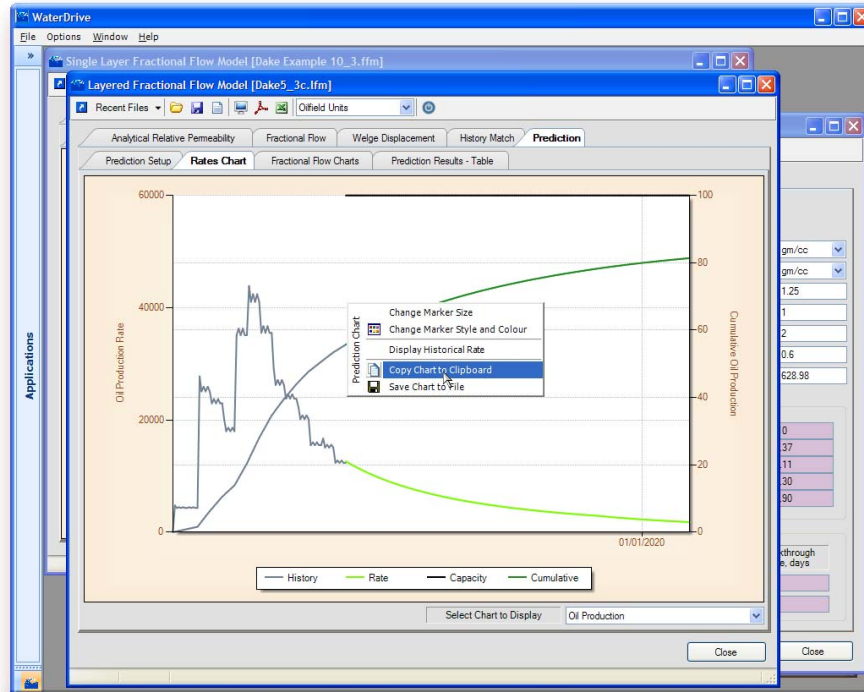


# Introducing ..... *Waterdrive*



# Waterdrive is a collection of classical calculations that .....

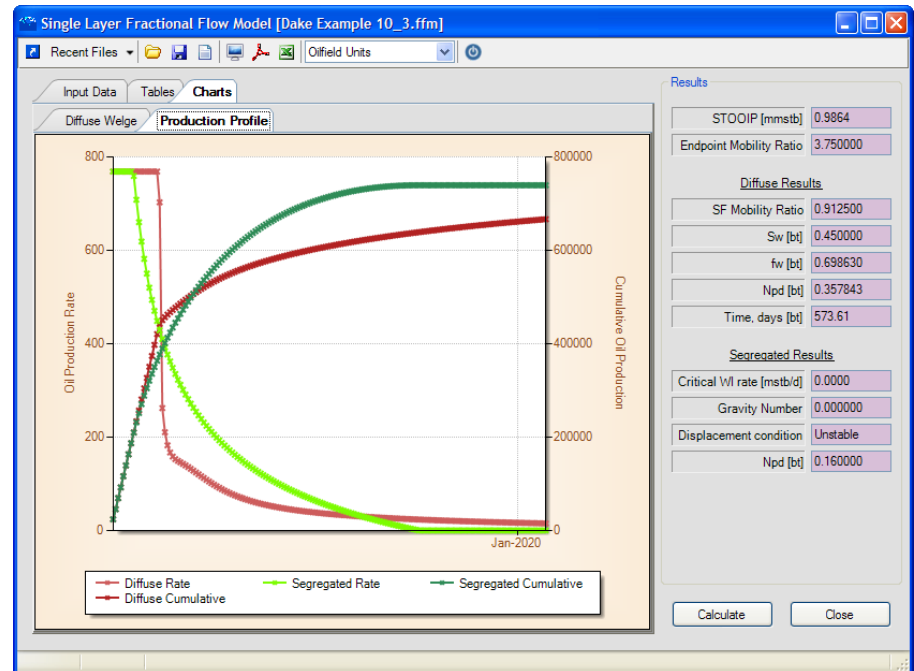
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- ❑ Analyse the water-oil displacement processes for both single layer and multi-layered systems.
- ❑ Examine the waterdrive performance of reservoirs, or models, from an inspection of their production & injection history.
- ❑ Calculate performance with time for a five-spot pattern, using the approach of Craig, Geffen, and Morse.
- ❑ Calculate Dykstra-Parsons and Lorenz Heterogeneity coefficients
- ❑ Calculate performance with time, using two approaches based on the original work of Dykstra-Parsons, relating oil recovery and producing WOR to cumulative injected water
- ❑ Calculate water coning in vertical and horizontal wells, determine the critical flow rate, breakthrough time predictions and performance calculations after breakthrough
- ❑ Plus numerous other smaller routines.....



