A Reliable Tool for Steam Soak Process prediction and Optimization

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Agenda

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- Statement of The Problem.
- Objective and Methodology.
- Program Validation.
- Field Applications.
- Program Advantages over Previous Models.
- Conclusion.
- Questions?

Introduction

- **In Egypt, due to maturity of most of oil reservoirs, EGPC started in 2010 a strategic plan aiming to evaluate the assets of residual reserve in such fields and to determine its suitability for different EOR methods.**

- **In 2014, a corporation protocol was signed between Cairo University, and EGPC to develop an EOR Map for all the reservoirs.**

- **In 2007, Cairo University Research Team developed a general methodology describe different steps needed to select and implement an EOR project for a certain field.**

- **One of the essential tools needed to perform this methodology is to have a analytical software package able to predict the performance of the different EOR methods.**

Introduction

Comparison between The Existing Prediction Methods for an EOR Study

	Screening Guides	Analytical Softwares	Reservoir Simulators
Advantages	▪ The simplest prediction tool	▪ Consider the actual reservoir and fluid properties to a greater extent	▪ Widely used ▪ The most suitable prediction tool
Disadvantages	▪ No consideration for the composite effect of the all variables ▪ No indication of economic feasibility	▪ Assumptions made in their formulation	▪ The lack of necessary reservoir data ▪ The time consuming computations ▪ Very costly

Introduction

Programs in Progress

EOR Method	Progress
Chemical	Finished
Miscible	Finished
Unconventional EOR	Under study
Cyclic Steam injection	Present

Model Authors	Year	Wellbore Losses	Heated Radius	Average Temperature	Correction Factor	Remaining Heat
Boberg and Lantz	1966	2A	4A	5A	6A	9A
Towson and Boberg	1967	2A	4A	5A	6A	9A
Davidson, Miller and Mueller	1967	?	4A	5G	?	9B
Bentsen and Donohue	1969	2A	4A	5B	6A	9A
Seba and Perry	1969	?	4B	5F	-	-
Kuo, Shain and Phocas	1970	?	4B	5F	-	-
Jones	1977	2A	4A	5C	6B	9A
Gontijo and Aziz	1984	?	4D	5D	6C	9A
Gros, Pope and Lake	1985	?	4A	5E	-	?
Sylvester and Chen	1988	2A	4A	5B	6C	9A
Gozde, Chhina and Best	1989	2B	4D	5D	6D	9A
Jones	1992	2A	4C	5H	?	?
Rivas and Boccardo	1994	?	4A	5B	6A	9A
Buitrago and Boccardo	1997	?	4A	5B	6A	9A

Previous Work in Analytical Models

Sub-routine	Number of Methods	Drawbacks
Wellbore Losses	2	-
Heated Radius	4	• Vertical losses only
Average Temperature	8	-
Correction Factor	4	-
Remaining Heat	2	-
Flow Equation	3	• Transient rate isn't accurate. • Early water production. • Steam rate.
Saturation	1	• Oil saturation increases with production. • No account for steam saturation.

Statement of the Problem

- Form the previous work survey, it is clear that:

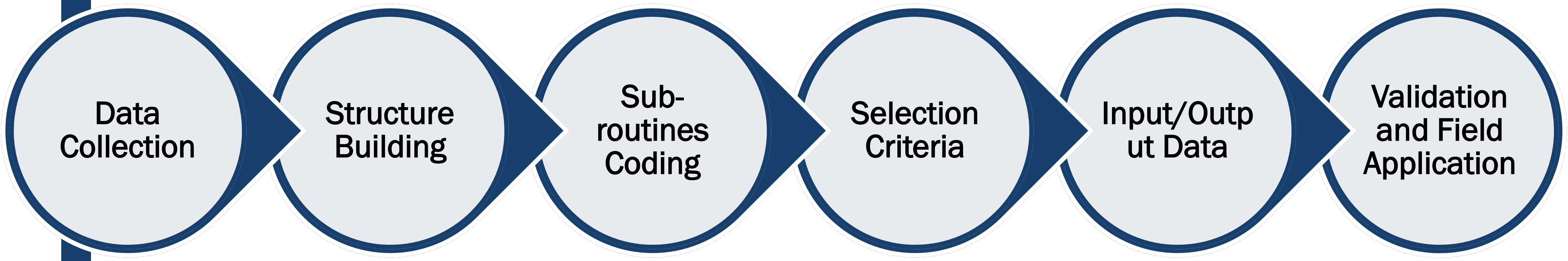
1. There is no effective or powerful predictive model that takes into consideration all the features relating to the process and the wellbore conditions.
2. There is a need to have a software package able to assess the residual reserves of Egyptian reservoirs.

