy was not applicable for predicting the mass transfer in turbulent flows where the concentration field was correlated to the temperature field, and suggested a way to calculate mass transfer based on solubility. Singh's model was modified based on the suggestions given in the paper of Venkatesan et al (2004). It is shown in Figure 4 and 5 that there is a good improvement between simulation results and experimental data for both wax thickness and wax content prediction. However, when compared with TU's experimental data, the modified Singh et al. model usually underestimates the wax thickness.

A literature review has been ongoing for the addition of a shear stripping/prevention term to the model. Several models have been found in the literature and their applicability to the wax deposition problem is under review. More recent research studies on stripping effect on wax deposition have been conducted by other researchers. However, these studies have not yet been published and are currently unavailable to us.

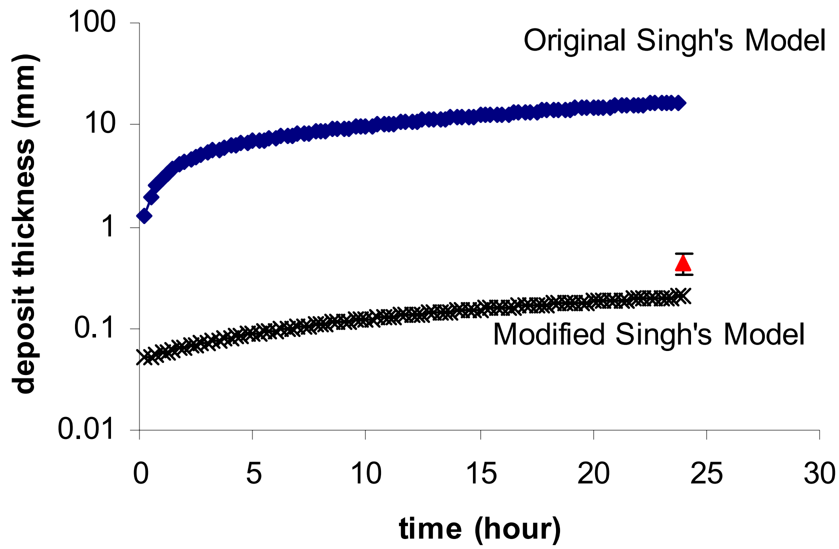


Figure 4 - Comparison for Deposit Thickness between Singh's Model and Data for a Typical Test, South Pelto Oil, Re=7200

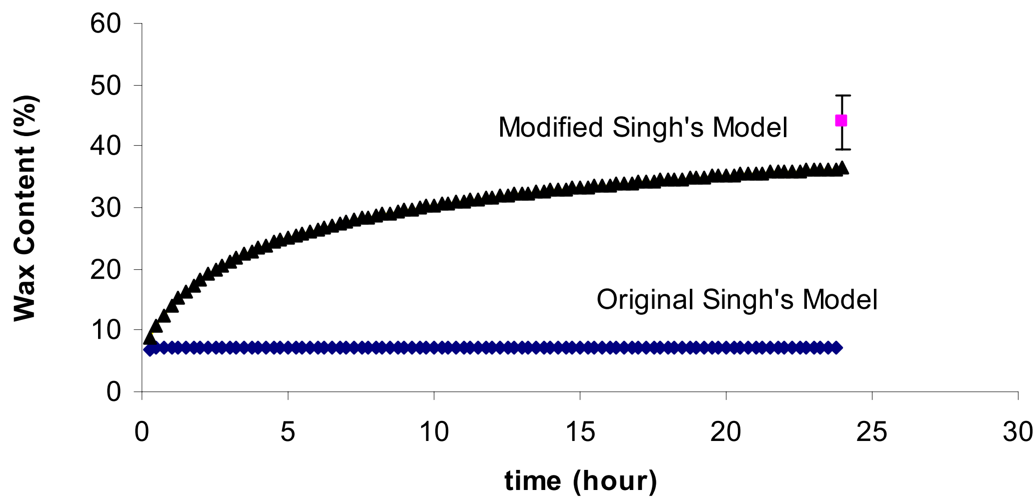


Figure 5 - Comparison for Deposit Wax Content between Singh's Model and Experimental Data for a Typical Test, South Pelto oil, Re=7200

Study on Thermal Conductivity of Wax Deposit

An accurate estimation of thermal conductivity of the wax deposit is essential for wax deposition simulation and heat transfer calculation. There is little experimental data on the thermal conductivity of wax deposits available in the literature. A thermal properties analyzer based on monitoring the dissipation of heat from a line heat source was purchased and is being used to measure the thermal conductivity of some materials such as air, water, sand, candle wax, crude oil etc. Thermal conductivities measured by this thermal properties analyzer agree with those published in the literature. A preliminary measurement found that the thermal conductivity of the RADOIL wax which is a type of soft wax deposit collected from the pipeline is 0.18 W/mK. This device will be used to measure the thermal conductivity of wax deposit with different wax content. Based on the measurement data, a correlation will be established between the thermal conductivity of wax deposit and its wax content. This correlation will then be used in the wax deposition model.