# Dake – Welge Calculations

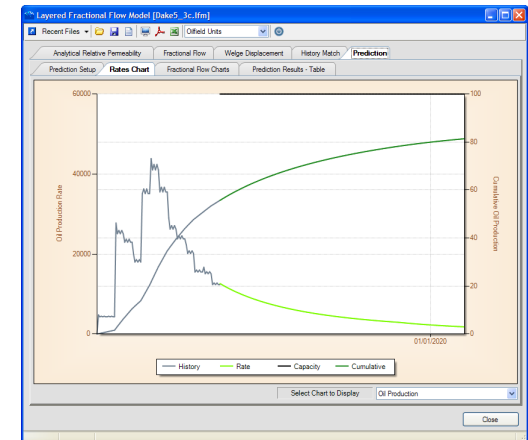
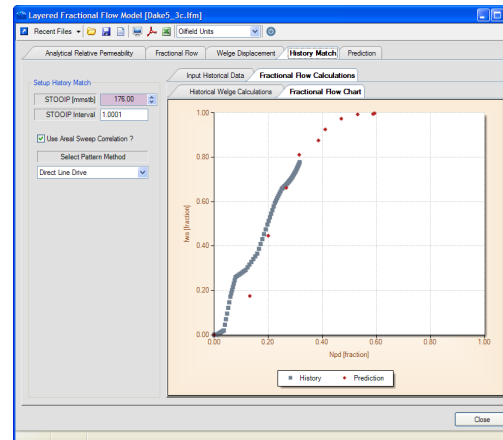
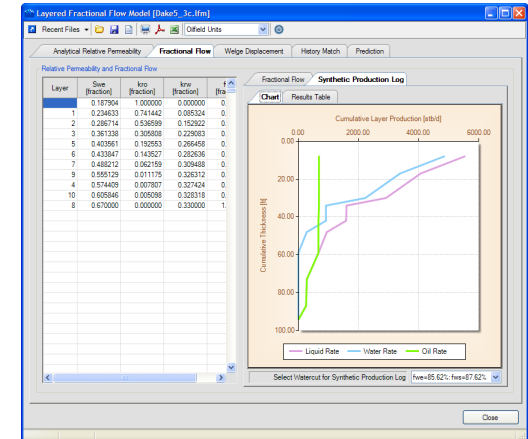
- Single layer diffuse and segregated flow analysis