- So, it is essential to develop a software package that can predict effectively the performance of different EOR methods by taking into consideration all the features accompanying the process.

Objective

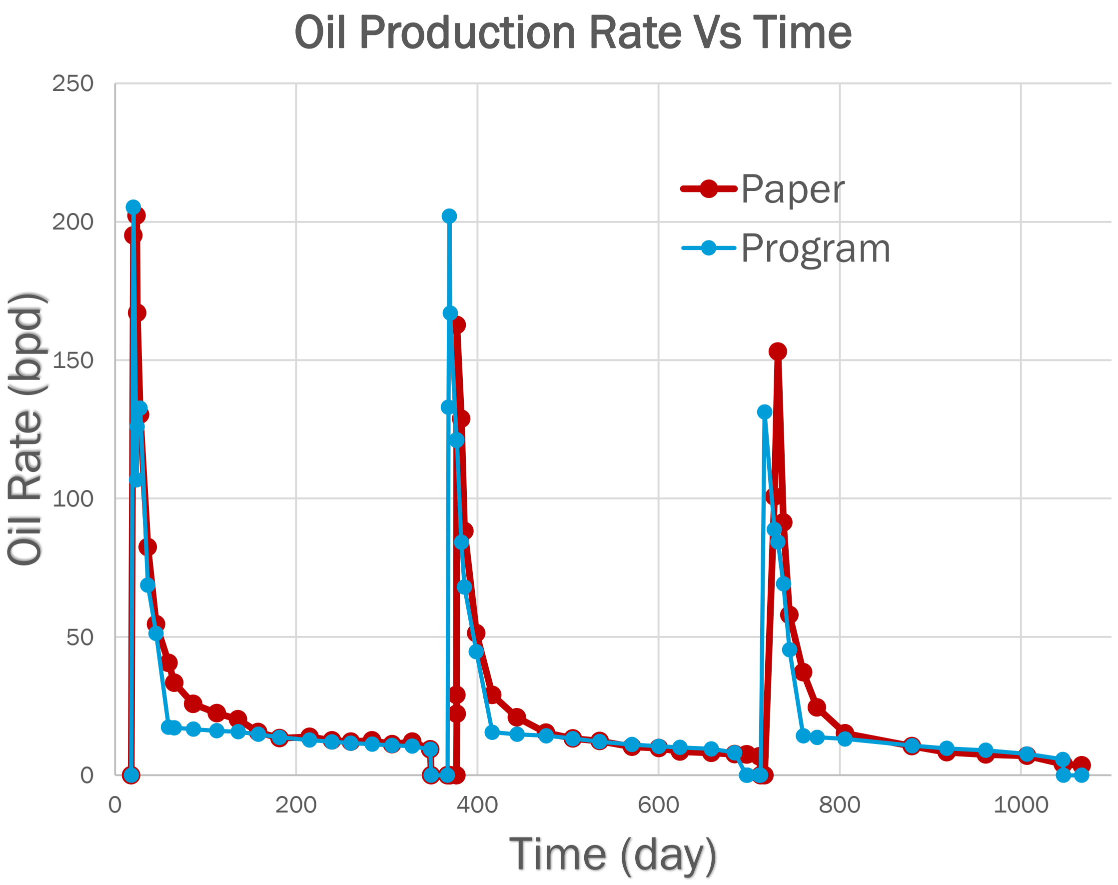
- Developing a new reliable and efficient tool to forecast and optimize the performance of cyclic steam injection. This tool depends on an analytical model which can solve the drawbacks of the previous models.

