

Flow Behavior in a Tight Gas Reservoir

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Resolve-Pan System Case Comparison Details

- Square Reservoir – 35450 ft side length
- Vertical Well Radius of .25ft radius located at the center
- Layer Parameters:
 - Porosity Reference Pressure 6500psia
 - Pore Volume Compressibility 0
 - Layer Thickness 20ft
 - Isotropic Permeability of 0.003mD kr
 - Porosity 0.1
 - Net to Gross 1
 - S_{wr} 0
- Dry Gas, Standing Correlation was used in Resolve:
 - Initial Reservoir Pressure 6500psia.
 - 150 deg F Bottom Hole Temperature
 - Separator Gas Gravity 0.6
- Vapor Production Rate: 5Mscf / day
- Fracture Properties: Half Length xf 750ft, Width wf 0.1ft, Porosity 0.1, Permeability 225md kf, Non Dimensional Fracture Conductivity Fcd = 10
- Fracture Mesh Parameters: 8 Ring, 10 Divisions Per Side, Minor Axis 1
- Pan System Correlation Data was used:
P(layer) =6500psia, T(layer)=150 F, 0.6 Gas Specific Gravity
- Spatial Mesh Factor Set to Fine

$$\text{Non Dimensional Fracture Conductivity (Fcd)} = k_f * w_f / (k_r * x_f)$$

Comparing Resolve vs. Pan System™

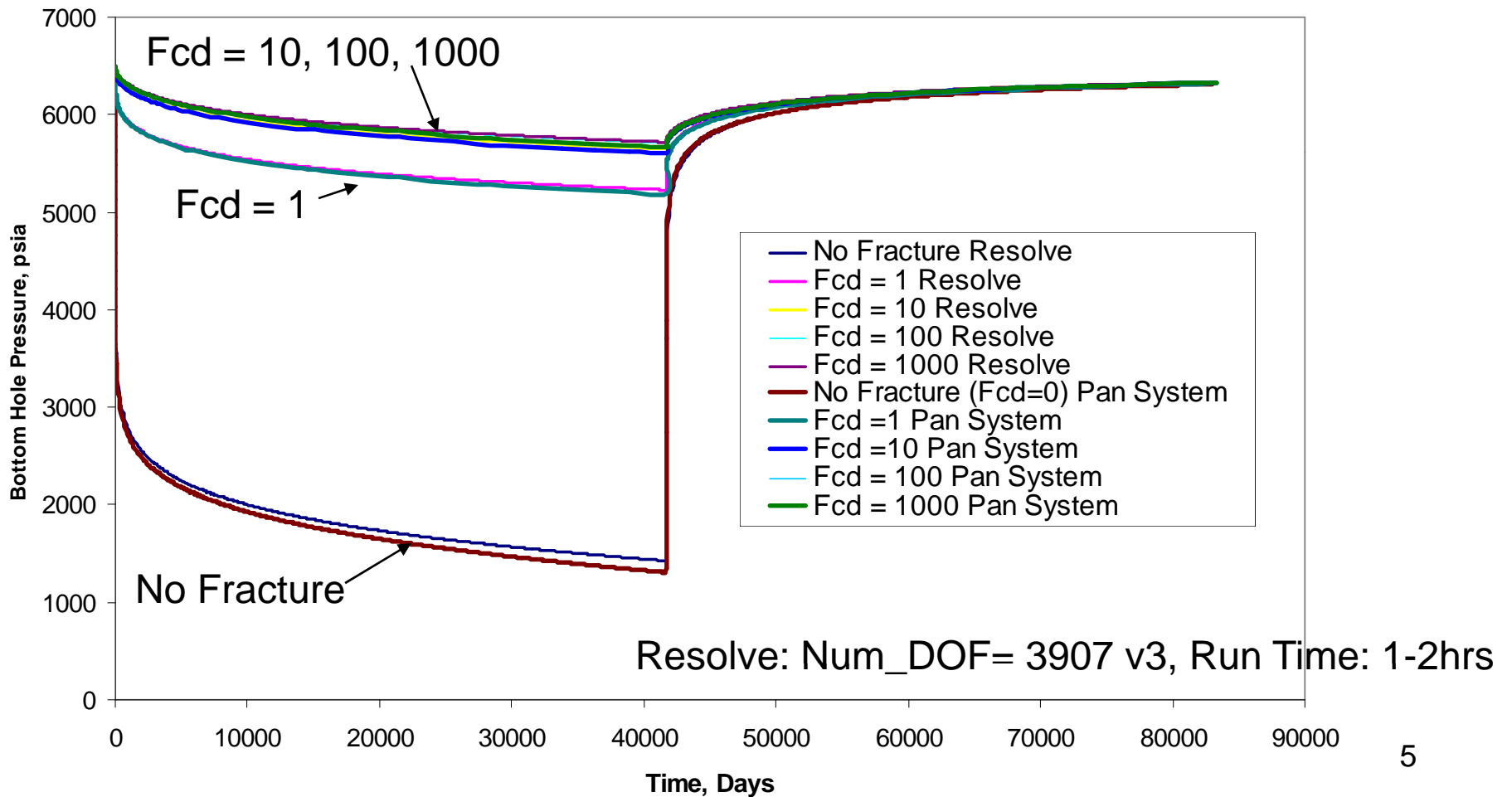
- Ran Cases for the Following Values of Reservoir Permeability:
 - .003mD
 - .001mD
- No Fracture vs. Fracture Vertical Well
- Dimensionless Fracture Conductivity (Fcd) Values Studied:
 - 1
 - 10
 - 100
 - 1000
- At the Same Fcd change x_f and w_f :
 - Fcd 10, Reservoir Perm 0.003 for $x_f=750$, $w_f=0.1$ and $x_f=375$ $w_f=0.05$ ft
- All Cases Used Pan System Correlation Data as user fluid property input