# Dake – Welge Calculations

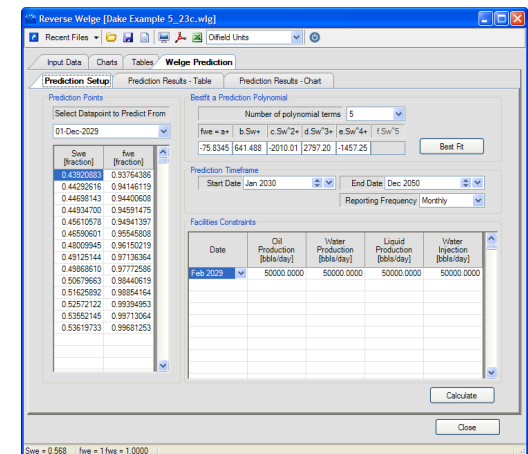
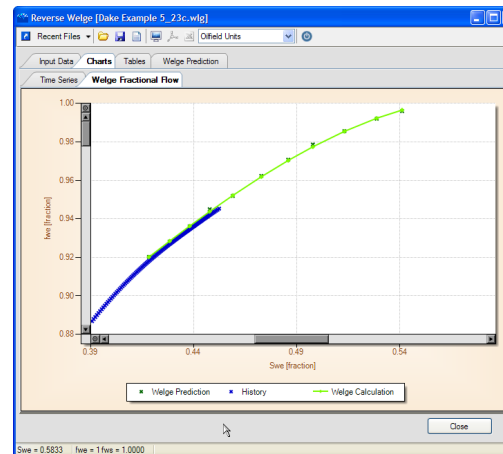
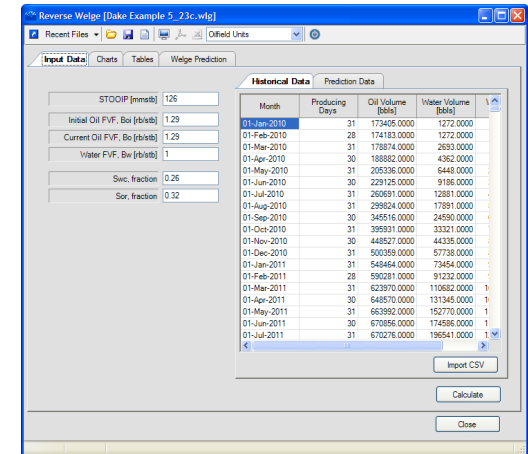
## Multiple layered analysis

- Layer flooding
- Pseudo production log prediction
- History Matching
- Life of field Prediction



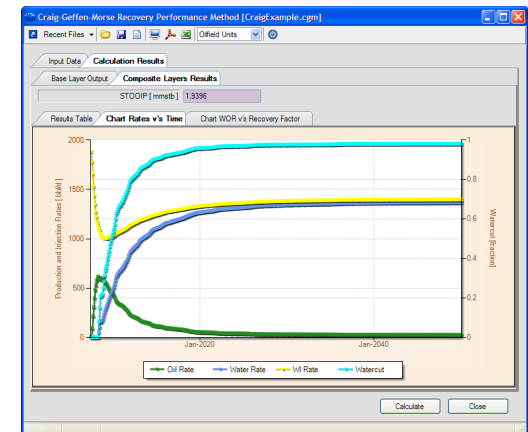
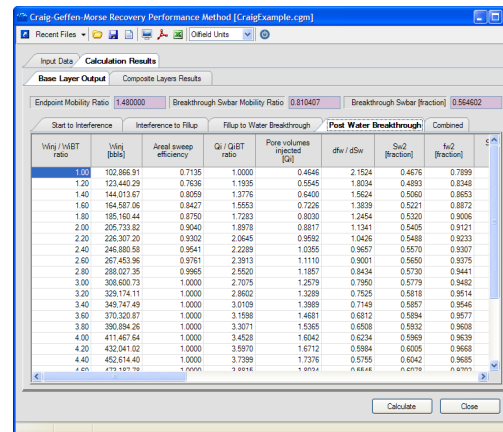
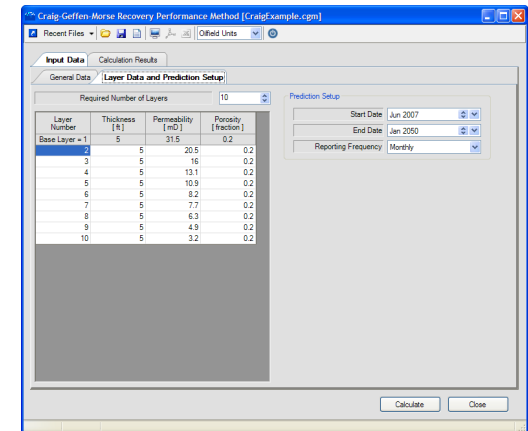
# Dake – Welge Calculations

- Examine Waterdrive Performance
  - Historical data & model predictions
  - Solves Welge's equation in reverse
  - Life of field Prediction