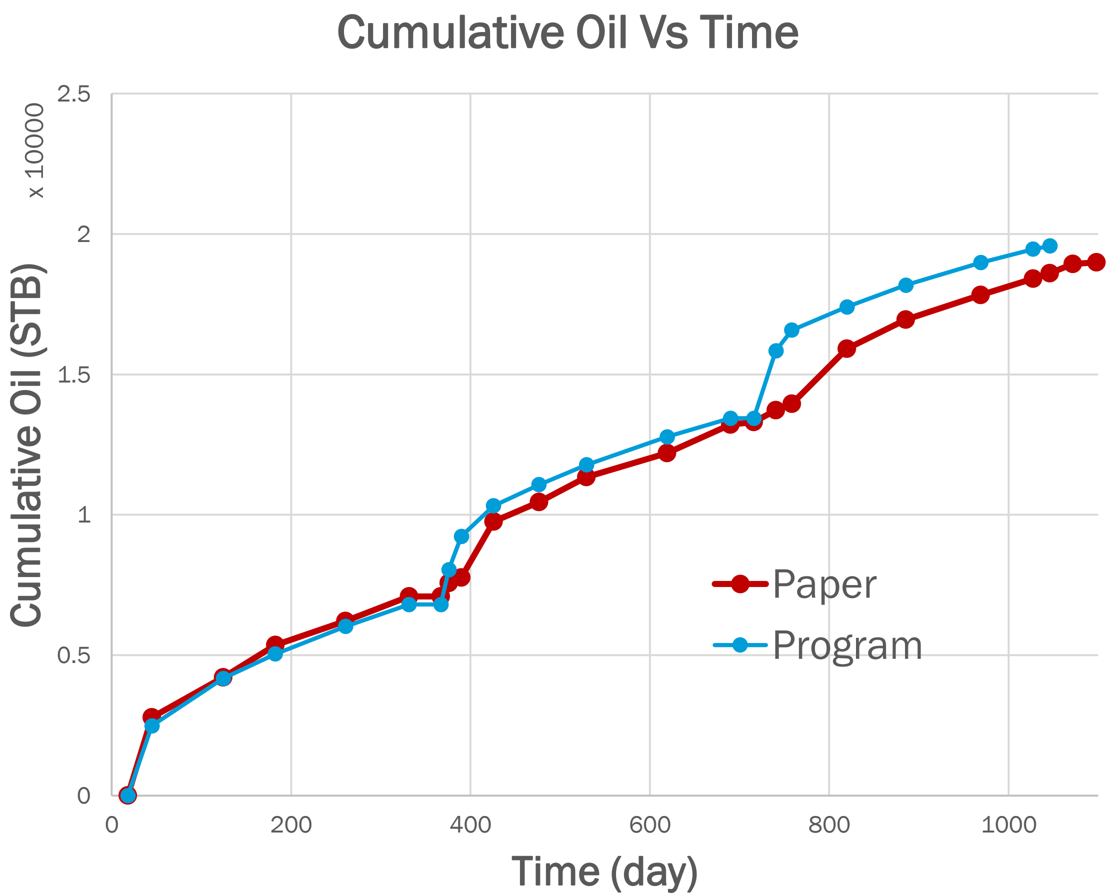
Methodology



Program Validation

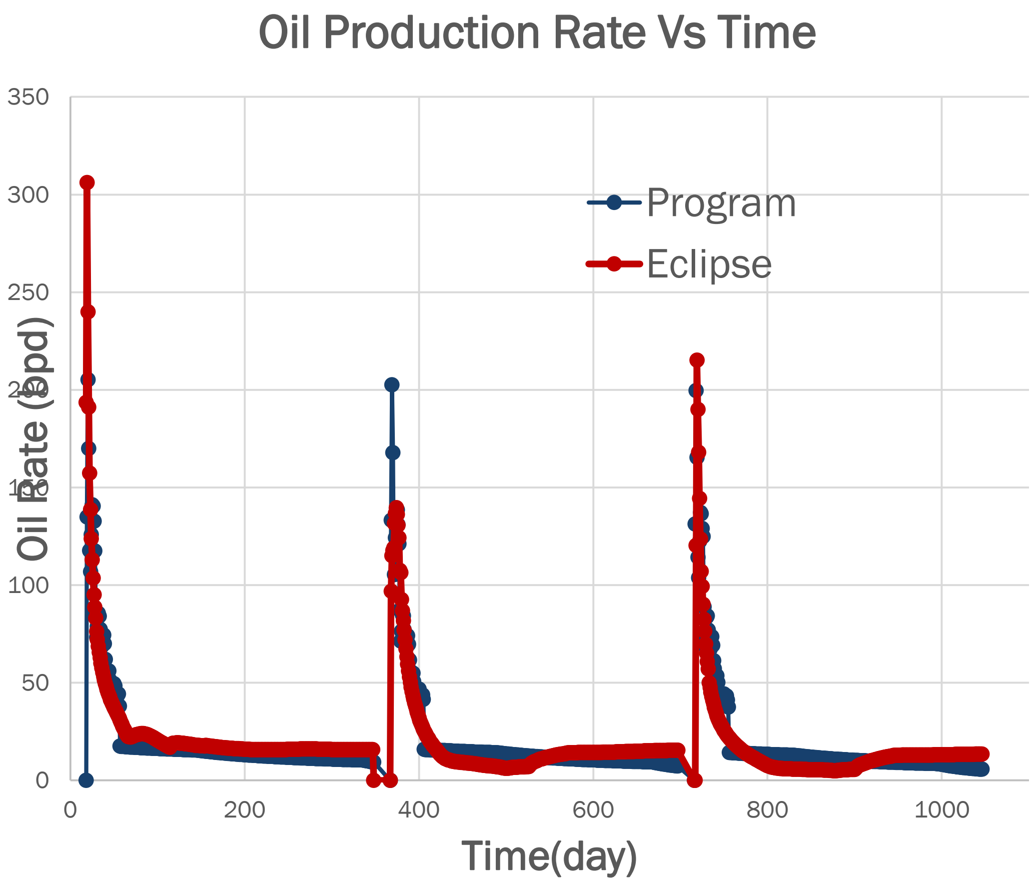
Validation with SPE Fourth Comparison Study

