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DECLINE CURVE ANALYSIS FOR ZELLA OIL FIELD - “CASE STUDY”

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Abstract

In this work the decline curve analysis is implemented to study the effect of some parameters on calculated reserves of Zella Oil Field. The basic concepts and applications of decline curve analysis are determining the remaining reserve, total reserve and forecasting future production rate. The production intervals selected long enough so, the data will be sufficient to give good and reliable results. The production data points for each interval are analyzed separately to evaluate the effect of the change in the production and reservoir conditions on the remaining reserves. In this work, production decline curve was analyzed for five wells producing from the reservoirs under strong water drive mechanism; perform well by well and total field performance decline curve analysis using three scenarios (all data, averaging data and screening data).

Key Word: Decline curve; field performance; remaining reserve; scenario.

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1. Introduction

Decline curve analysis is a technique used to predict future production rates, estimating oil reserves, and estimating remaining productive life. It is found that the calculated remaining reserve depends on: production points that are selected to represent the real well behavior, way of dealing with the production data, production operations implemented in the Field, human errors that might happen during the life course of the Field.

The most popular decline curve is that represents the decline in the oil or gas production rate with time (rate time plot), another common technique is the plot of the production rates versus cumulative oil or cumulative gas production, normally termed (rate-cumulative plots).

These techniques can be applied to single well, total reservoir, cumulative company production, or even on a national level. The production rates are normally expressed as STB or MMSCF per day however, monthly and yearly rates are also popular [1].

Decline curve analysis can only be used as long as the mechanical condition and reservoir drainage remain constant in well and the well is produced at capacity [2].

The two basic problems in appraisal work are the determination of the most probable future life wells and the estimation of its future production. Sometimes one or both problems can be solved by volumetric calculations, but sufficient data are not available to eliminate all guesswork.

In those cases, the possibility of extrapolating the trend of some variable characteristic of such a producing well may be of considerable help. The simplest and most readily available variable characteristic of producing well is its production rate, and the logical way to find an answer to the two problems mentioned above, by extrapolation is to plot this variable production rate either against time or against cumulative production extending the curves thus obtained to the economic limit. The point of intersection of the extrapolated curve with the economic limit then indicates the possible future life or the future oil recovery.

The basic of such an estimate is the assumption that the future behaviour of a well will be governed by whatever trend or mathematical relationship is apparent in its past performance. This assumption puts the extrapolation method on a strictly empirical basis and it must be realized that this may make the results sometimes inferior to the more exact volumetric methods [3].

Estimating oil reserves is one of the most important phases of the work of petroleum engineer since the solutions to the problems it deals with usually depend on a comparison of the estimated cost in terms of barrels of oil [4].

Forecasting future production is the most important part in the economic analysis of exploration and production expenditures. Frequently this can be the weakest part of our analysis, for it may be based on little if any actual production performance[5] .

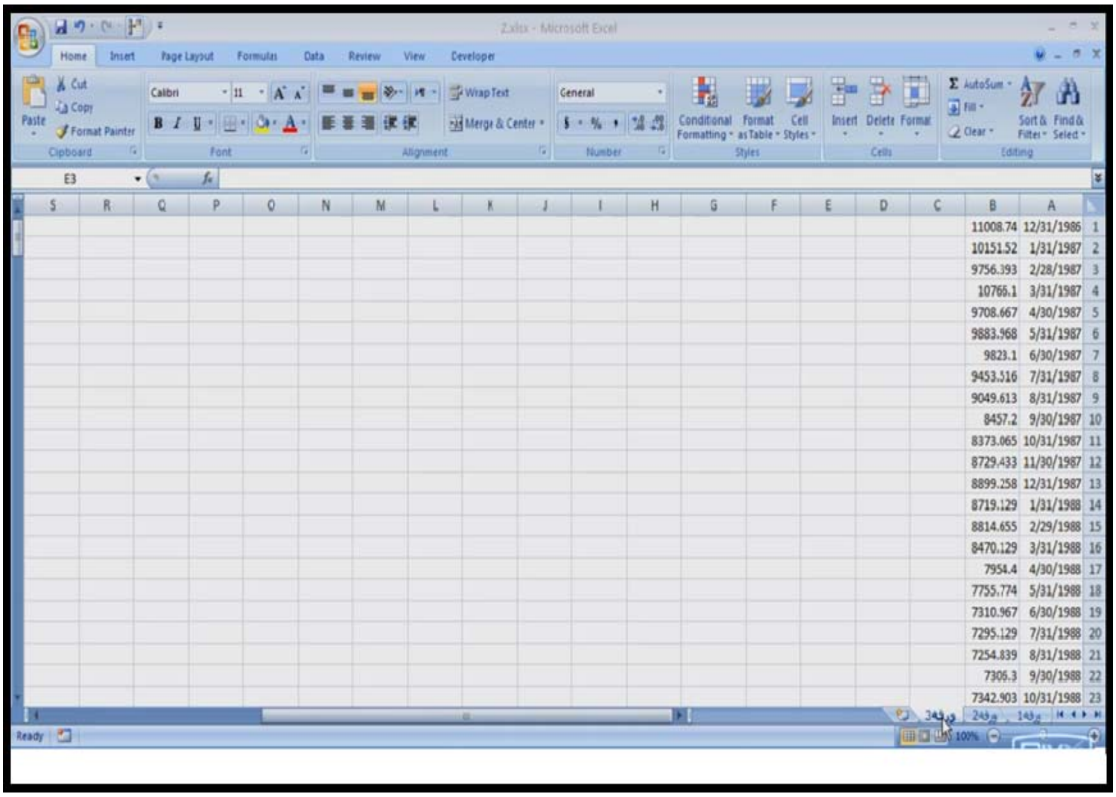
Estimation of petroleum reserves are prepared for a specific reason. The purpose of the estimate will in large measure dictate the method employed and the time spent in making the estimate**.** The estimate is seldom an end in itself, but is merely the first step in a series of calculations for the purpose of gaining knowledge that will influence current or future decisions [6].

The main objectives of this study are: to perform well by well and total field performance decline curve analysis in order to predict the future oil flow rate and estimate the remaining reserves for the field, **(a)** investigate the value of reservoir factor (**b**) to know the type of reservoir driving mechanism, studying the effect of some parameters such as multi layered system and water injection on the field performance, comparing the results we obtained with the results we obtained with the screening, averaging, all date point and DCA program, estimate the remaining reserve of the reservoir, and study management of the field.

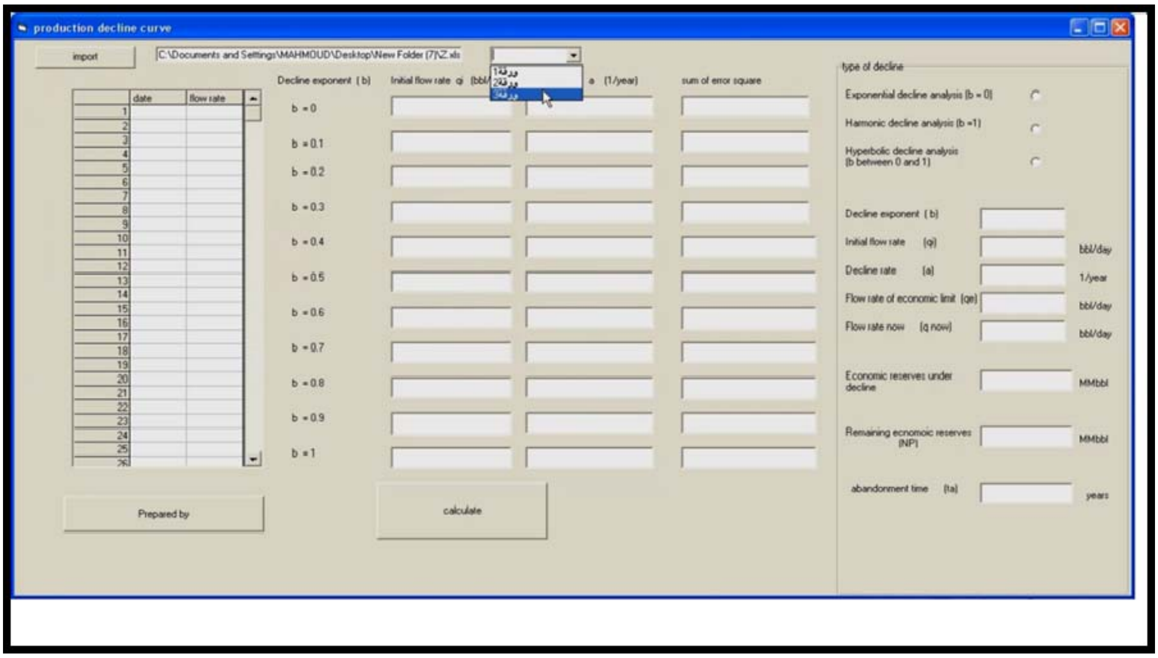
2. Procedure Followed

In this work the following procedure was followed:

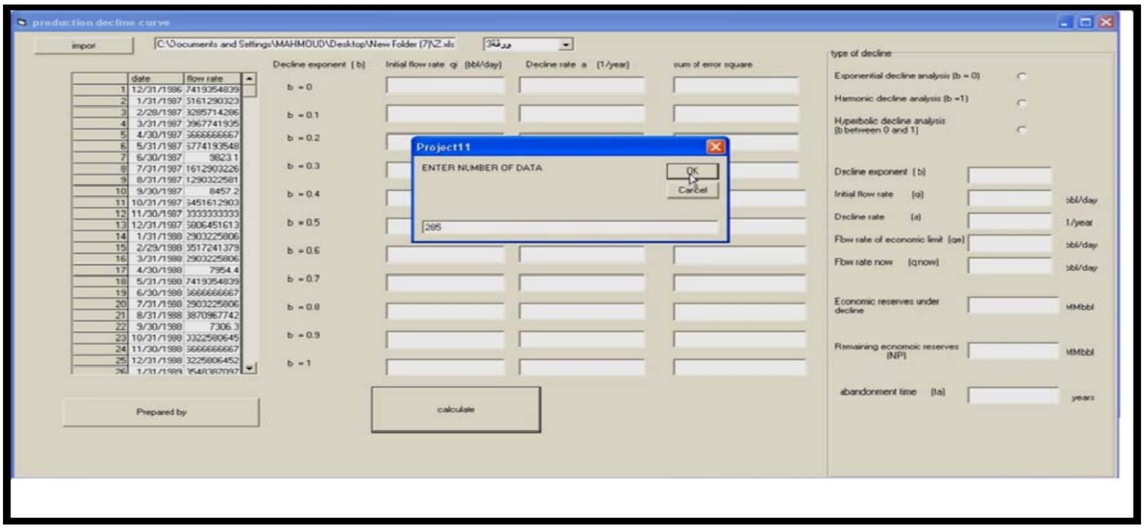
1. The production history of the field as well as the wells was collected.
2. The production history was plot as a flow rate versus time for each well and for the reservoir.
3. Then, the decline intervals were selected to perform the DCA.
4. The DCA was repeated under three scenarios: all data points were considered, averaging the data points and screening the data points.
5. The results were interpreted and plotted in figures from (1 to 24).
6. *6.* The effect of operations done on the selected wells was studied.
7. Using visual basic program to determine production decline curve by following steps: Input flow rate and date or time (production period) in excel sheet by input date in cell A1 and flow rate in cell B1.



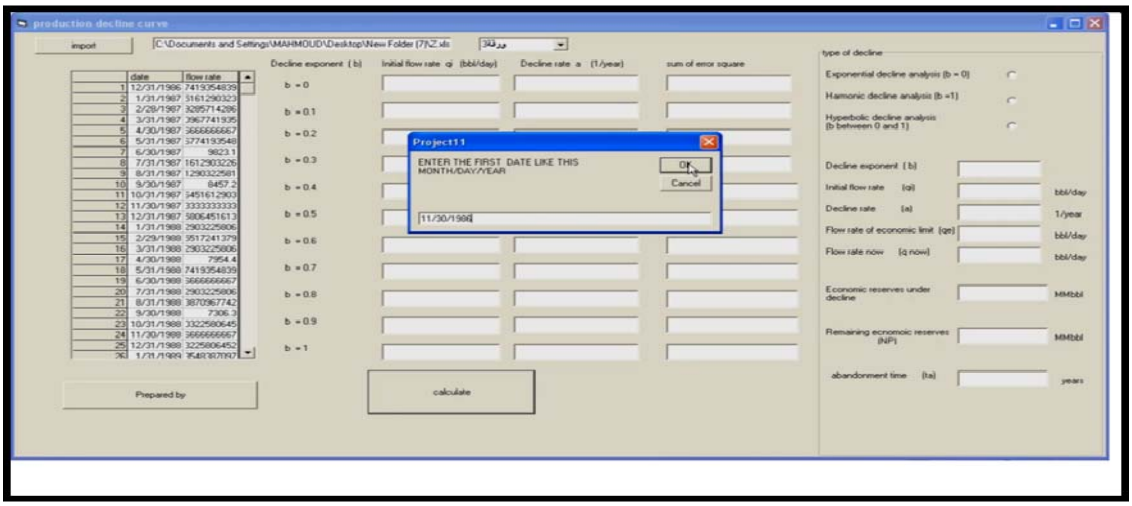
Open the program and enter click into button import chose the excel file it was prepared and after that chose sheet it was pre-pared in the excel file.



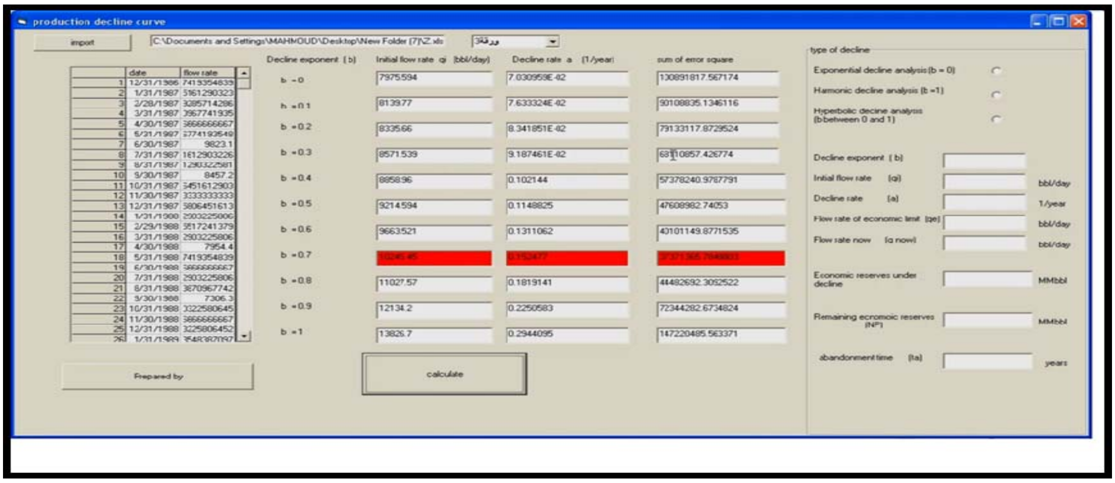
Enter click into button of calculate and enter the date before the date of the first period and enter click into button of ok.



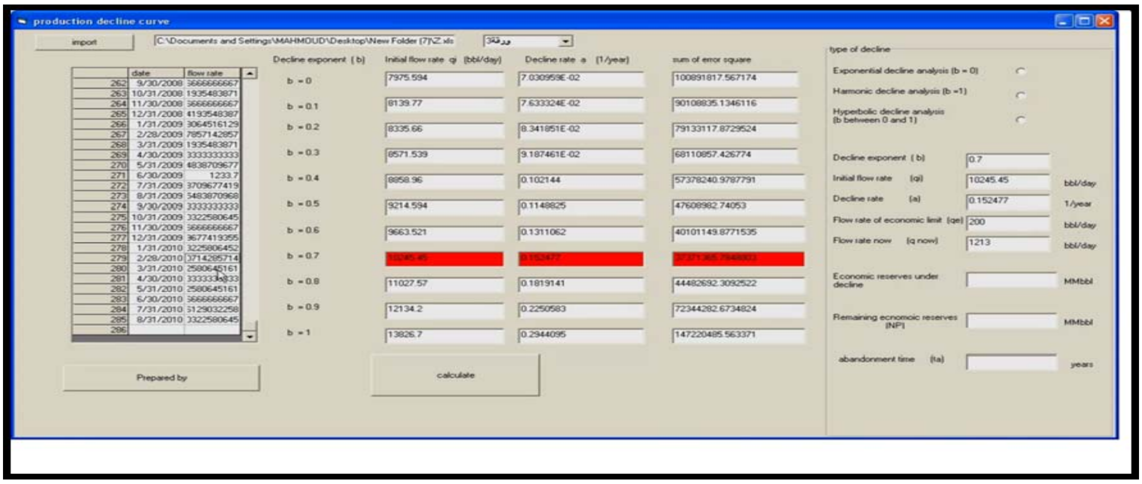
Enter the number of data after that enter click into button ok.



