Well Flow Performance = WFP

omparative analysis between:

- the reservoir fluid deliverability (the ability of reservoir to produce or take-in the fluid) which is called Inflow Performance Relation (IPR)

and

- wellbore fluid deliverability (the ability of well to lift up or lift down the fluid) and which is called Lift Curves (LC) (also called Vertical Lift Performance (VLP) or Tubing Performance Relation (TPR))

It is based on correlation between surface flowrate q and bottomhole pressure p_{wf} as a function of tubing-head pressure p_s and formation pressure p_r and current reservoir saturation.

Application

- Setting up the required production or injection regime for each well upon the current formation pressure, reservoir saturation and production target specified by FDP
- Generating Lift Curves (LC) tables as input for Reservoir Flow Modelling (RFM)

Technology

Most reservoir engineers exploit material balance thinking which is based on long-term well-by-well surface flowrate targets (whether producers or injectors).

In practice, the flowrate targets are closely related to bottomhole pressure and associated limitations and require a specialised analysis to set up the optimal lifting (completion, pump, chocke) parameters.

This is primary domain of WFP analysis.

WFP is performed on stabilised wellbore and reservoir flow and does not cover transient behaviour which is one of the primary subjects of Well Testing domain.

The conventional WFP – Well Performance Analysis is perfomed as the $\{p_{wf} \text{ vs } q\}$ cross-plot with two model curves:

- Inflow Performance Relation (IPR) – responsible for reservoir deliverability (see below)

- Lift Curves (LC) – responsible for well deliverability (see below)

The intersection of IPR and Lift Curves represent the Stabilised wellbore flow (see **Fig. 1**)

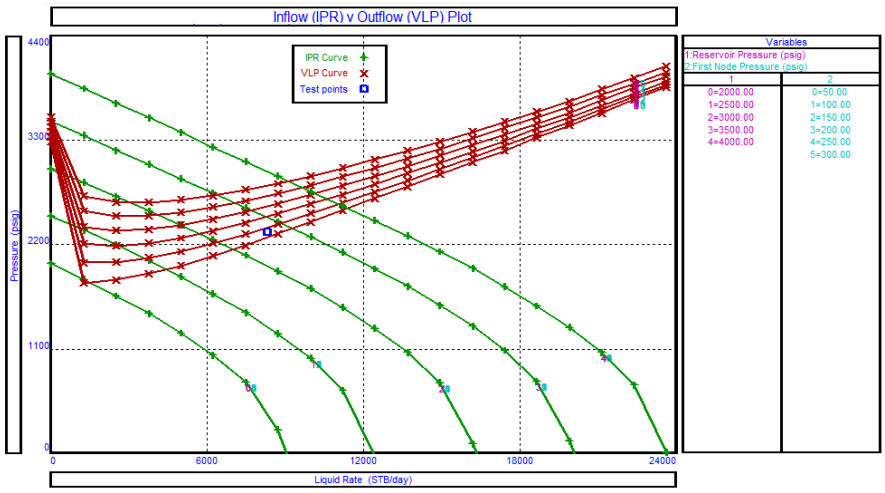

Fig. 1. A sample case of stabilised wellbore flow represented by junction point of IPR and Lift Curves.

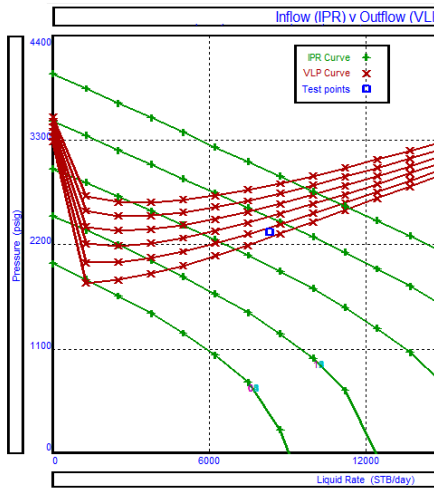

Fig. 2. The dead well scenario.

Given a tubing head pressure p_s the WFP Junction Point will be dynamic in time depending on current formation pressure (see Fig. 2) and formation saturation (see Fig. 3).