Future Work

The validation and sensitivity study on Singh et al. model will continue against a TU wax deposition database to identify the most important parameters and their proper values that will be used in the model. A literature review will continue to find a proper model for predicting the stripping/prevention effect. Measurements will be made to establish a relationship between the thermal conductivity of wax deposit and its wax content.

References

Ramachandran Venkatesan and H. Scott Folger, 2004, “Comments on Analogies for Correlated Heat and Mass Transfer in Turbulent Flow”, AIChE J: July 2004, Vol 50, pp. 1623-1626.

Model Validation

Standard Model Validation Data Set

The most reliable experimental data was chosen in order to evaluate the performance of selected models and any new development. Selection was based on the following criteria:

- Stability of inlet conditions: Oil Inlet Temperature: ± 2°F, Glycol Inlet Temperature: ± 3°F, Oil flow Rate: +/- 1%, Glycol flow rate: +/-200 BPD (corresponds to a +/-8% in the outside heat transfer coefficient).
- Stability of ΔP and ΔT.
- Availability and reliability of LD-LD and DSC results.

The tests presented in Table 1 were selected to cover the range of possible conditions on the facilities.

Table 1 - Validation Data Set*

Test Code	Fluid	Qoil (bpd)	Re	Toil (F)	ΔT (F)	Time (hr)
10	South Pelto	150	639	85	15	24
18	South Pelto	500	3590	105	15	24
22	Garden Banks	1500	21309	85	30	24
17RR	South Pelto	1000	7179	105	15	24
3R	South Pelto	1500	10769	105	15	120
12	South Pelto	1500	10769	105	30	24
14	South Pelto	1500	10769	105	45	24
WAX2001-033	Garden Banks	1000	14206	85	30	24
WAX2001-026	Garden Banks	1500	21309	85	15	24
WAX2001-025	Garden Banks	1500	21309	85	30	24

*Single Phase Flow Loop. Glycol flowing counter-current at 2000 BPD.

Sensitivity Analysis

Test 14 was chosen as the Base Case but simulations were run for 20 days and with an oil inlet temperature of 134°F above the WAT to allow thickness growth stabilization.

The base case was simulated under the following conditions: ratio of wax and oil thermal conductivities: 1, oil fraction in deposit: 0.71 (experimental), effect of roughness: 0, diffusion coefficient: Hayduk-Minhas. Multiplier: 1, stripping Coefficient: 0

A sensitivity analysis was performed for the following parameters: model of deposition, deposit thermal conductivity, outside heat transfer coefficient, oil in deposit, effect of roughness, diffusion coefficient and multiplier, pipe thermal conductivity, fluid heat capacity and flow rate. The output under consideration is the average thickness vs. time. The relative variations with respect to the base case were calculated and plotted. Each parameter was changed independently even though they may affect each other. A summary of the results are presented in Tables 2 and 3, and example plots are given in Figs. 6 and 7.

Table 2 - Average Thickness

Parameter	Thickness(mm)						
	Time (hr)	**6**	**24**	**48**	**120**	**240**	**480**
	Base Case	0.36	0.71	0.91	1.07	1.08	1.08
Deposit Thermal Conductivity	1.5 Koil	0.36	0.83	1.15	1.50	1.57	1.57
	2 Koil	0.36	0.90	1.32	1.85	2.04	2.04
Outside Heat Transfer Coefficient (W/m/K)	574	0.23	0.58	0.77	0.94	0.94	0.94
	1720	0.43	0.77	0.96	1.12	1.12	1.12
Fraction of Oil in Deposit	0.9	1.03	1.17	1.17	1.17	1.17	1.17
	0.5	0.21	0.50	0.72	0.98	1.07	1.07
	0.25	0.14	0.37	0.57	0.86	1.03	1.07
Diffusion Coefficient	Wilke-Chang	0.25	0.60	0.82	1.05	1.08	1.08
Fluid Heat Capacity	2500	0.37	0.70	0.85	0.90	0.90	0.90
Reynolds Number	9738	0.25	0.64	0.98	1.52	1.90	2.11
	29213	0.41	0.64	0.71	0.71	0.71	0.71
	38951	0.44	0.55	0.55	0.55	0.55	0.55