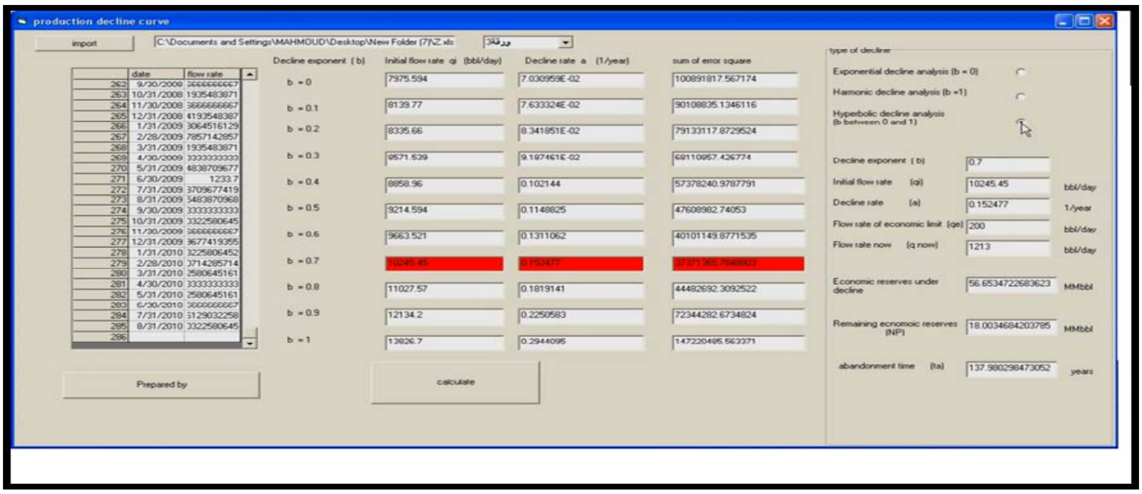
waiting until it give the answer " red back color boxes" whose give the less sum of error square .



take the value of Decline exponent (b), Decline rate (a), Initial flow rate (qi), after that transfer these data into has place and input flow rate of economic limit (qe) and input flow rate now (the last flow rate in the excel sheet period).



Chose the type of decline after it gives reserve and remaining reserve and abandonment time.



To find values of Decline exponent (b), Decline rate (a), Initial flow rate (qi), to get the values of reserve under decline, abandonment time and remaining reserves. The calculated remaining reserve becomes more reliable whenever data points are well screening and well averaging. Averaging the data points will minimize the effect of unwanted data points on the accuracy of the results; on the other hand the screening (canceling the faulty or non representative data point) is the best way to get more reliable remaining reserve from the production decline curve analysis.

Zella Field

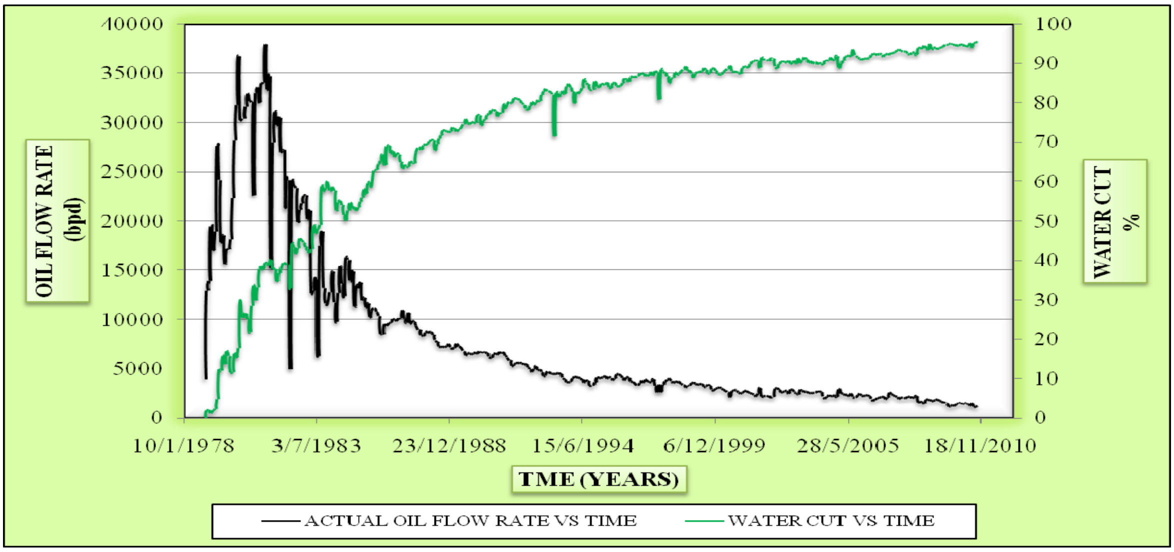


Figure (1) production field history

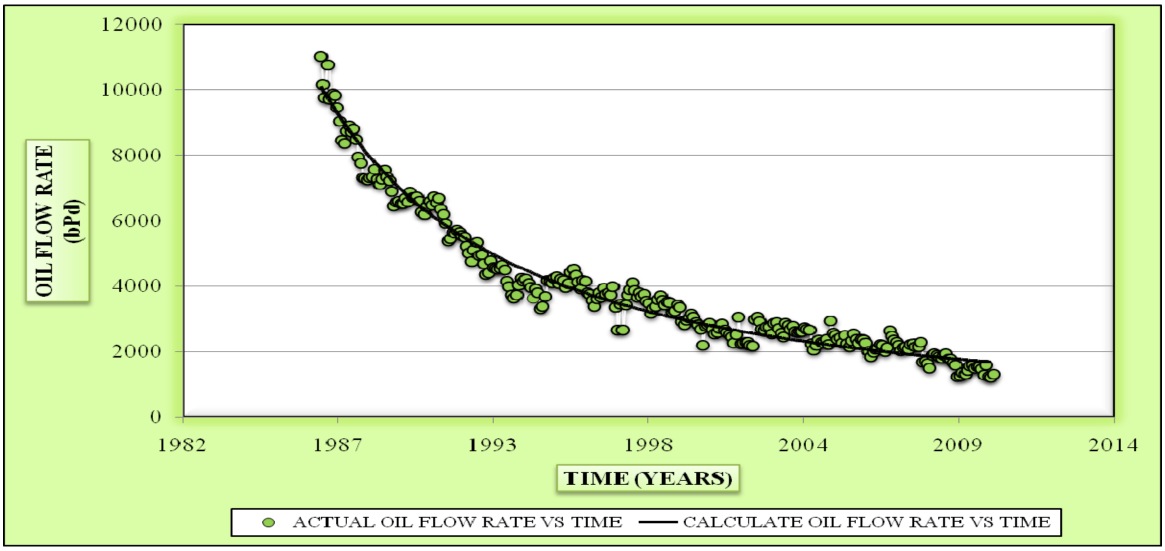


Figure (2) flow rate verse time (All date)