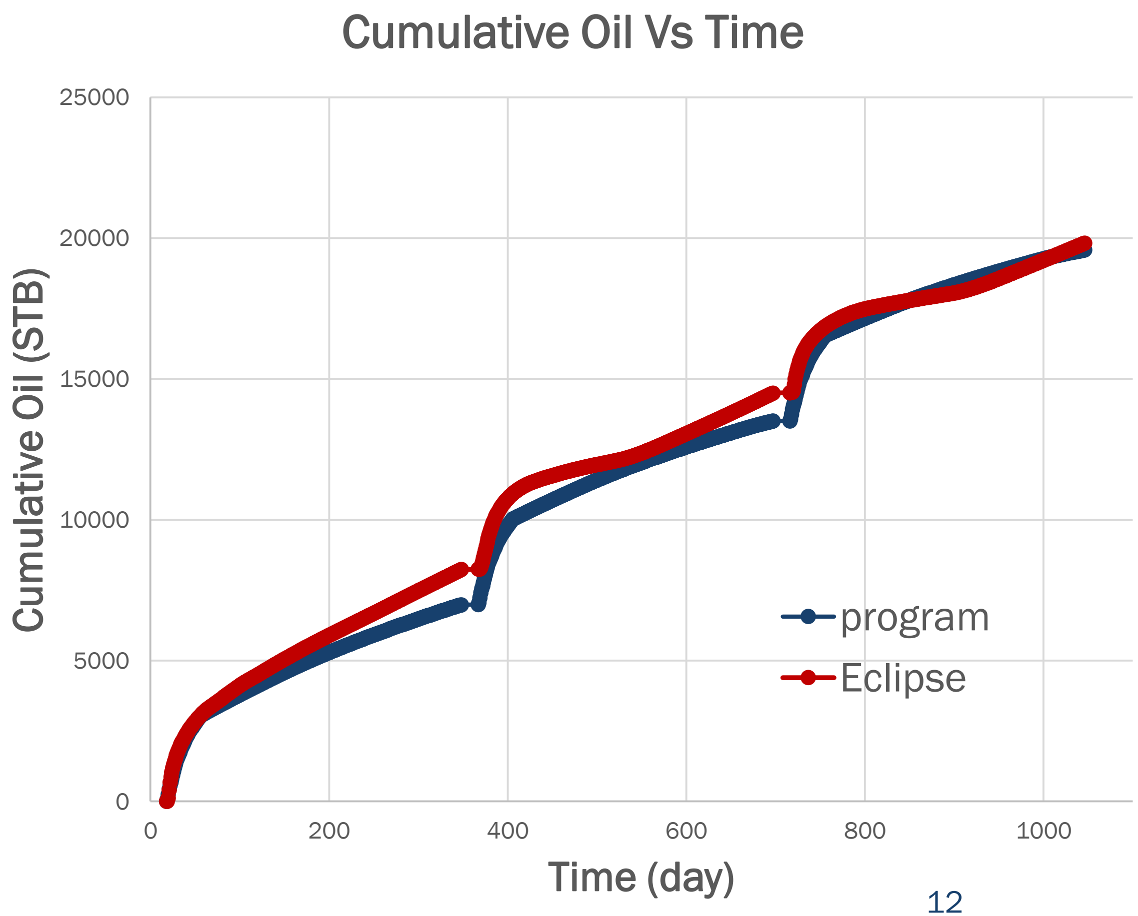




Program Validation

Validation with SPE Fourth Comparison Study (ECLIPSE)