Table 3 - % Relative Variations with Respect to Base Case

Parameters	% Relative Variations						
	Time (hr)	**6**	**24**	**48**	**120**	**240**	**480**
Deposit Thermal Conductivity	50%	0.0	16.9	26.3	39.8	46.0	89.5
	100%	0.0	27.1	45.8	72.4	89.5	131.0
Outside Heat Transfer Coefficient (W/m/K)	-50%	-35.6	-18.5	-14.8	-12.6	-12.6	-12.6
	50%	22.3	8.5	5.5	4.2	4.1	4.1
Fraction of Oil in Deposit	20	190.0	65.2	28.5	8.6	8.3	8.3
	-33	-42.0	-29.4	-21.1	-8.7	-0.3	-0.3
	-67	-61.3	-48.0	-37.2	-19.7	-4.2	-0.5
Diffusion Coefficient	Wilke-Chang	-30.2	-15.7	-9.7	-2.4	-0.1	-0.1
Fluid Heat Capacity	25	5.3	-1.0	-6.5	-16.2	-16.5	-16.5
Reynolds Number	-50%	-28.8	-10.0	7.7	42.0	76.8	96.0
	50%	14.4	-9.8	-21.7	-33.5	-33.7	-33.7
	100%	24.4	-22.4	-39.6	-49.0	-49.1	-49.1