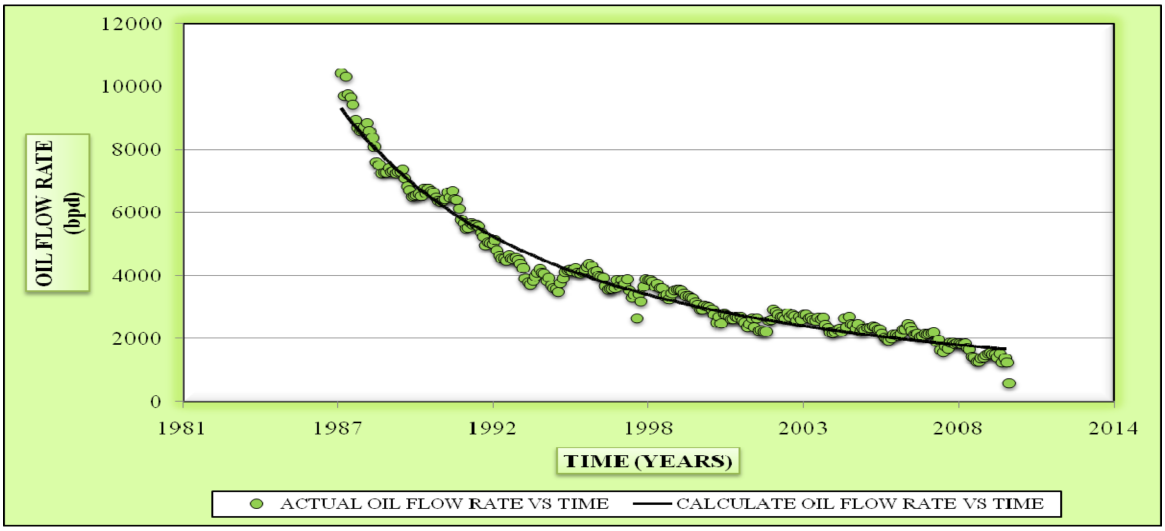


Figure (3) flow rate verse time (Averaging)

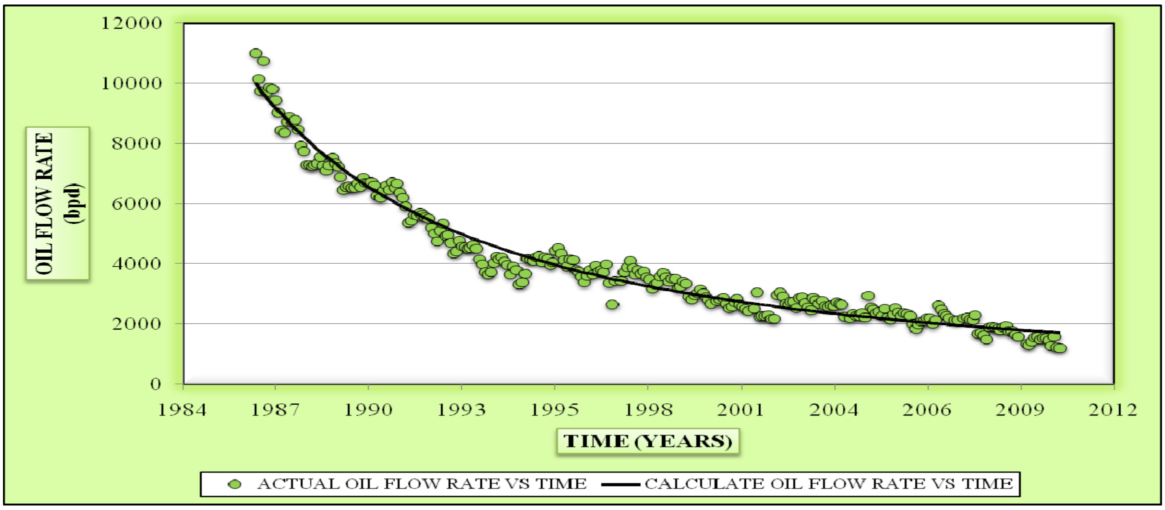


Figure (4) flow rate verse time (Screening)