$$\text{Dimensionless Fracture Conductivity (Fcd)} = k_f * w_f / (k_r * x_f)$$

Results with Reservoir Permeability of 0.001mD

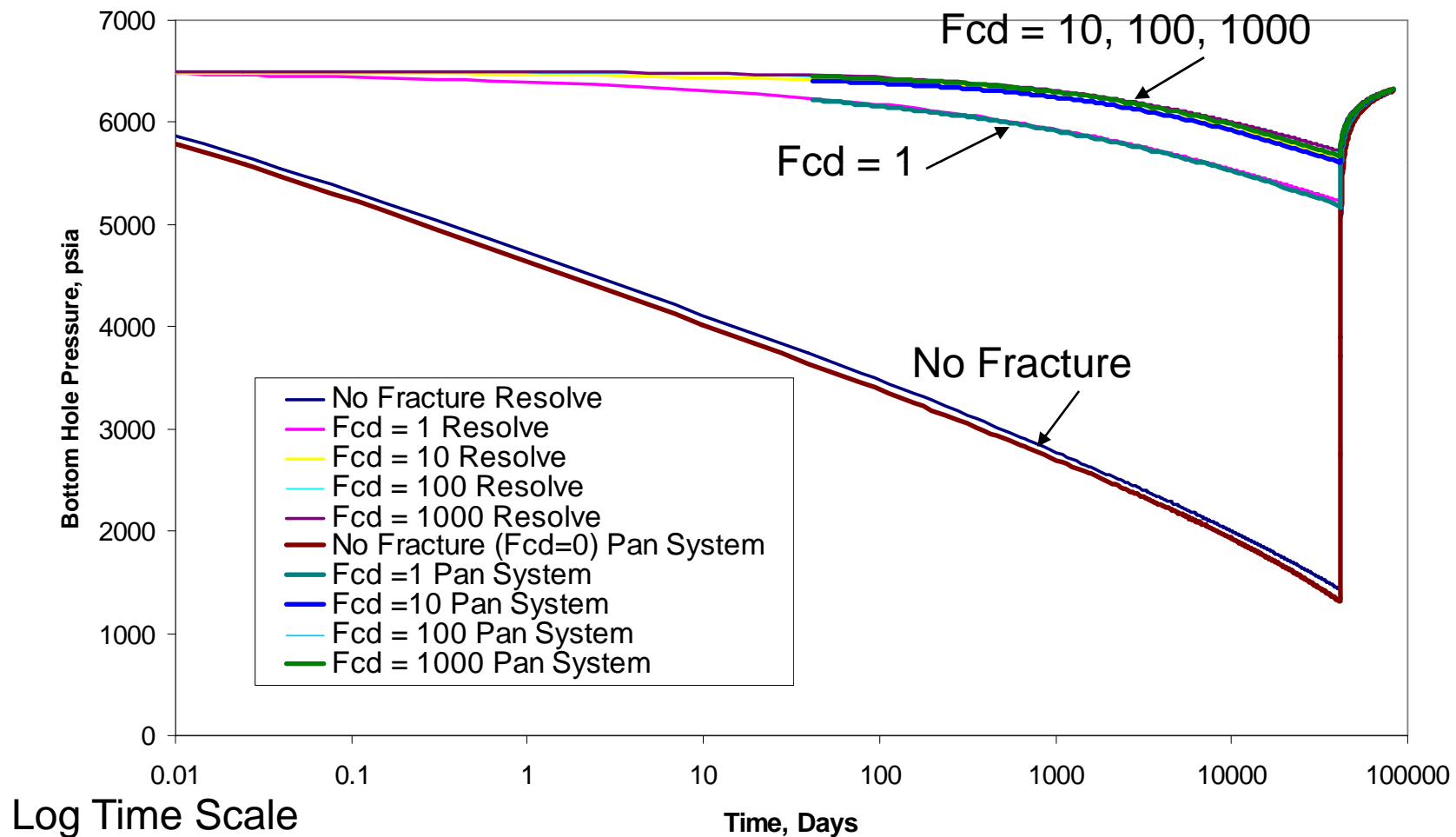
Effect of Reservoir Permeability 0.001mD