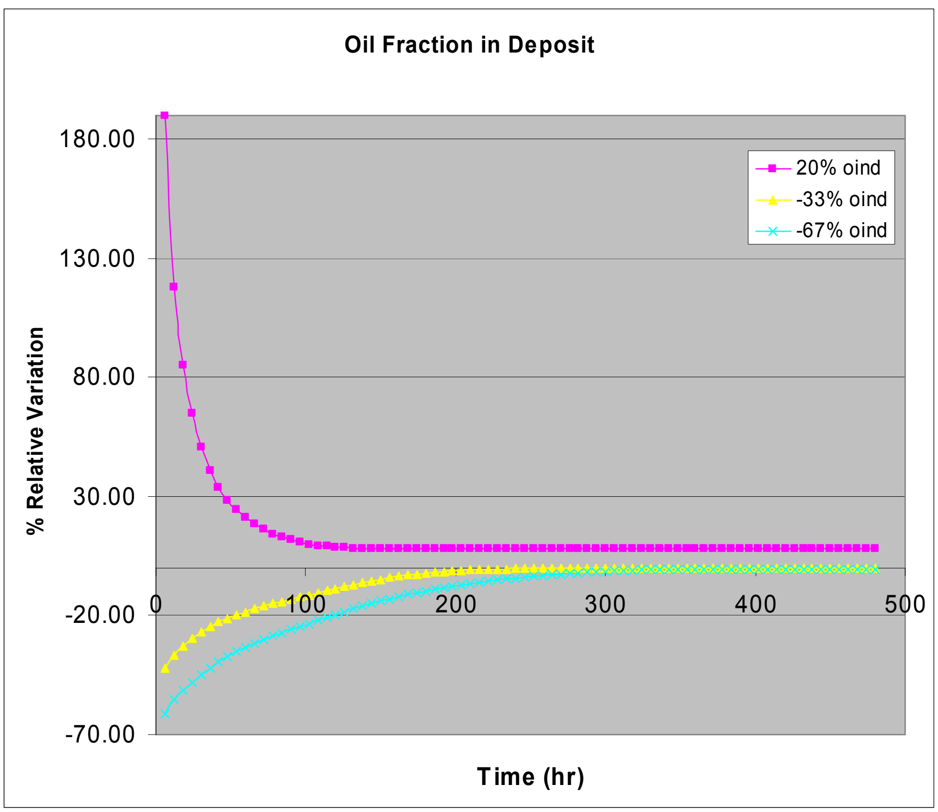


Figure 6 - Average Thickness vs. Time

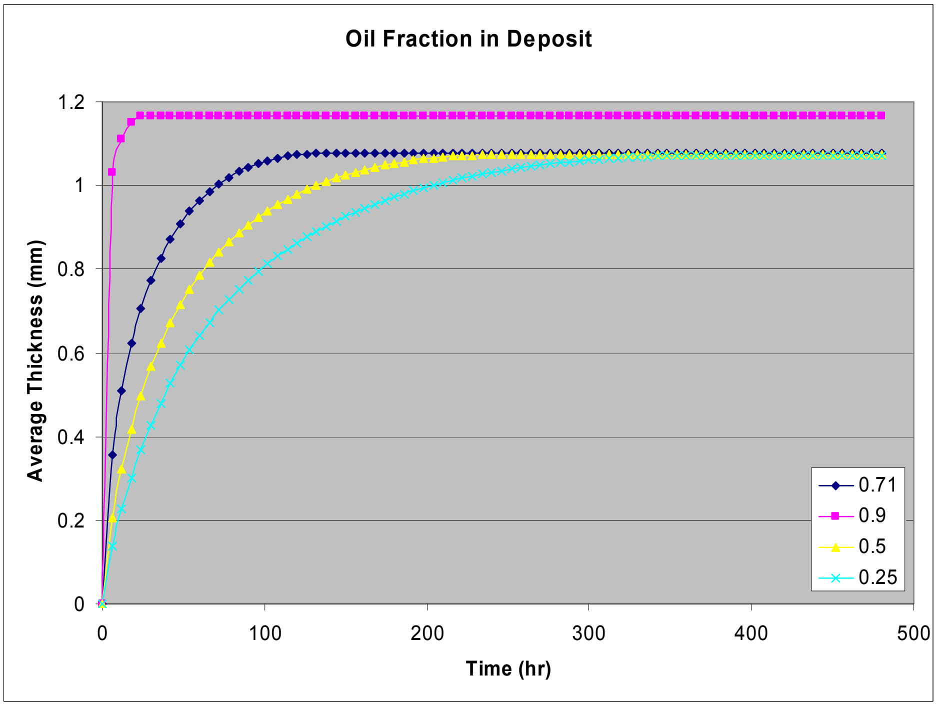


Figure 7 - % Relative Variation vs. Time

Conclusions and Future Work

The sensitivity study showed the following trends:

- Film mass transfer predicts higher thickness than diffusion.
- Predictions with Wilke-Chang are smaller than with Hayduk-Minhas but the difference decreases with time.
- The sensitivity of the models to the deposit thermal conductivity is significant and increases with time.
- The differences in predictions resulting in changing the fraction of oil in deposit diminish with time.
- The trend of the models resulting from a change in flow rate varies with time, the first hours the thickness increases with an increase in the flow rate as time passes the trend is reverted.

In order to continue the evaluation of the models the next step will be to compare the validation data set with: film mass transfer and diffusion models (experimental values for oil in deposit), and Singh et al. model.

Multiphase Studies

First task not scheduled to begin until October 2004.

Pigging Studies

A literature search for pigging of paraffin deposits has been carried out as planned in Task 1 of the pigging studies. The following five key articles were studied.

1. Short, 1994, reported a pigging technology project. He mentioned "although much had been written on the experiences gained with pipeline pigging, little firm quantitative data exists to enable the most-effective selection of pigs and pigging procedures to be made. There is still not a clear understanding of the mechanisms and interactions involved in pigging operations". The pig type and pig cleaning efficiency is discussed in the paper.

2. Lino, 1995, carried out experiments on pigging of paraffin deposits. Different types of pigs were tested. The experience gained during almost 800 runs in the test loop was of great help in actual field operations.

3. Souza, at el, 1999, investigated wax shear strength by compressing wax sample between two plates. The maximum measured value of the compression force is the minimum force required to cause plastic deformation to the wax sample, and hence it corresponds to the minimum level of stress required to remove the wax deposit. A simple approach was presented to estimate the minimum pressure on pigs below which wax removal does not occur.

4. Experiments on the mechanics of wax removal were conducted by Wang & Sarica, 2000. Different types of pigs were pulled through a cast wax pipe. Wax thickness, oil content, pig type and pigging efficiency were investigated. The pigging force was divided into three parts; base line force, breaking force and wax plug transportation force. The base line force is the force required to move pig in a clean pipe, which varies with pig types and pig oversize. The breaking force, similar with wax shear strength tested by Souza, is the force that causes plastic deformation of the wax layer, which depends on wax thickness, wax properties and pig type. The wax plug transportation force is the force required to move the wax plug cut off from the pipe wall out of the pipe.

5. Hovden et al, 2004, modeled the pigging procedure based on the findings in Wang & Sarica's study. In this model, the wax breaking force is predicted by following equation,

$$F_{wbf} = C_{pw} \cdot \tau_y(C_0) \cdot \delta_{wl} \cdot \pi \cdot d_{ip} \cdot \eta \cdot (1-\Phi) \quad (1)$$

C_{pw} - Tuning factor for forces induced on pig due to wax removal and transport.

$\tau_y(C_0)$ - Yield stress of wax layer, C_0 is porosity (volume fraction of oil in the wax layer)

δ_{wl} - Thickness of wax layer deposited on the wall

d_{ip} - Inner pipe diameter (clean pipe)

η - Pig wax removal efficiency

Φ - Pig form factor

The wax plug transportation force is only determined by wax plug shear stress. The effective viscosity of wax plug is calculated by Pedersen and Rønningsen model.