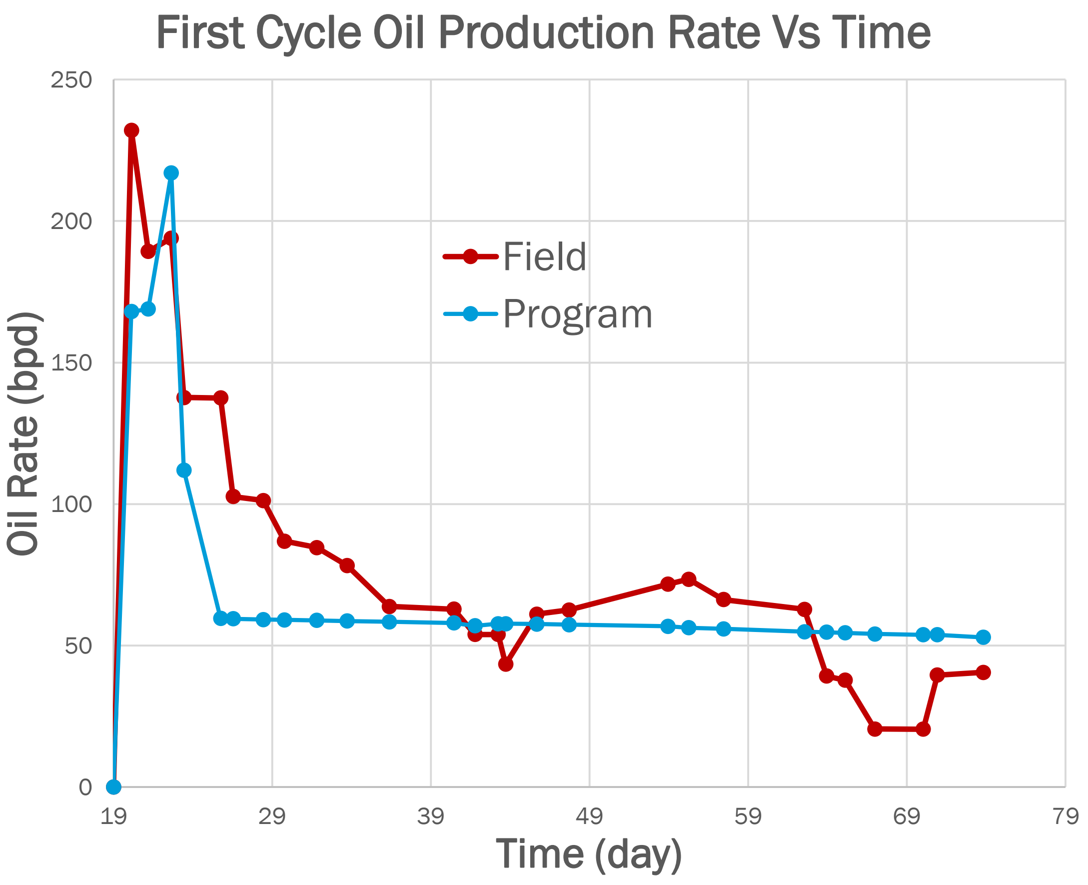
Field Applications

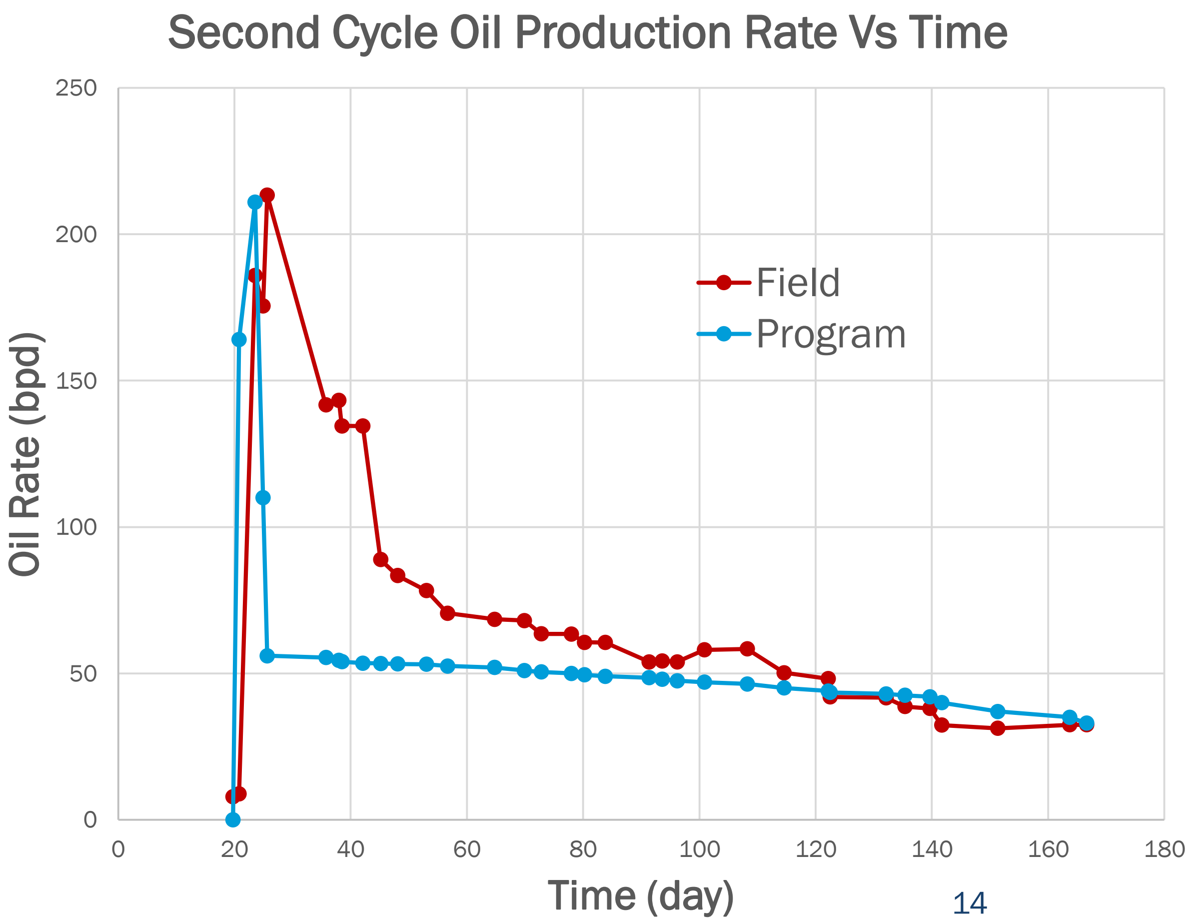
Midway Sunset Field

Cycle	Cumulative Oil Production (STB)		Cumulative Water Production (STB)	
	Field	Program	Field	Program
1	5584	4741	1855	3743
2	8779	8013	5874	3642
3	5698	5469	2798	3497
4	5893	6581	3182	3390
5	7213	8831	4572	4266
6	5132	6661	4377	3082
7	7389	7686	3937	4413
8	1924	3280	3069	4161

Field Applications

Midway Sunset Field





Field Applications

Huntington Beach field