Resolve vs Pan System Results



Effect of Reservoir Permeability 0.001mD (Pressure vs. Log Time)

Resolve vs Pan System Results



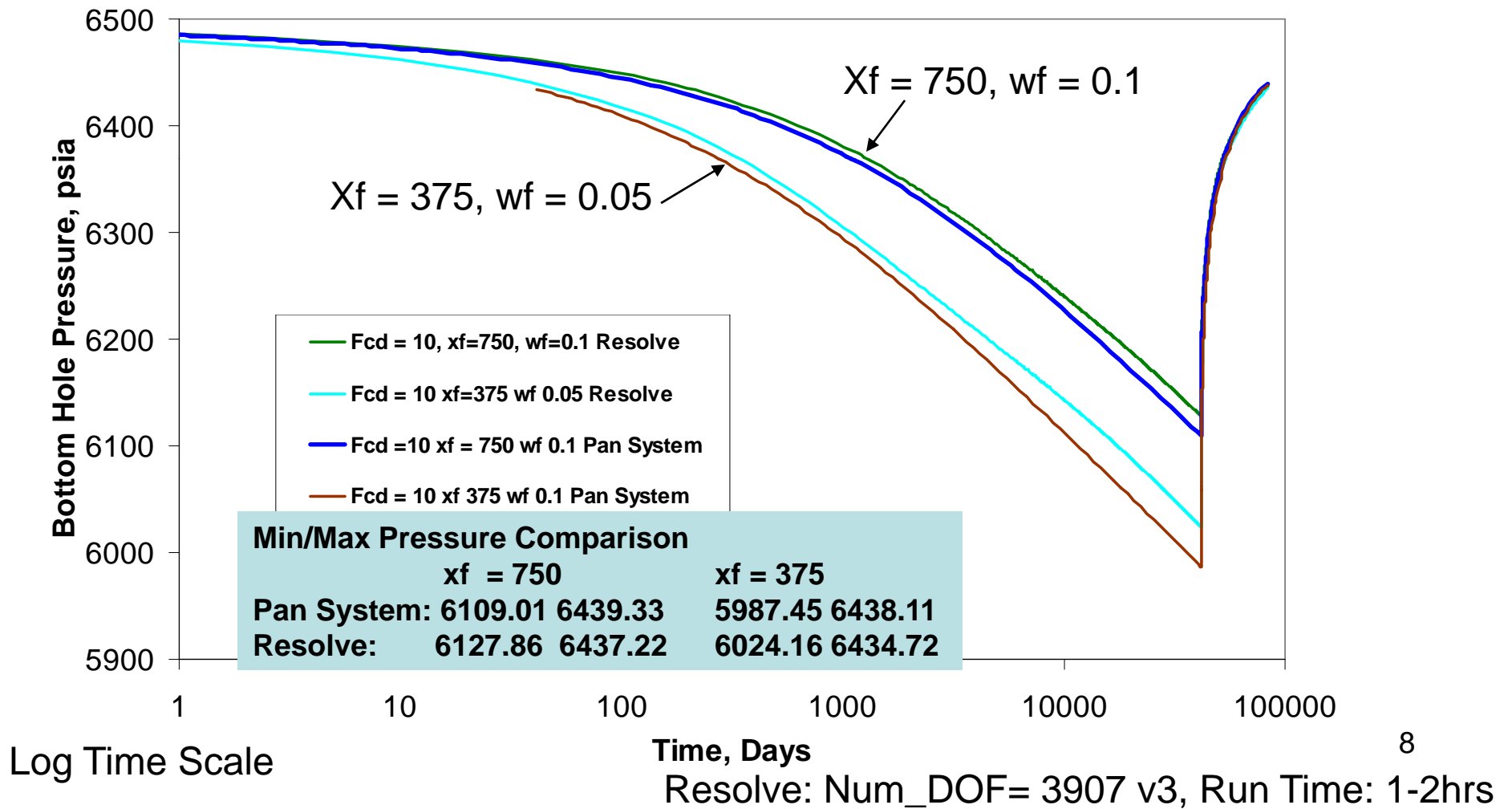
Results with different values of x_f
and w_f with $F_{cd} = 10$
Reservoir Permeability of 0.003md