All wax pigging studies found in the literature indicate that the mechanisms of wax pigging have not been investigated sufficiently. There is no wax pigging model which includes all the variables needed. Souza investigated wax plastic deformation force (breaking force); but the offline study is quite different than encountered in the field. Wang & Sarica found the effect several factors have on pigging force and identified different forces during the pigging procedure. However, there is no fluid flowing in the pipe. Other factors may play a role in this fluid flowing case. Hovden et al developed a pigging model. In this model, several factors are unknown and need to be determined by user. The wax plug transportation force was not analyzed in detail.

Analyzing the force measured in the Wang & Sarica study, the fraction of the wax plug transportation force in the total force increases as the pig moves towards the end of the pipe. For a 21 ft pipe (test section length), the wax plug transportation force is the same order with the breaking force. In practice, the pipe length is much longer. The pigging procedure will be dominated by wax plug transportation force rather than the wax breaking force.

Conclusions

Pigging studies for wax removal are insufficient but those conducted by Lino were of greatest help to the operators in the field. Experimental data under the fluid flowing condition and wax pigging model are not available. The wax plug transportation force should be the emphasis in pigging studies. It will dominate the pigging procedure in pipelines used in the oil and gas industry.

Future Work

A feasibility study will be conducted. The wax breaking force will be calculated using the Sousa correlation and Hovden correlation. The possibility of a pigging test using the existing single-phase paraffin deposition loop will also be examined.

References

Hovden, L., Xu, Z.G., Ronningsen, H. P., Labes-Carrier, C. and Rydahl, A., "Pipeline Wax Deposition Models and Model for Removal of Wax by Pigging: Comparison between Model Predictions and Operational Experience," *4th North American Conference on Multiphase Technology*, 3-4 June 2004, Banff, Canada

Lino, Antonio C.F., Pereira, Fernando Borja and Gomes, Marcelino Guedes F. M., "Developing Techniques, Facilities for Deepwater Flowline Pigging," *Pipe Line & Gas Industry,* Vol. 78, n8, Aug. 1995, pp. 31-36.

Mendes, Paulo R. Souza, Braga, Arthur M.B., Azevedo, Luis F.A. and Correa, Karine S., "Resistive Force of Wax Deposits during Pigging Operation," *ASME Petroleum Division (Publication) PD,* ETCE99-6671, *Petroleum Production Technology*, 1999.

Short, G. C., "The Pigging Technology Project: The First Three Years," *Pipes and pipelines international*, Vol. 39, n4, Jul-Aug., 1994, pp. 23-27.

Wang, Q. Sarica, C and Chen, T. X., "An Experimental Study on Mechanics of Wax Removal in Pipeline," SPE 71544.

Cold Finger Studies

Paraffin deposition tests using the cold finger device have been conducted with South Pelto and CBI oils. South Pelto oil was tested with different water cuts using fresh water and brine. The effects of temperature gradient, deposition time, water cut, water salinity and emulsion characteristics were investigated The final results obtained with South Pelto oil were reported at the last Advisory Board Meeting (April, 2004). A total of six single-phase tests with CBI oil were conducted next, at different ΔTs and deposition periods of 24 and 48 hours.

Table 4 shows the test matrix for the tests conducted with CBI.

Table 4 - Test Matrix for CBI crude oil

Test #	Time (hrs)	ΔT (°F)	Weight (g)	Wax content (% wt.)
2004-CF-039	24	15	0.5	20
2004-CF-040	24	30	0.7	10
2004-CF-041	24	45	0.6	7
2004-CF-042	48	15	0.6	23
2004-CF-043	48	30	0.9	14
2004-CF-044	48	45	0.7	10

The effect of ΔT could be investigated from both deposition periods tested. Figures 8 and 9 summarize the results obtained. The wax content in the deposit decreases with increasing ΔT and increases with deposition time, similarly to results obtained at the flow loop. It can be seen that the deposit mass is slightly higher for 30°F than for 15°F and 45°F ΔT tests for both deposition periods tested, different than what was observed at tests with South Pelto, where the mass of deposits increased with increasing temperature differences. This is, however, in agreement to what was observed by Alaña (2003). Cold finger tests with CBI presented a depositional behavior similar to what was observed at the flow loop. No significant depletion of the wax in the oil could be seen for any deposition period tested. DSC analyses conducted for tests with South Pelto showed differences in the WAT before and after the tests up to 9°F, with wax fractions in the oil ranging from 4.5% to 1.0% by weight. Analyses for CBI oil showed the differences in WAT to be around 2°F in average, within the error measurement band of the device.

One test with Petrobras' Caratinga oil has been conducted at the cold finger to help evaluate its depositional tendencies. The oil was first tested at the flow loop and no significant amount of wax was observed in the spool pieces after shutdown. It was a 24-hour test, with the oil temperature set to 70 °F and a ΔT of 30°F between the oil and the cold finger probe. No significant amount of wax was observed for this test, in accordance to the flow loop tests. At the end of 24 hours, only 0.17 g of wax was deposited around the probe, while CBI presented 0.7 g of wax and South Pelto presented around 3.0 g of wax, on the average.