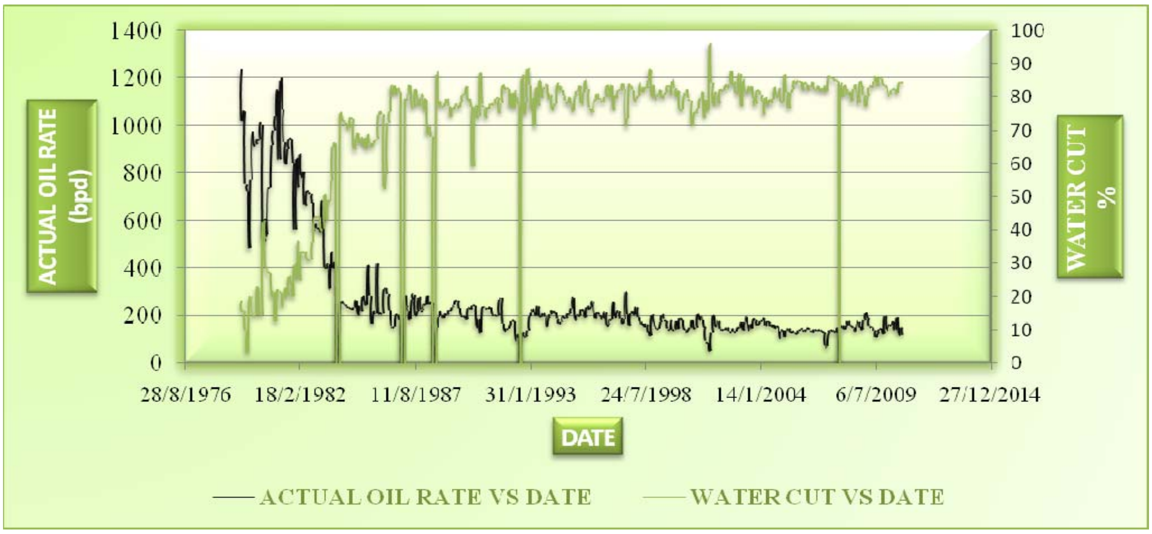


Figure (5) production performance of well A15

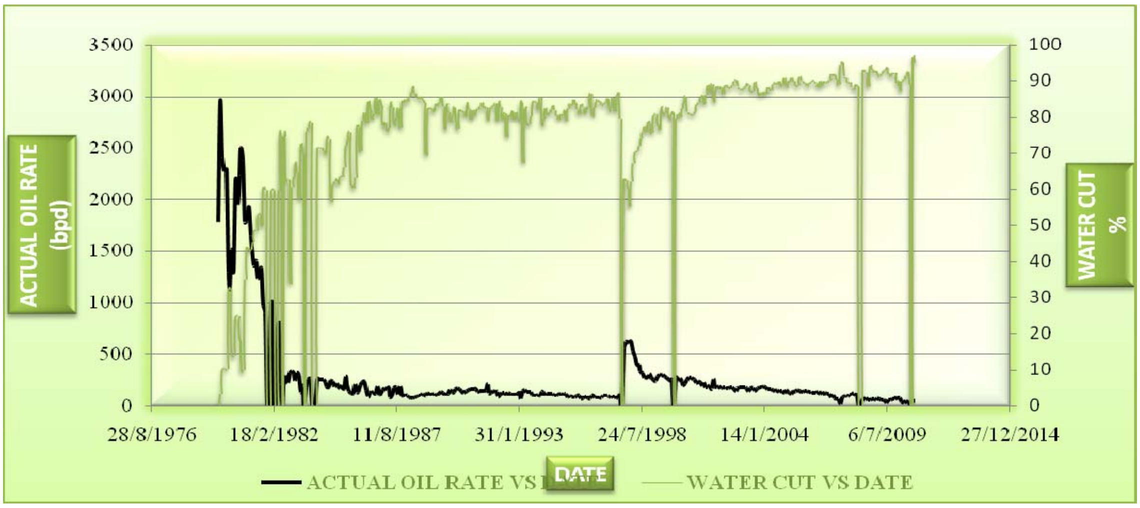


Figure (6) production performance of well 22

Figure (7) production performance of well A25

Figure (8) production performance of well A28

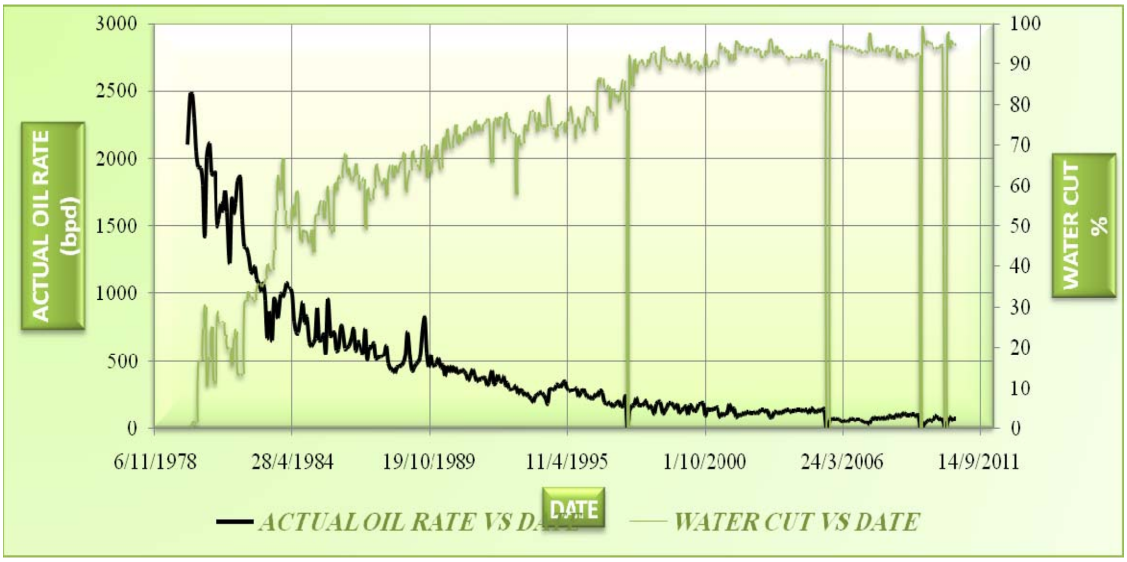


Figure (9) production performance of well A39

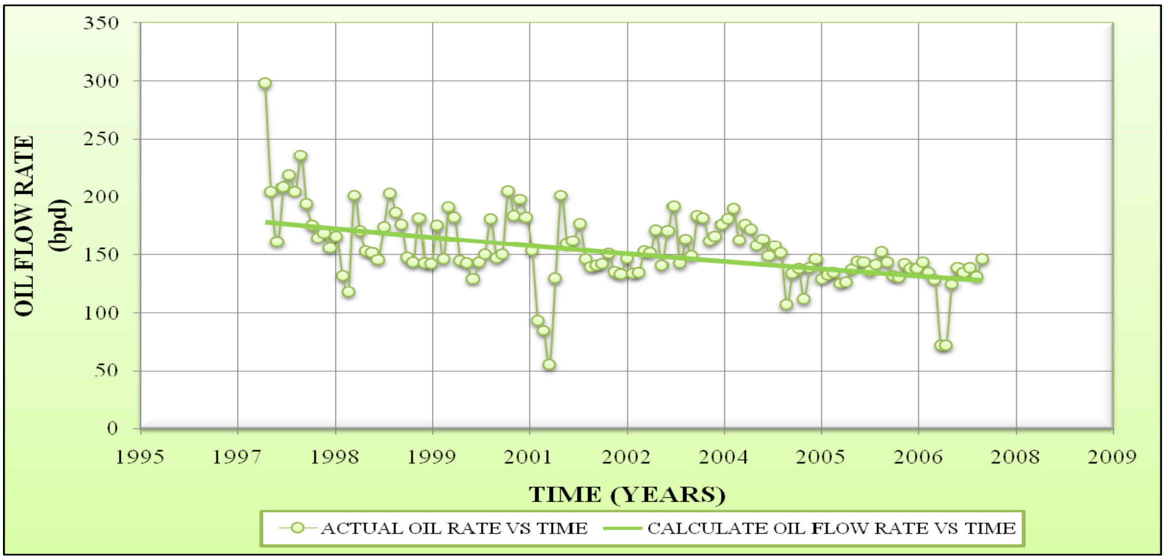


Figure (10) well A15 flow rate verse time (All date)

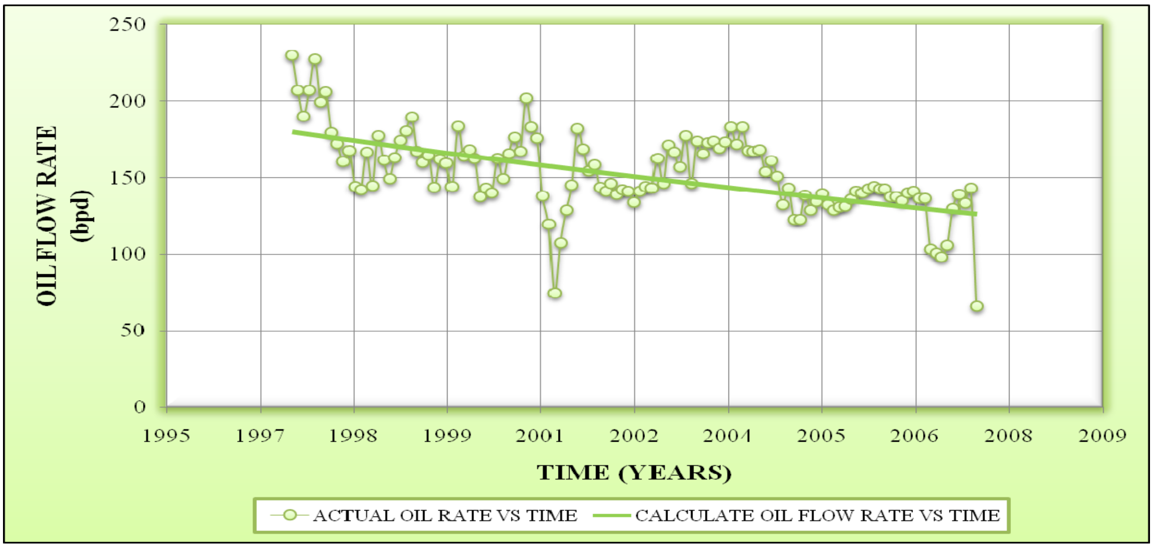


Figure (11) well A15 flow rate verse time (Averaging)

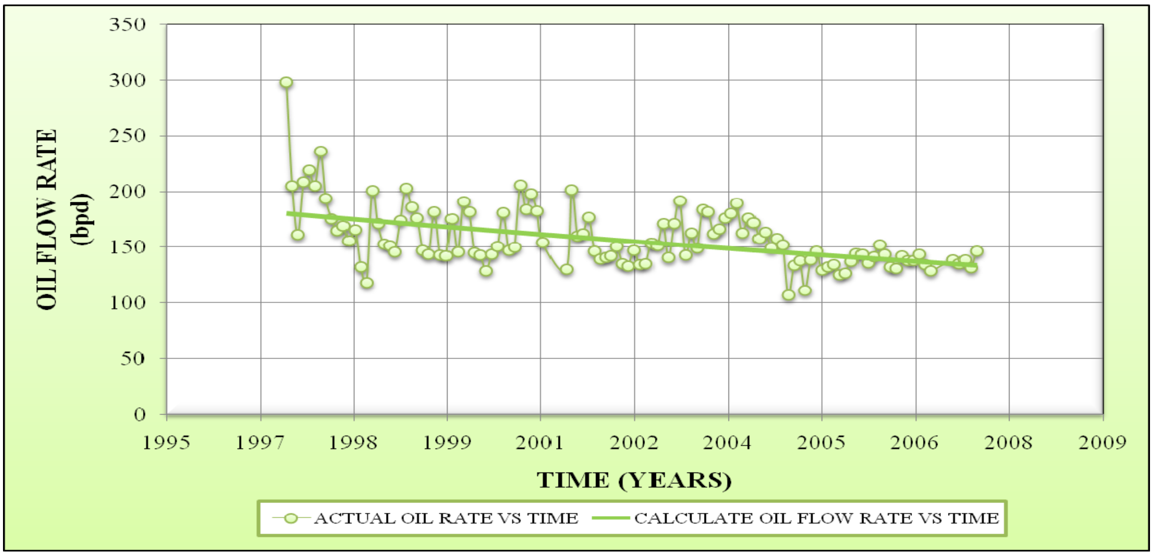


Figure (12) well A15 flow rate verse time (Screening)