Cycle	Cumulative Oil Production (STB)		Cumulative Water Production (STB)	
	Field	Program	Field	Program
1	29500	22600	84987	60000
2	22767	21880	61994	64000
3	13553	17700	41824	66000

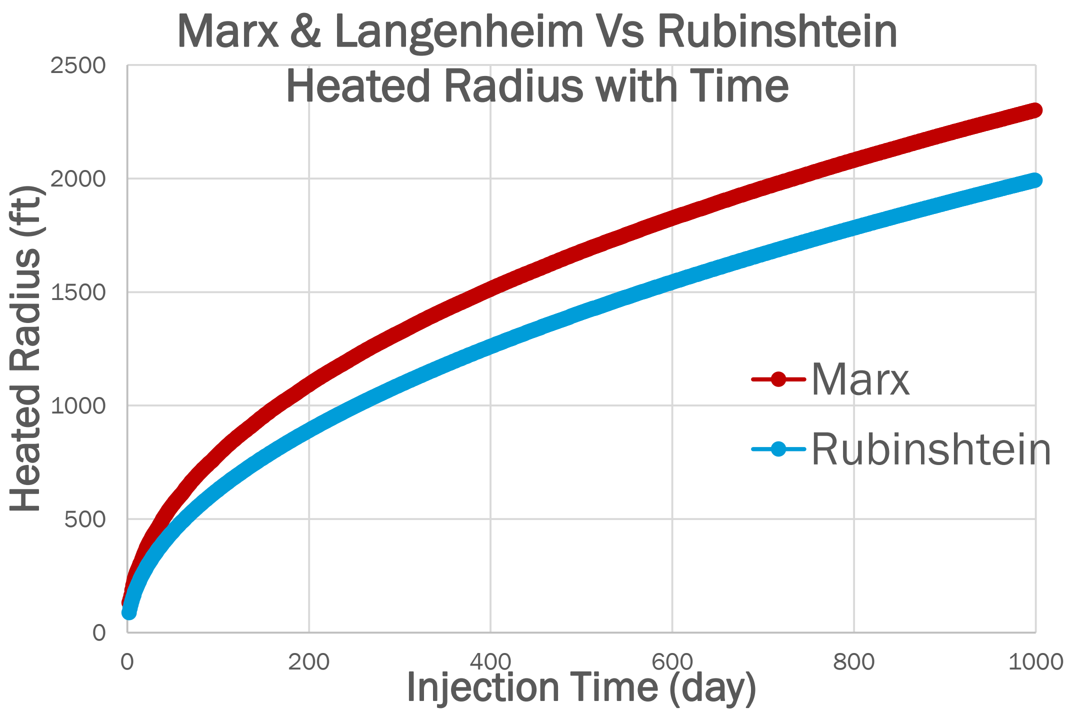
Program Advantages over Previous Models

- The developed Program solve some of the drawbacks of the models in the literature.
- This advantages improve the quality of the output data to match the reality as possible.
- The program provide four main advantages which are:

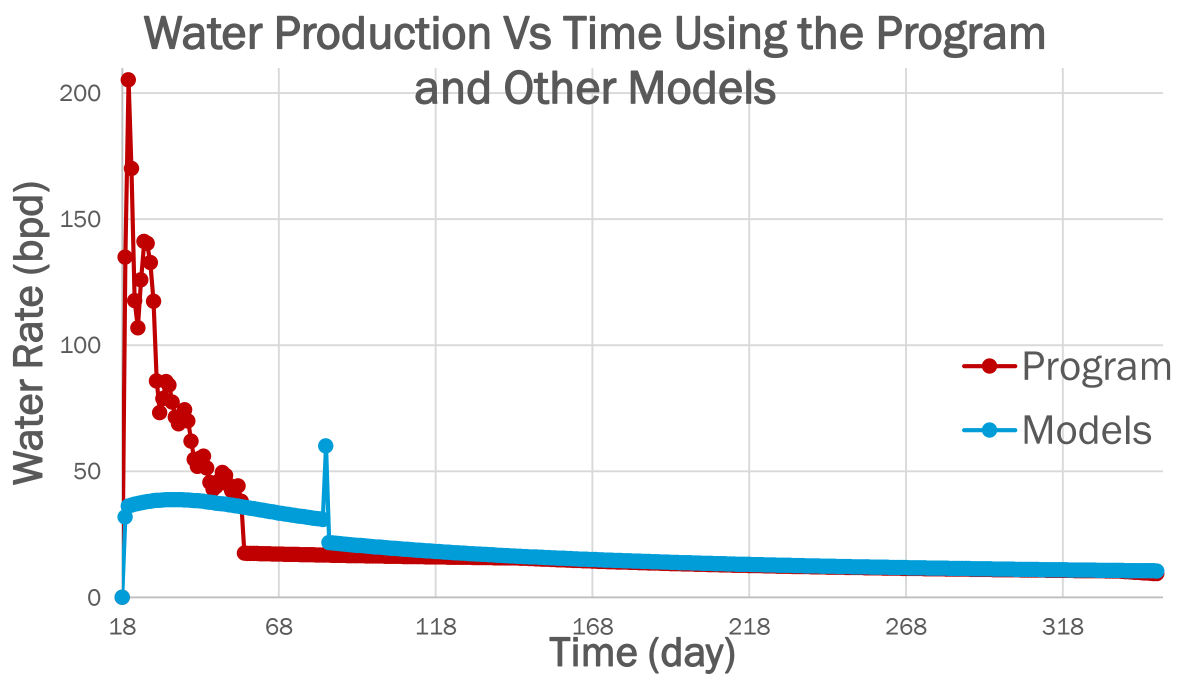
1. Rubinshtein's thermal efficiency.
2. Early water production.
3. Flow rate regimes.
4. Saturation changes in the heated zone.