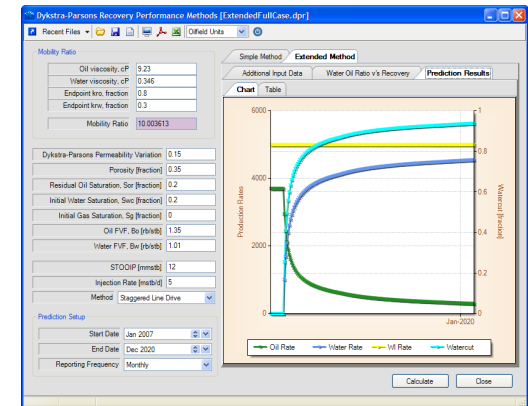
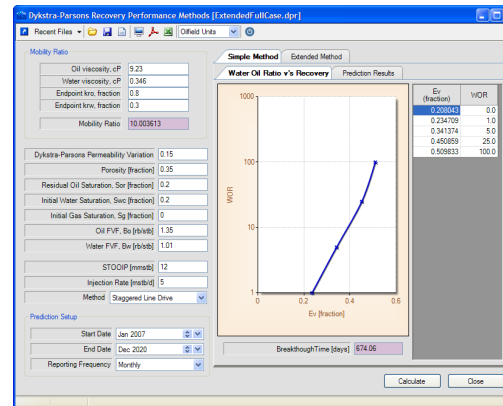
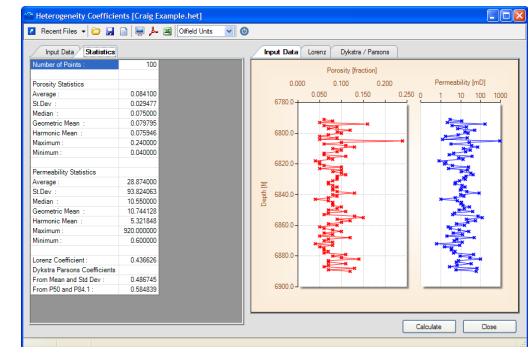
# Craig-Geffen-Morse Calculations

- Waterflood performance with time for a five-spot pattern
  - Relates oil recovery and producing WOR to cumulative injected water



# Dykstra-Parsons Calculations

- Heterogeneity coefficients
- Waterflood performance with time
  - Relates oil recovery and producing WOR to cumulative injected water



# Water Coning – Vertical Well

- ❑ Critical rate
- ❑ Breakthrough time
- ❑ Post breakthrough performance

Vertical Well Water Coning Calculations [Chierici Example.cng]

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Input Data Results

Calculate ?

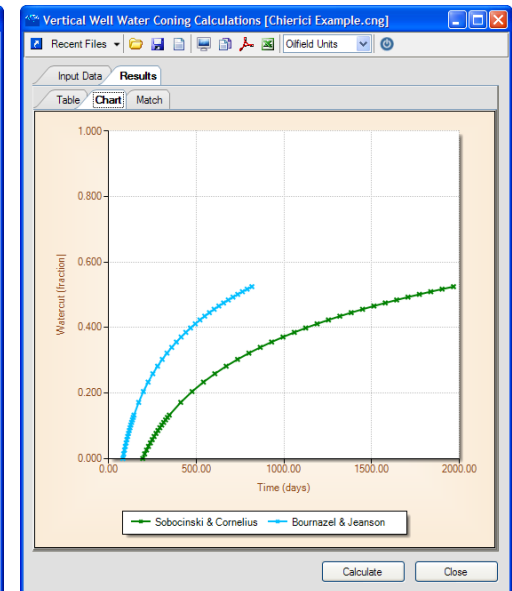
Critical Rate  Production above Critical Rate

Perforated Interval, ft	19.685	Oil Density	0.78	gm/cc
Thickness of Oil Zone, ft	98.4252	Water Density	1.03	gm/cc
Total Thickness, ft	164.042	Oil FVF, Bo rb/stb	1.25	
Wellbore Radius, ft	0.345	Water FVF, Bo rb/stb	1	
Drainage Boundary Radius, ft	1053.1496	Oil Viscosity, cP	2	
Porosity, fraction	0.25	Water Viscosity, cP	0.6	
Radial Permeability, mD	500	Oil Flow Rate, bbl/d	628.98	
Vertical Permeability, mD	500			
Endpoint kro, fraction	0.9	Critical Flow Rate, bbl/d		
Endpoint krw, fraction	0.4	Meyer and Garder	80.10	
		Chierici	182.37	
		Hoyland et al	166.11	
		Chaperon	138.30	
		Schols	120.90	