Comparison of Pan vs. Resolve

Reservoir Permeability 0.003mD

Effect of Fracture Length & Width for $F_{cd} = 10$

Resolve vs Pan System Results

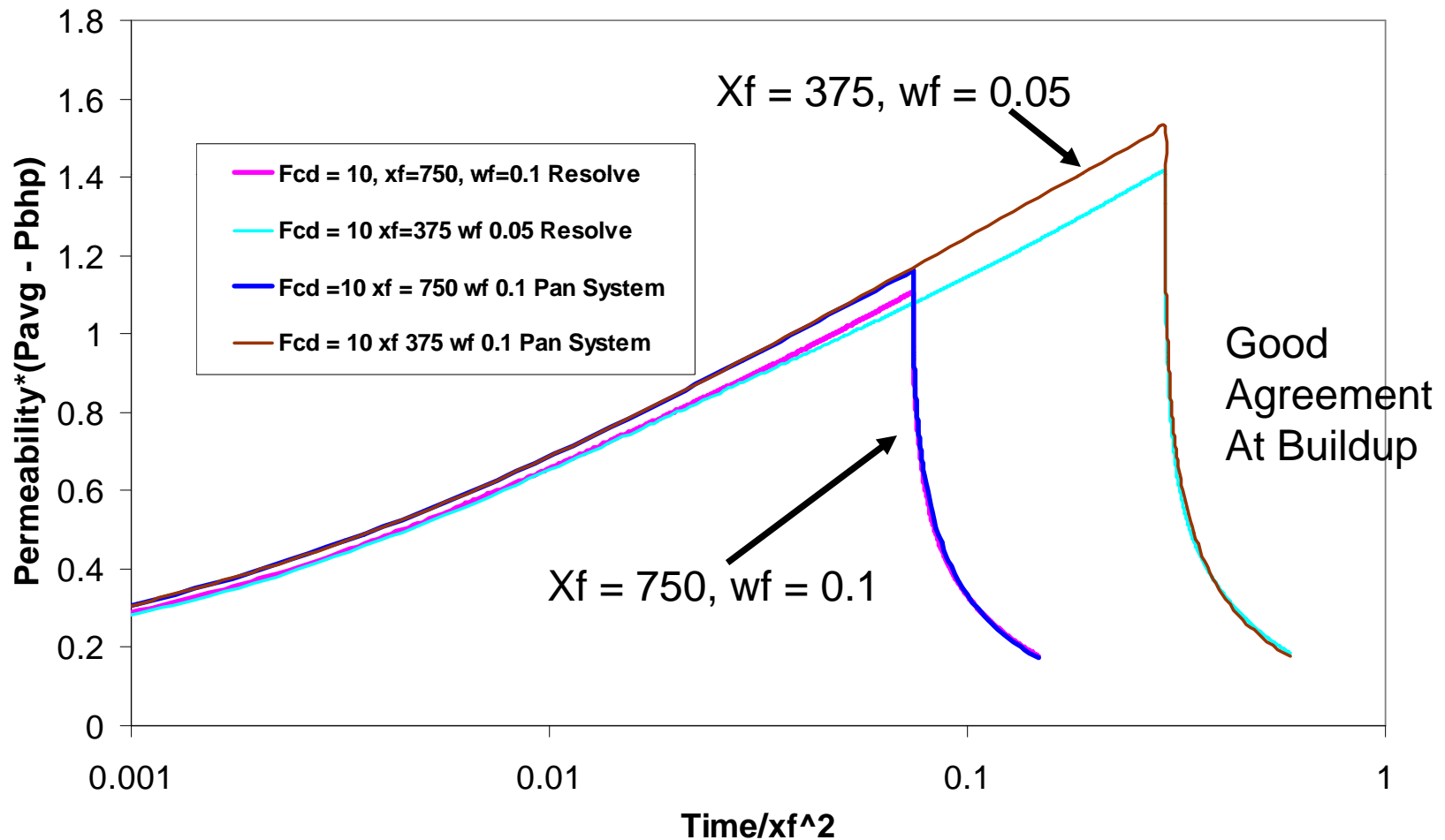


Comparison of Pan vs. Resolve

Reservoir Permeability 0.003mD

Effect of Fracture Length & Width for $F_{cd} = 10$

Resolve vs Pan System Results

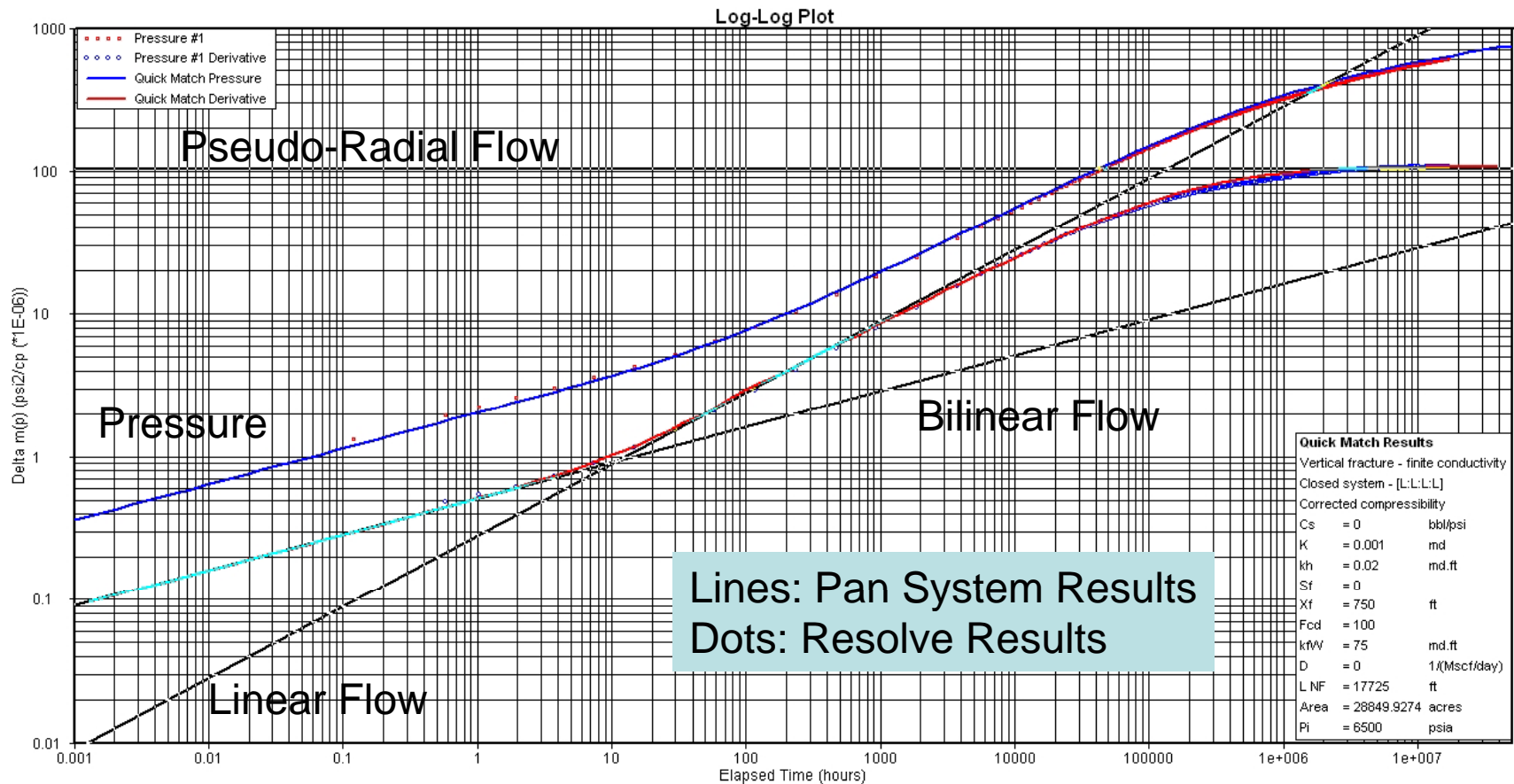


Log x Scale, Quantities Plotted are proportional to Non Dimensional Values

Results with Reservoir Permeability of 0.001mD with No Buildup

No Buildup Comparison Between Resolve & Pan System