Program Advantages over Previous Models

1) Rubinshtein's Thermal Efficiency

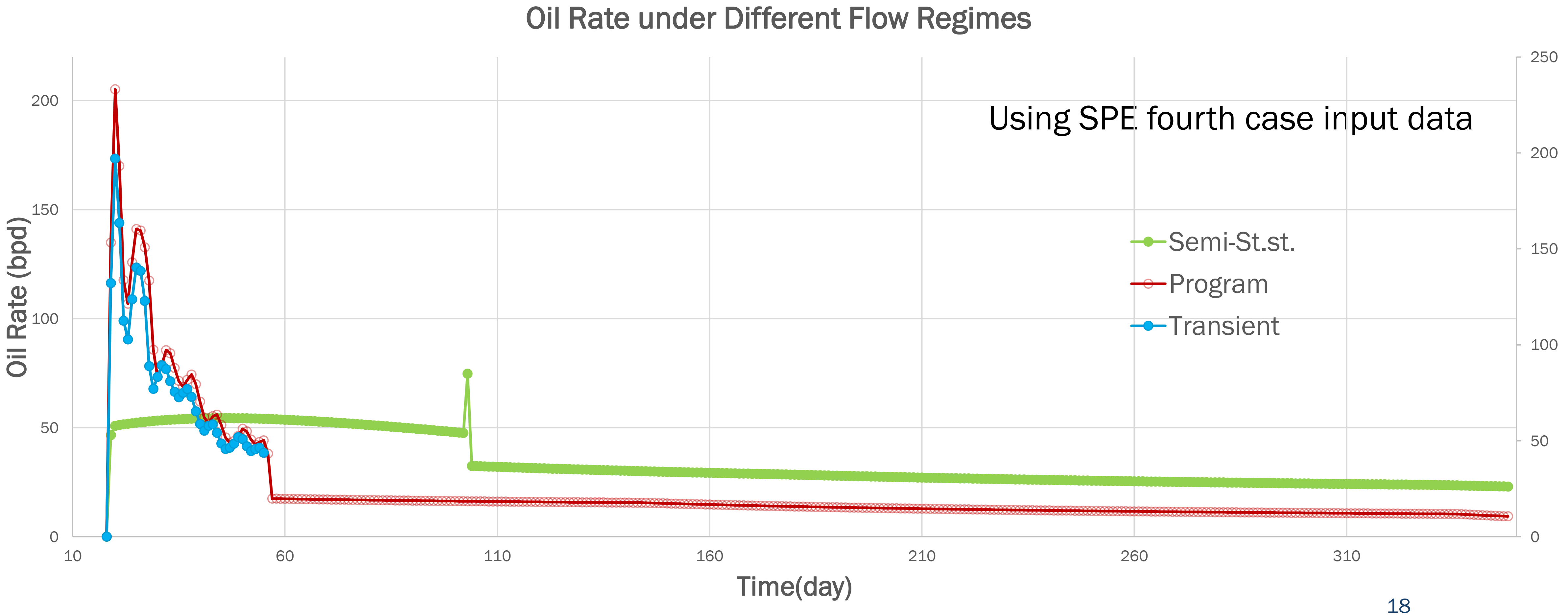


2) Early Water Production



Program Advantages over Previous Models

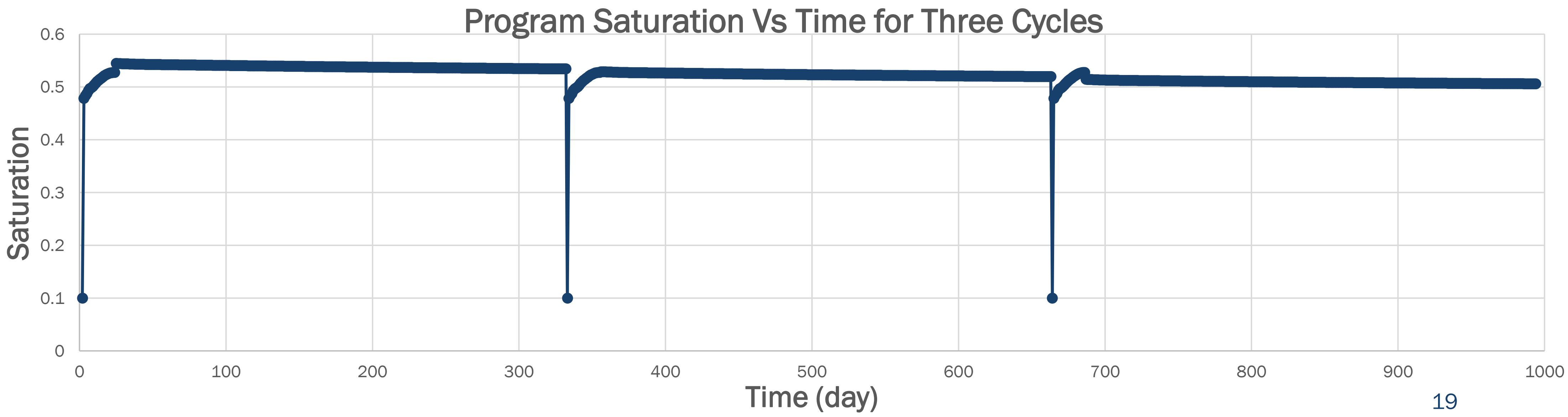
3) Flow Rate Regimes.



Program Advantages over Previous Models

4) Saturation Changes in the Heated zone

	Previous Models	Program
Initial Oil Saturation	Oil residual saturation to water	Oil residual saturation to steam
Material Balance	Water	Oil, water and steam
Increase till	Sw=Swc	So=Soavg Then decreases



Conclusion

- A new computer program is developed to forecast the performance of cyclic steam injection process.
- The program contain many methods of calculating a single sub-routine which increases its capabilities.
- The drawbacks of the previous models such as early water production, flow regimes, saturation changes and thermal efficiency are solved.
- Program validation and its field application prove that it could be used as a forecasting tool.


Спасибо
Gracias
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Спасибо
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