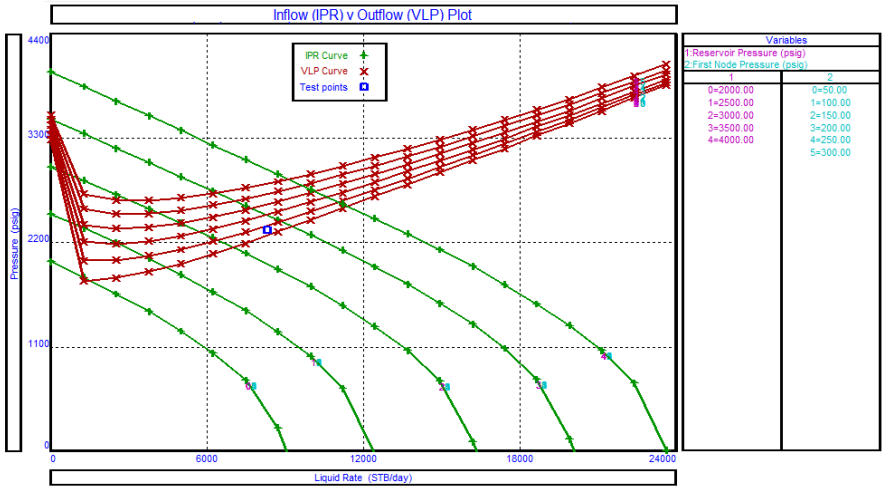

Fig. 3. A sample case of stabilised wellbore flow as function of formation pressure.

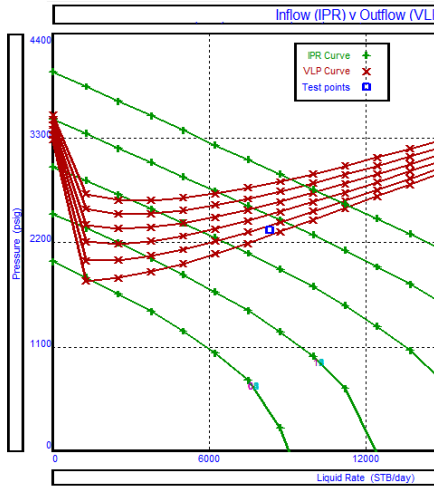

Fig. 4. A sample case of stabilised we watercut

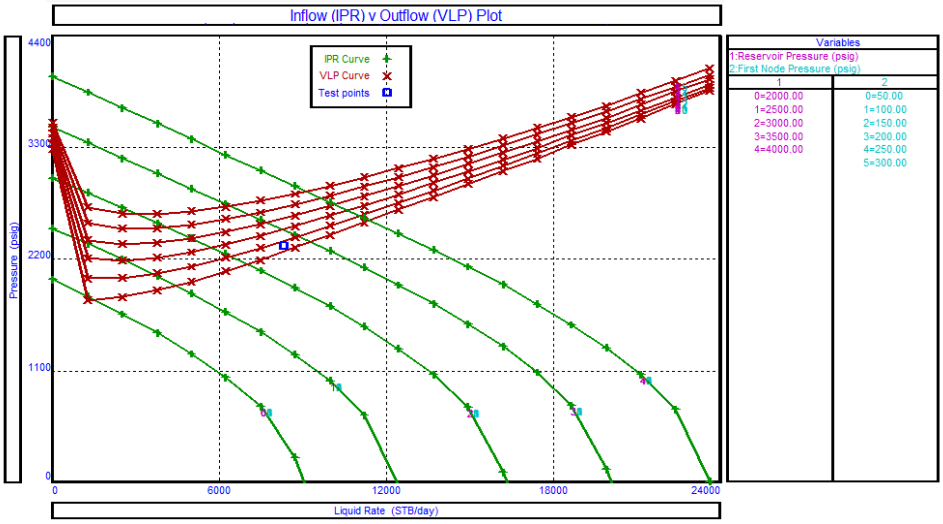

Fig. 5. A bunch of IPRs at different formation pressures and Lift Curves at different THPs.

Workflow

1. Check the current production rate against the production target from FDP
2. If the diffference is big enough to justify the cost of production optimization (see point 8 below) then proceed to the step 3 below
3. Assess formation pressure based on well tests
4. Simulate IPR / LC based on the current WOR/GOR
5. Calculate the stabilized flow bottom-hole pressure
6. Gather the current bottom-hole pressure p_{wf}
7. Check up the calculation aganst the actual p_{wf}
8. Recommend the production optimisation activities to adjust bottom-hole pressure p_{wf}:
    - adjusting the choke at surface
    - adjusting the pump settings from surface
    - changing the pump depth
    - changing the tubing size
    - changing the pump

The above workflow is very simplistic and assumes single-layer formation with no cross-flow complications.

In practise, the WFP analysis is often very tentative and production technologists spend some time experimenting with well regimes on well-by-well basis.

See Also

Petroleum Industry / Upstream / Production / Subsurface Production / Well & Reservoir Management

Subsurface E&P Disciplines / Production Technology

[WFP – Water Injector]

[Inflow Performance Relation (IPR)] [Lift Curves (LC)]

References

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