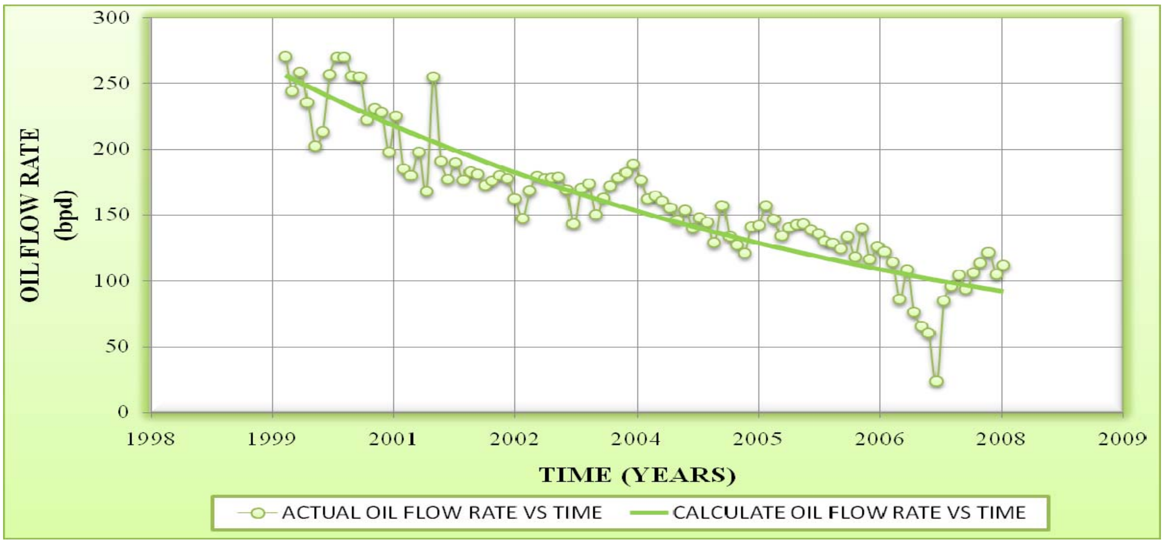


Figure (13) well A22 flow rate verse time (All date)

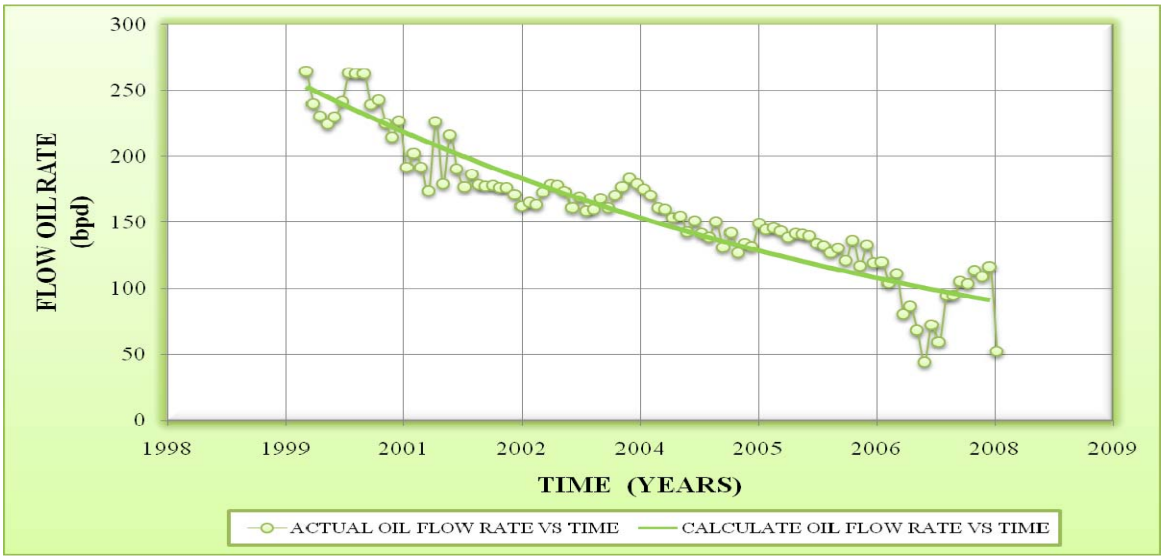


Figure (14) well A22 flow rate verse time (Averaging)

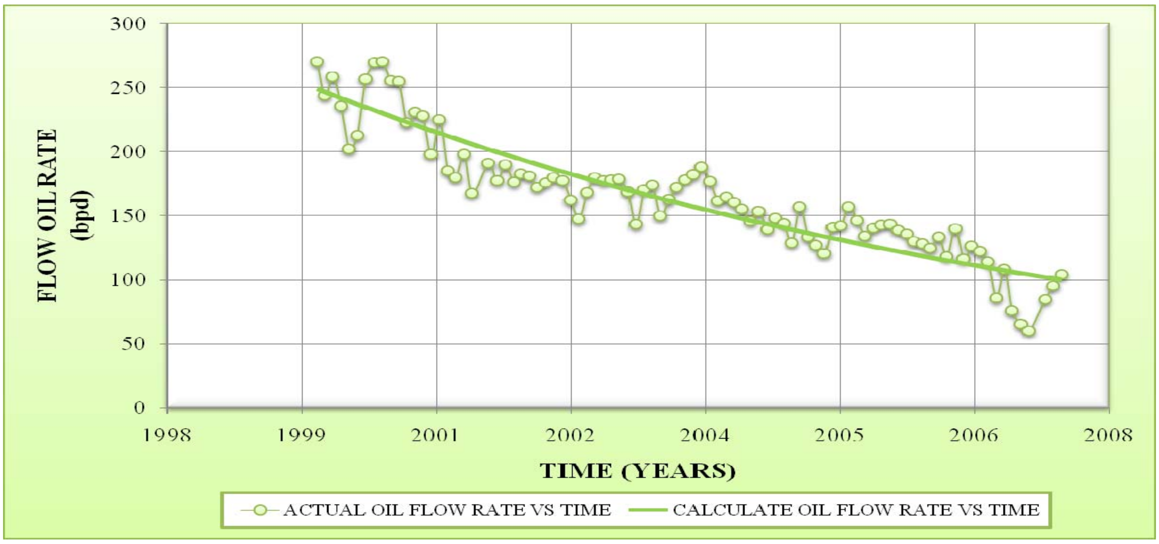


Figure (15) well A22 flow rate verse time (Screening)

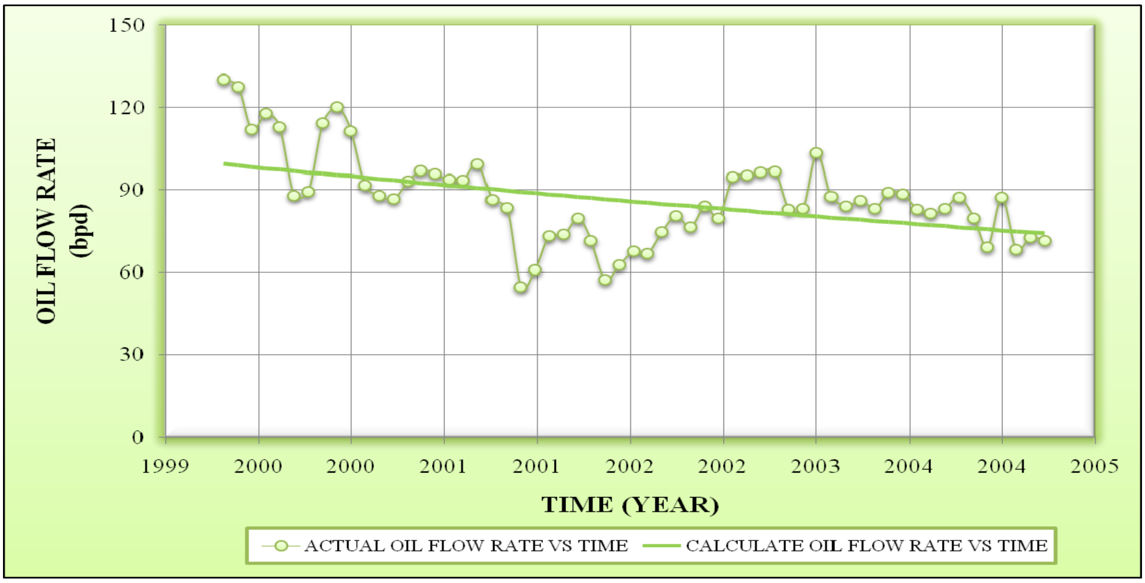


Figure (16) well A25 flow rate verse time (All date)