Fcd = 100, Reservoir Permeability 0.001mD

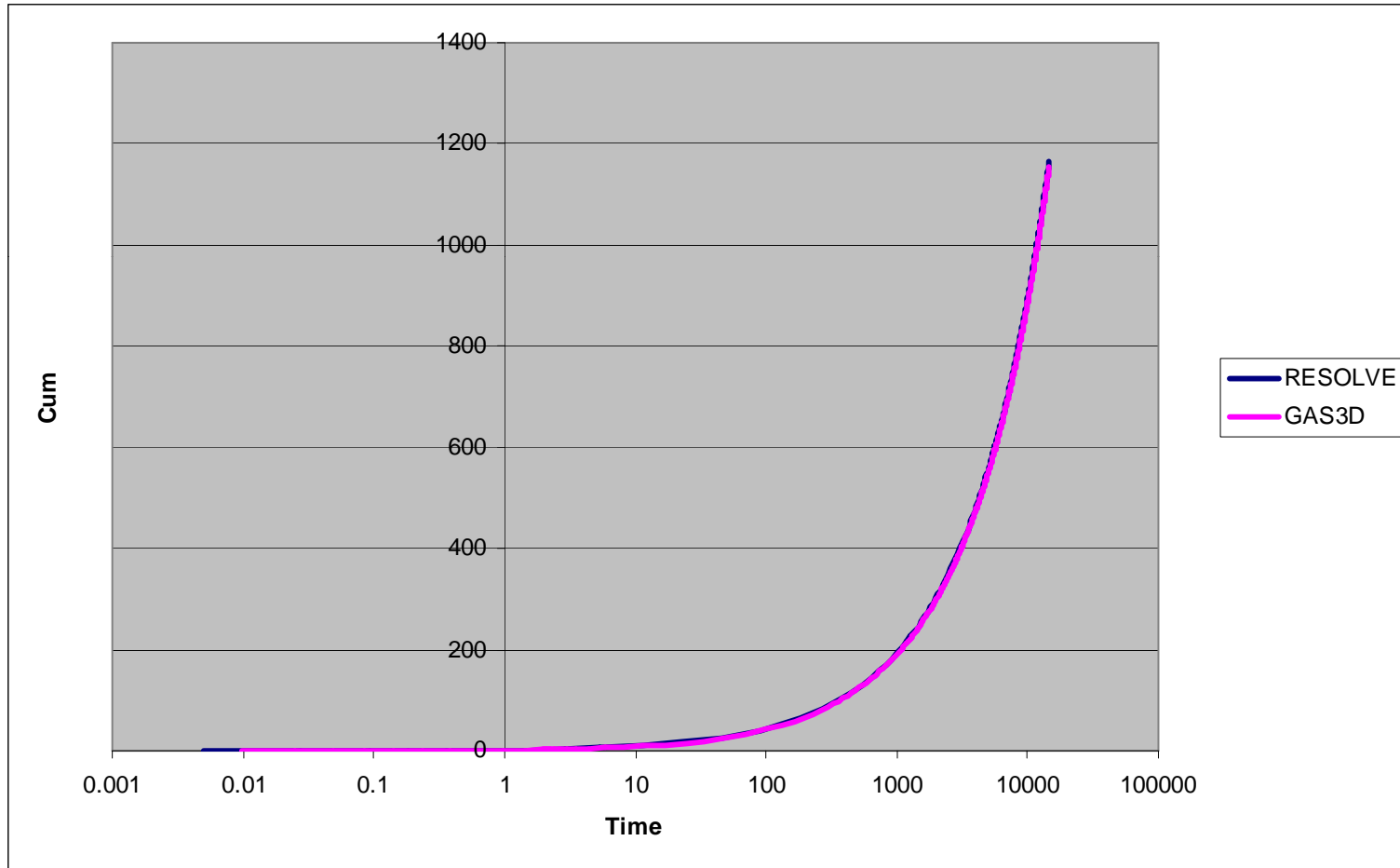


Resolve vs. GAS3D™ Case Details

- Square Reservoir – Side Length 5280ft (Left Corner at 0,0)
- Porosity Reference Pressure 6500psia
- Layer Thickness 20ft (From -8000to8020ft)
- Layer Parameters:
 - Permeability 0.003mD kr
 - Porosity 0.1
 - Net to Gross 1
 - S_wr 0.5
- Well Located in Center (2640,2640 xy)
 - Cullender-Smith Parameters:
 - Tubing Length 8000 ft, Inner Diameter 2in, Relative Roughness 0.0018, surface temperature 60F, bottom hole temperature 150F, water gas ratio 0