Results for Production above Critical Rate

	Critical Flow Rate, bbl/d	Breakthrough Time, days
Sobocinski and Cornelius	340.23	345.05
Bournazel and Jeanson	276.93	143.16

Calculate Close





# Water Coning – Horizontal Well

- ❑ Gas and Water Critical rate
- ❑ Breakthrough time
- ❑ Post breakthrough performance

Horizontal Well Coning Calculations [Josh Example811.cnh]

Recent Files | Offfield Units

Input Data Results

Calculate Critical Rate - Water Coning

Thickness of Oil Zone, ft	92	Gas Density	0.13	gm/cc
Thickness of Water Zone, ft	80	Oil Density	0.79	gm/cc
Height - GOC and Well, ft	72	Water Density	1.01	gm/cc
Height - OWC and Well, ft	80	Oil FVF, Bo rb/stb	1.178	
Well Length [L], ft	1500	Water FVF, Bw rb/stb	1	
Well Radius, ft	0.328	Oil Viscosity, cP	1.6	
Major Length [xe], ft	2640	Water Viscosity, cP	0.4	
Minor Length [ye], ft	2640	Swc, fraction	0.27	
Porosity, fraction	0.31	Sor, fraction	0.25	
Radial Permeability, mD	5580	Endpoint kro, fraction	1	
Vertical Permeability, mD	1.8	Endpoint krw, fraction	0.35	
		Oil Flow Rate, bbl/d	8000	

Show Well Schematic

Critical Flow Rate, bbl/d

Josh	4938.206
Giger and Karcher	1157.507
Chaparon	9216.832
Efros	1157.216

Breakthrough time, days

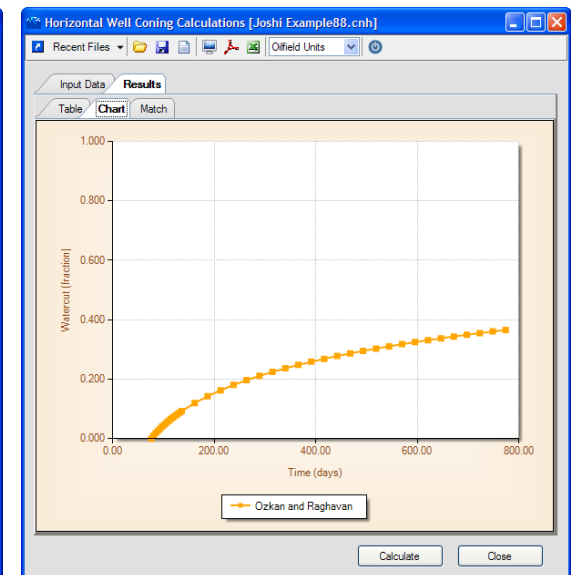
Ozkan-Raghavan

Papatzacos

Optimum well placement above the OWC, ft

Papatzacos

Calculate Close



# plus numerous other tools.....

The screenshot displays the WaterDrive software interface with several tool windows open:

- Mobility Ratio**: A dialog box for calculating mobility ratios based on input parameters like oil and water viscosity, endpoint relative permeabilities, and mobility ratio.
- Convert between Recovery Factors**: A dialog box for converting between different recovery factors, including porosity, water saturation, and oil FVF.
- Convert between Watercut and Water Oil Ratio**: A dialog box for converting between watercut and water-oil ratio.
- Fit Corey Relative Permeability Curves**: A chart showing the relationship between water saturation (Sw) and relative permeability (kro and krw). The x-axis is Sw [fraction] from 0.00 to 1.00, and the y-axis is relative permeability from 0.00 to 1.00. The kro curve (green) starts at 1.00 and decreases, while the krw curve (blue) starts at 0.00 and increases.
- Convert**: A unit conversion tool with tabs for Length, Area, Volume, Mass, Density, Velocity, Pressure, and Temperature. The Density tab is active, showing conversion from 1 kg/m³ to other units like g/cm³, kg/L, lb/gal, lb/ft³, and SG.



# More information ...

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