Figure (17) well A25 flow rate verse time (Averaging)

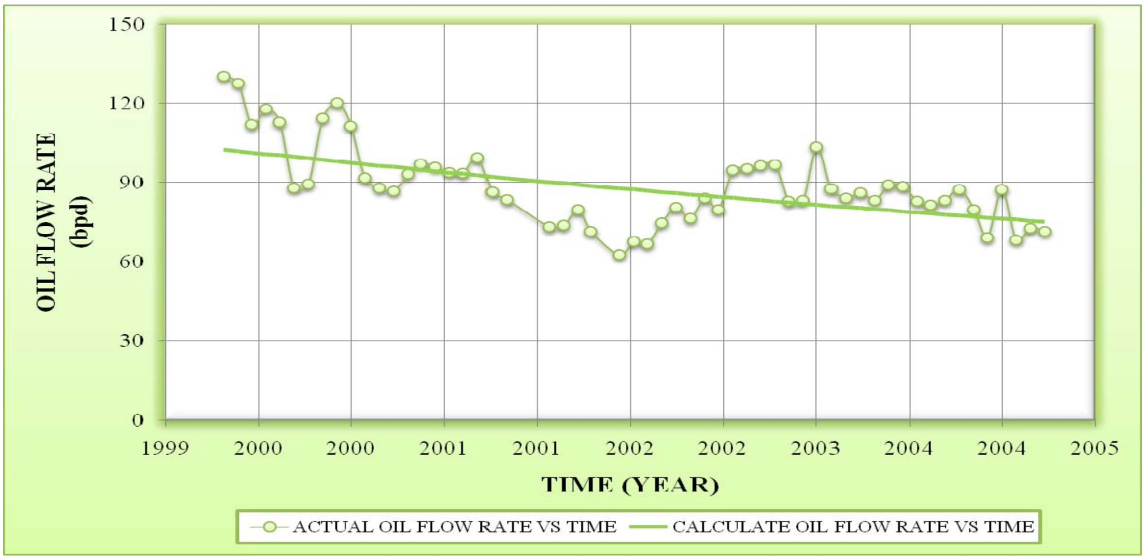


Figure (18) well A25 flow rate verse time (Screening)

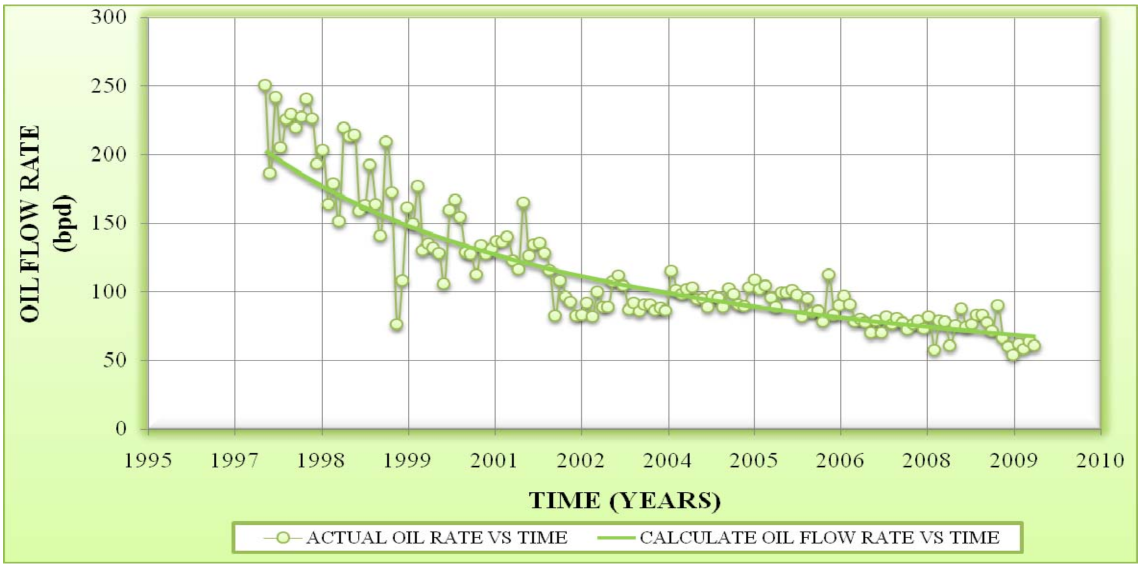


Figure (19) well A28 flow rate verse time (All date)

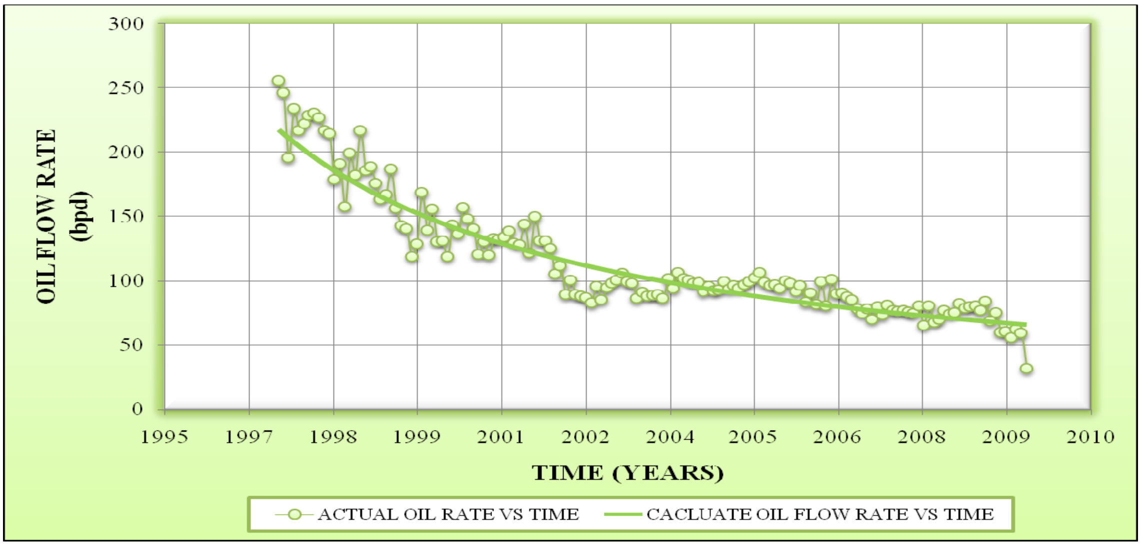


Figure (20) well A28 flow rate verse time (Averaging)

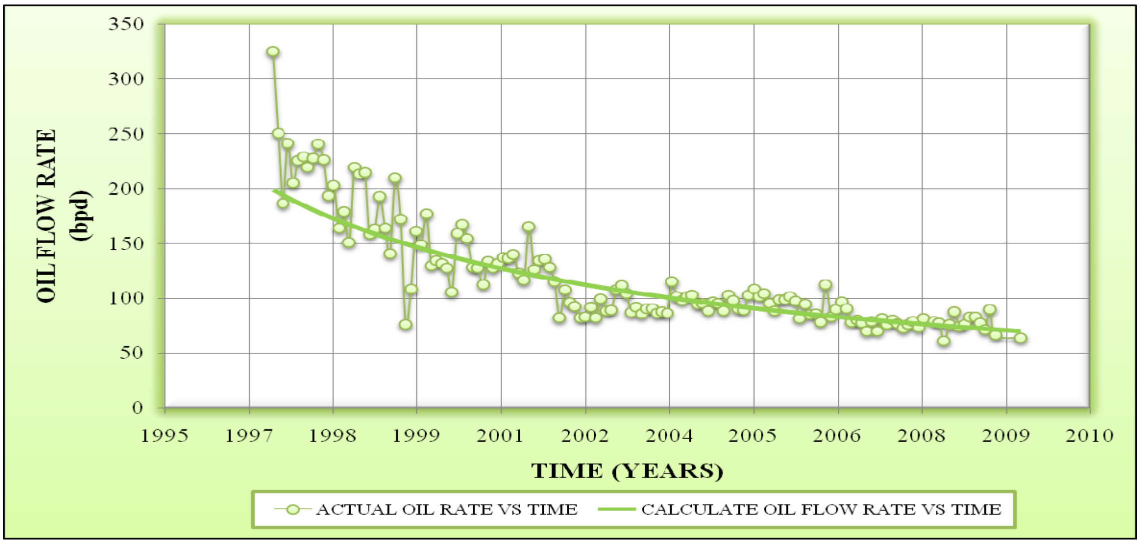


Figure (21) well A28 flow rate verse time (Screening)