 - Fracture Properties:Half Length xf 750ft, Width wf 0.1ft, Porosity 0.1, Permeability kf 225md, Non Dimensional Fracture Conductivity 10
 - Fracture Meshing Parameters: Frac Rings 5, Divisions Per Side10, Minor Axis Factor 0.15 (No Ellfrac)
 - Fracture Meshing Parameters(With Ellfrac): Frac Rings 8, Divisions Per Side10, Minor Axis Factor 1
- Fluid Parameters – Dry Gas – User Specified Data
 - Standard Density 0.04961lbm/ft^3
 - Corrected Critical Pressure: 670.1psia
 - Corrected Critical Temperature: -94.6 deg F
- Vapor Production Rate of 1200 Mscf/day for 14,600 days
- With Ellfrac – Spatial Mesh Factor Set to Fine (0.001)

$$\text{Non Dimensional Fracture Conductivity (Fcd)} = k_f * w_f / (k_r * x_f)$$

Cumulative vs. Log Time Scale GAS3D vs. Resolve



8 Fracture Rings, 10 Divisions/Side, Minor Axis 1
Resolve: Num_DOF = 3531, Run Time: 10 minutes

Conclusions

- Good Agreement Between Resolve and GAS3D™
- Using Pan System™ Fluid Property Data in Resolve improves build-up & pseudo-radial derivative prediction
- Fairly good agreement between Resolve and Pan System™ over wide range of reservoir permeability for low production rates.