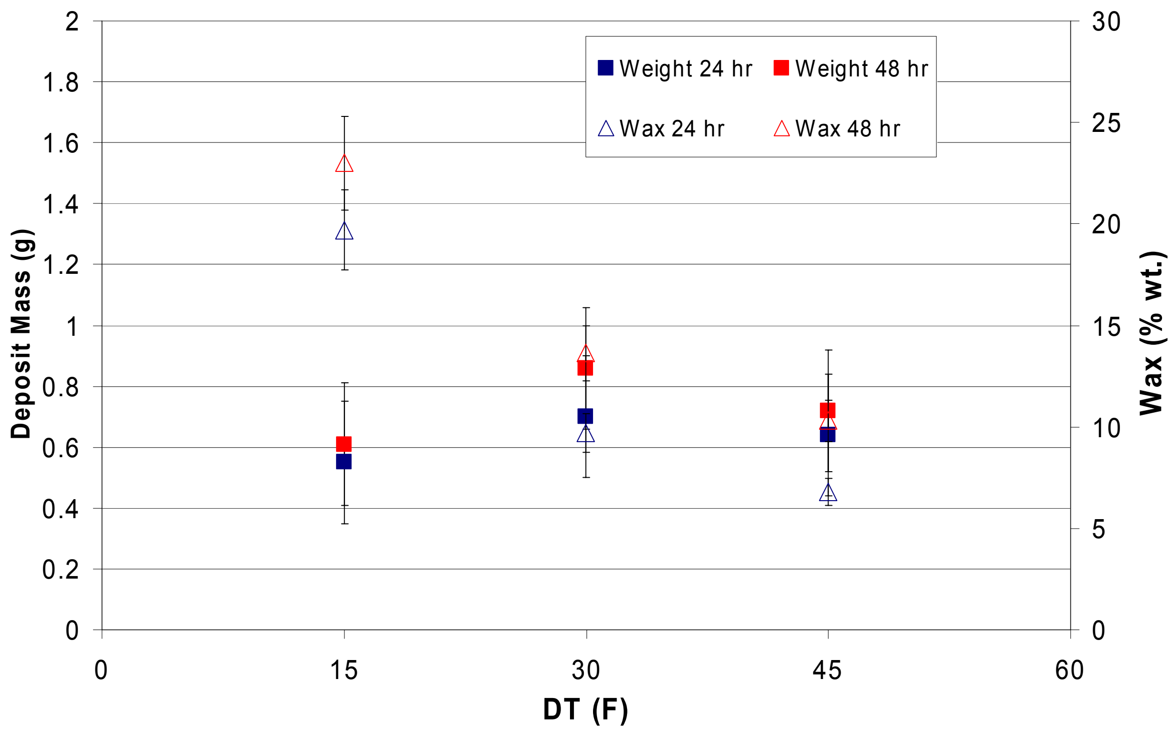


Figure 8 – Effect of Temperature Difference for CBI

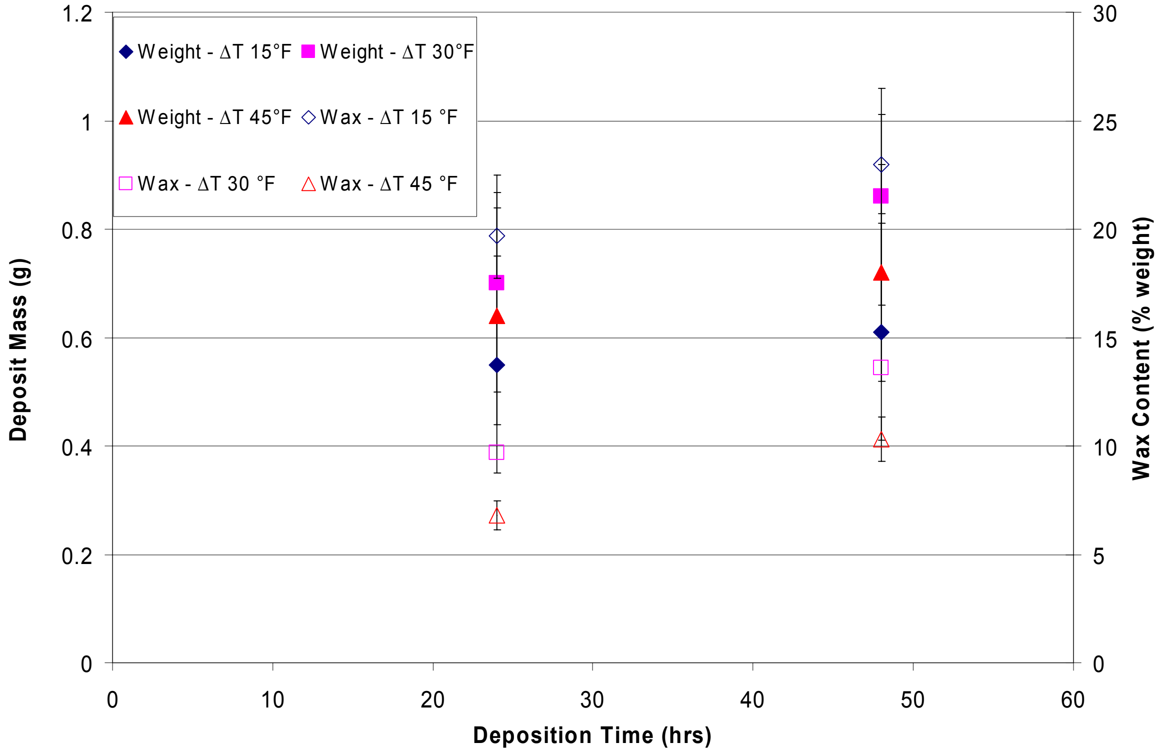


Figure 9 – Effect of Temperature Difference for CBI

Conclusions

Single-phase tests with CBI presented results similar to what has been observed at the flow loop. The deposits were softer than with South Pelto for all conditions tested. Aging of the deposits can be verified for the tests conducted up to 48 hours, and no significant depletion of the wax in the oil could be detected. Tests with Caratinga oil did not present significant amount of wax, as in the flow loop.

Oil-Water Simulations

Weispfennig (2001) model to correlate wax deposition between the cold finger device and pipe flow that is used in this study.

Applying the Chilton-Colburn analogy, an expression relating the mass transfer process within pipe flow and the cold finger device can be given as in Equation 2.

$$\dot{m}_p = \dot{m}_{CF}\left(\frac{Nu_p}{Nu_{CF}}\right)\left(\frac{d_{CF}}{d_p}\right)\left(\frac{A_p}{A_{CF}}\right) \qquad (2)$$

The Reynolds number for the cold finger can be calculated from Equation 3:

$$\mathrm{Re}_{CF} = \frac{\frac{\rho \omega D_S D_{CF}}{2}}{\mu} \quad \text{.......} \quad (3)$$

The Nusselt number for the cold finger device was calculated as for a rotating cylinder in a fluid of unlimited extent. Equation 4 is recommended for a wide range of Reynolds and Prandtl numbers:

$$Nu_{CF} = 0.6366 (\mathrm{Re}_{CF}\ \mathrm{Pr})^{1/2} \quad \text{.......} \quad (4)$$