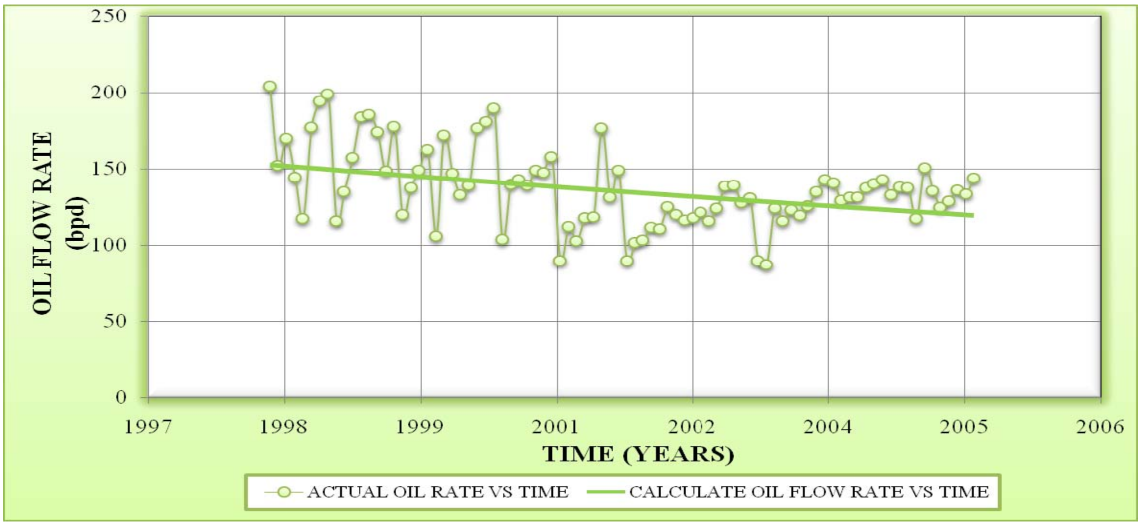


Figure (22) well A39 flow rate verse time (All date)

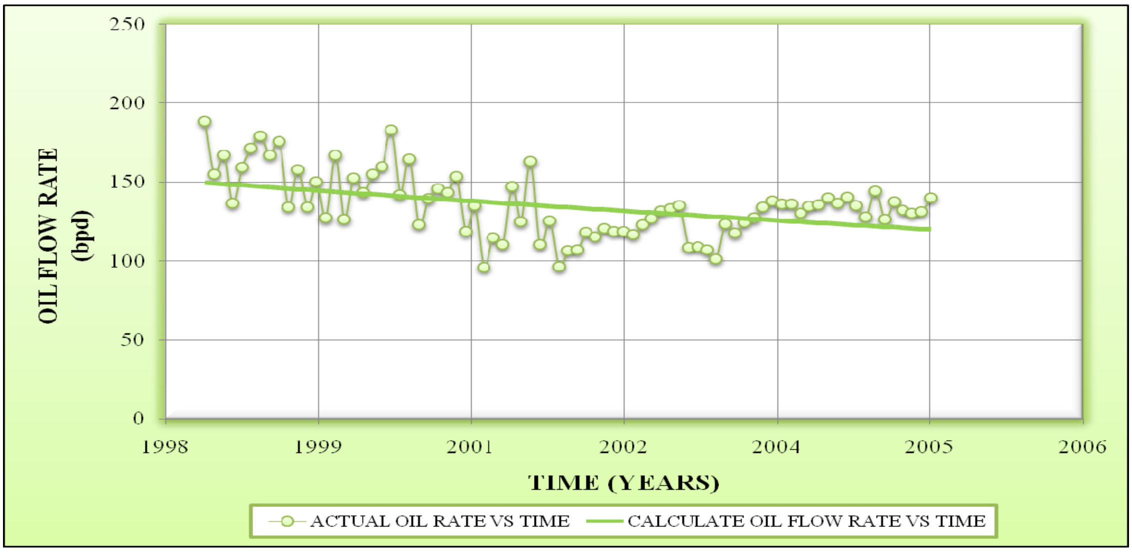


Figure (23) well A39 flow rate verse time (Averaging)

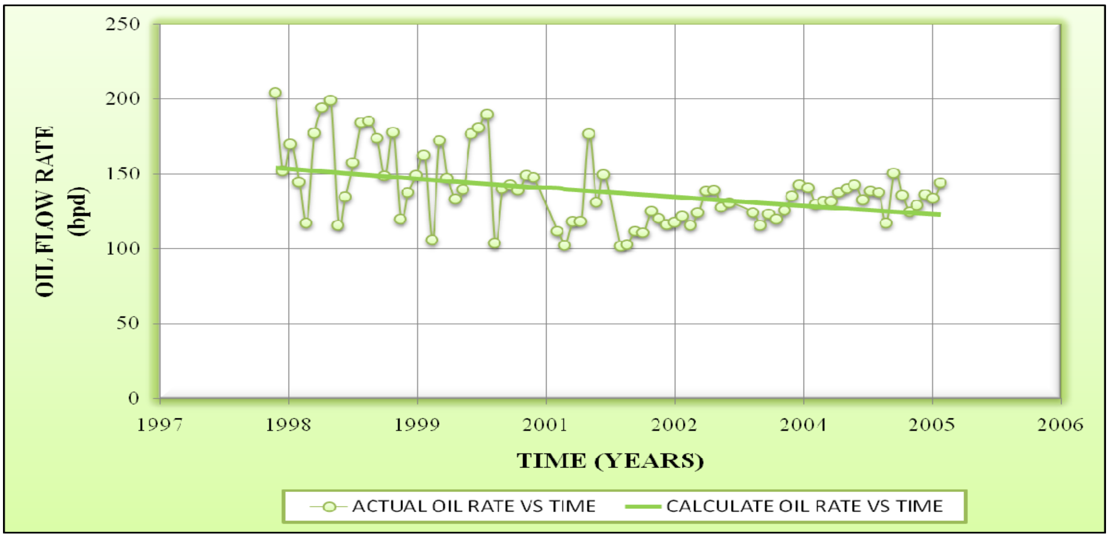


Figure (24) well A39 flow rate verse time (Screening)

3. Conclusions & Recommendation:

The main conclusions & recommendations of this study can be summarized as follows:

1. Not long initial oil rate plateau is indicative of successive oil fronts breaking through multiple layers and/or limited pump capacity, where the Short fill up period means little free gas in system.
2. The value of reservoir factor (b) is almost equal to zero which mean the water injection applied in the reservoir are working as water drive mechanism.
3. It was noticed that the value of reservoir factor (b) differs from one well to the other within the reservoir, this is a result of that some of the wells are far from the injector wells.
4. The wells which located near to the water injection wells have a value of (b) equal to zero which mean the water injection project was successful.
5. The calculated remaining reserves by DCA are affected by:
   - The type of decline exhibited by the production history
   - The operating procedure implemented on the well and hence on the reservoir
   - The way the production data was handled
   - The effect of human error
   - Production Conditions
   - The diagnostic plot showed that the water injection profile in Zella field is edgewater flood
   - Two breakthroughs took place during the field life indicating that two layers are taking the injection
   - Water injection has a regional effect as a result of permeability variation and fracture flow system
   - WOR in Zella is in critical phase and need to be optimized
   - Analysis by production decline curve program takes the less time comparing by hand analysis.
6. We recommend that after sufficiently production history is obtained a comprehensive DCA should be performed to see the effect of the orations procedure on the remaining reserves.
7. It is recommended to optimize the water injection pattern on regions basis in order to decrease the WOR to an acceptable range by reduce water injection.
8. In order to have better understanding for the effect of injectors on production wells and due to fracture flow system and permeability variation, it is recommended to do the recommended actions for each well separately based on time schedule and keep the most nearby wells under close monitoring.
9. Pressure records is an important control to continue optimization, so it is recommended to keep monitoring on reservoir pressure while doing the injection optimization.

Acknowledgement

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