# OPTIMIZING SHUTIN TIME FOR PUMPOFF CONTROLLERS

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INTRODUCTION

In many if not most wells producing by beam pump a pump off controller is used . The controller detects when the well is pumped-off and shuts down the pumping unit for a period of time to allow fluids to accumulate in the wellbore. The pump is started again and the cycle continues.

Methods to detect a pumped off condition are well known, but the amount of time to shut-in the well is often determined by trial and error,

This paper presents the results obtained using a numerical model to computer energy requirements and production from a typical beam pumped well and generalizes the results to obtain a method for determining the optimum shut-in time based on minimizing the energy usage per barrel of production.

Model

The numerical model (Fair 2019) was used to model a 4000 ft beam pumped well with 2-3/8 in tubing and ¾ in rods with a 1000 ft 2 in flowl;in producing to a to a constant pressure tank. The model was run for 48 hours of simulated time. Pump off was determined when the annulus fluid level reached the pump depth. /The well was shut in for a predetermined time and then turned on again. The total production and energy requirements were determined and the efficiency presented in Figure 1.

Pressure transients

In order to generalize the results, pressure transient behavior was considered where a pressure buildup test can model the shut-in behavior of the well.

In a buildup test, it is common to observe a period of wellbore storage, where the pressure is determined by the amount of fluid in the wellbore and is not indicative of reservoir performance. During the wellbore storage dominated period, the pressure rises linearly with time, indicating that the wellbore is filling at a constant rate. Only at later times does the pressure fall below the linear trend, indicating that reservoir inflow is slowing down.

The time when wellbore storage effects diminish can be estimated from(Earlougher1977)

T

$$t > -\frac{200{,}000 \ + 12(,)000C}{(kh\mu)}$$

Where

t = time (hr)

C= Wellbore storage (bbl/psi

K = permeability (md)

H = formation thickness (ft)

μ = fluid viscosity ( cp)

In a beam pumped well, the Wellbore Storage is typically equal to the Anullus area in bbl/ft divided by the reservoir fluid density in psi/ft C= A/ρ

For the well shown in Figure 1, the end of wellbore storage is 0.67 he or 40 min, which coincides with the optimum shown.

Conclusions

As a result of this work, it is concluded that the optimum shut-in time for pumpoff controllers is equal to the wellbore storage dominated time from pressure transient analysis. This provides an interesting link between reservoir engineering and operational considerations. Since the wellbore storage time can be calculated from wellbore fluid properties and tubular sizes, it is no longer necessary to determine the optimum based solely on trial and error procedures.

Based on experience with Pressure buildup analysis, shut in times should generally be on the order of about an hour.

Instead of calculating the time, it is also possible to acoustically measure the fluid level after shut-in. The wellbore storage time is the time when the fluid level rise begins to slow. and deviates significantly from a linear trend. Typical bottom hole pressure behavior is shown in Figure 2.

BIBLIOGRAPHY

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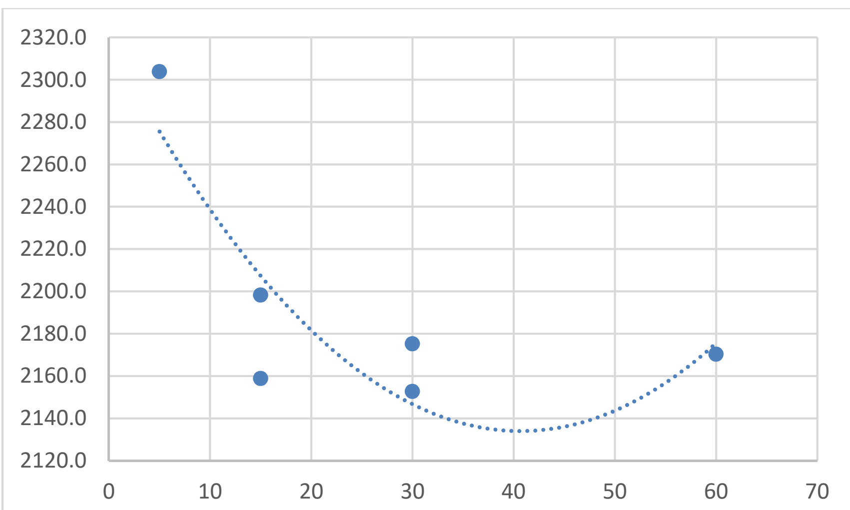


Figure1. Production energy required per bbl of production

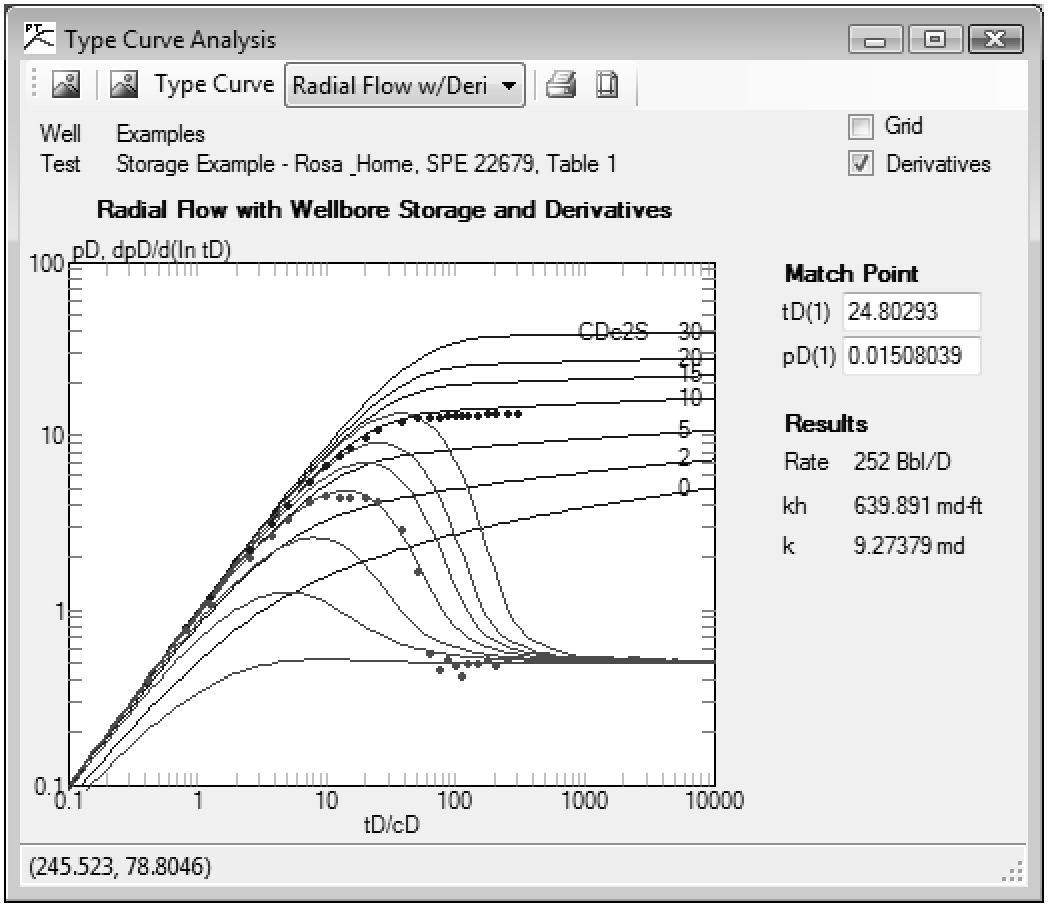


Figure 2. Typical Pressure transient behavior From P 4.0T software Comport Computing 1992