Two different flow loop tests, as shown in Table 5, were chosen to test the above model. The deposit thickness in the flow loop can be predicted from cold finger experimental data by applying Equation 2 for the test conditions from Table 5 and the cold finger data for single-phase tests. The flow loop experimental data and the predicted data agree fairly well, within 20% error band.

Table 5 – Test Conditions for Test Wax2002-019 and Test 12

	Small Scale Loop	**Single-Phase Loop**
	Test # 2002-019	**Test code 12**
Diameter (mm)	40.9	43.6
ΔT (°F)	30	30
Duration (hours)	24	24
Q (bpd)	850	1500
Re	6626	10970
Nu	95	142
Exp. thickness (mm)	0.8	1.2*
Corr. Thickness (mm)	0.65	1.05
Relative error (%)	18.8	12.5

Oil-water simulations have also been conducted using the TU Wax deposition program. After estimating the oil-water mixture properties, the thermodynamic module of the software is used to calculate the solid mole fractions as function of temperature for single-phase oil. After having calculated the solid mole fractions and the concentration gradients for the oil-water solutions, a look-up table is generated for single-phase oil. Along with the solid mole fractions and the concentration gradients, the fluid properties need to be replaced by the respective mixture properties. Using the oil-water modified look-up tables, the wax deposition module of the program was run to obtain the deposit thicknesses as function of time at the flow loop, as shown in Fig. 10.

