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## Production decline behaviors analysis of a vertical well with natural water influx/waterflood

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In petroleum engineering, the production decline type curves for the analysis and interpretation of production data has been considered as a robust method to obtain the flow parameters, and original gas in place etc. However, most of the previous production decline analysis model focused on primary depletion with closed boundary, rather than secondary depletion with water influx/waterflood. Thus, in this paper a model considering the water influx/waterflood with ramp rate case at the external boundary is developed. Subsequently, based on the material balance equation in consideration of the water influx/waterflood effect, the functions of Blasingame decline type curves for a vertical well with water influx/waterflood is derived and obtained so as to extend the theory of Blasingame production decline analysis to influx/waterflood reservoir. Further, advanced Blasingame production decline type curves of a vertical well in water influx/waterflood reservoirs are plotted through Stehfest numerical inversion algorithm and computer programming. Four flow regimes, including early unsteady flow regime; primary depletion flow regime; second unsteady flow regime; system pseudo steady flow regime, are recognized. Compared with Blasingame type curves without water influx/waterflood at the external boundary, the behaviors of the ones presented in this paper are quite different at the boundary responses. And the effect of relevant parameters, including the dimensionless maximum water flux, the dimensionless beginning time of the water flux and the dimensionless external boundary radius, are analyzed on the production decline type curves. Finally, Blasingame type curves of a vertical well in water influx/waterflood reservoirs are verified by a field case study. This study can provide very meaningful references for reservoir engineers in water flux and the beginning time of the water flux evaluation by matching the type curves with actual field data.

### References

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