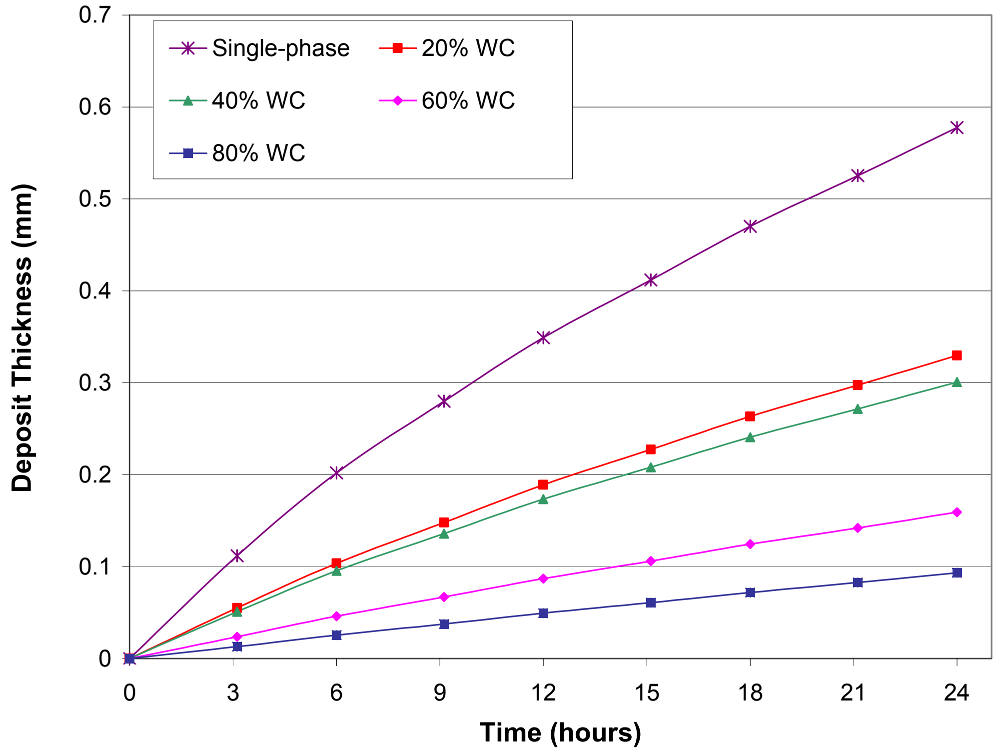


Figure 10 – Deposit Thickness as Function of Time for Different Water Cuts

The simulation results can be verified by substituting the cold finger oil-water experimental results in Eq. 2, estimating the pipe flow deposition rates and comparing them to the pipe flow simulations conducted with TUWAX, shown in Figure 10. Table 6 shows the deposit thicknesses obtained from cold finger tests and the thicknesses estimated from the model for the small scale flow loop. The comparisons are made for a ΔT of 30°F and flow rate of 850 bpd. The results from the simulations agree very well with the estimated results from cold finger experiments.

Table 6 – Deposit Thickness at Flow Loop from Cold Finger Data

Water cut (% vol)	Cold Finger Exp. Thickness (mm)	Flow Loop Thickness (mm) (Eq.5.13)	Flow Loop Exp/Model Error (%)
0	0.94	0.65	10.2
20	0.53	0.34	3.0
40	0.37	0.21	30.0
60	0.24	0.13	18.8
80	0.14	0.08	9.7

Conclusions

The proposed model correlating pipe flow and cold finger deposition proved to agree fairly well with the experimental data obtained from cold finger tests.

The two-phase oil-water simulations conducted with TU Wax software produced interesting results concerning the trend obtained with increasing water cuts. The decreasing amount of deposits with increasing water cuts match what was observed using the cold finger for all water cuts.

Administrative Issues

Membership Fees

As of July 27, 2004, we have not yet received payment from five companies for their April 2004 – March 2005 participation in the Paraffin Deposition Projects. Payment would be greatly appreciated.

Fall 2004 Advisory Board Meeting

Because we had a conflict with the Flow Assurance 2004 conference, the Fall 2004 Advisory Board Meetings for the Paraffin Deposition Projects and the Fluid Flow Projects has been rescheduled. We will now meet in Houston, Texas immediately following the SPE meeting. Request for Information forms will be emailed and uploaded to the web shortly. Meeting information is given in the following table.

Date	Event	Time	Location
September 8, 2004 (Wednesday)	Hydrate Flow Performance JIP Advisory Board Meeting	8:00 a.m. - 4:00 p.m.	BP Westlake Houston, Texas
September 30, 2004 (Thursday)	Paraffin Deposition Advisory Board Meeting	8:30 a.m. - 4:00 p.m.	ChevronTexaco Heritage Plaza - Houston, Texas
	TUFFP/TUPDP Reception	5:00 - 8:00 p.m.	Doubletree - Allen Center (directly across from ChevronTexaco Heritage Plaza)
October 1, 2004 Friday	Fluid Flow Projects Advisory Board Meeting	8:00 a.m. - 4:00 p.m.	ChevronTexaco Heritage Plaza - Houston, Texas