

## Discussion on Papers

### **A Note on Composite Pressure Head and Gravity Flow System\***

by

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THE authors are to be congratulated for their work. In analysis of three-dimensional case of a gravity well, authors employed Dupit's assumptions. But, it has now been accepted that Dupit's equation for an idealised gravity well gives an exact estimate of the quantity of flow (Hantush, 1962 and Polubarinova Kochina, 1962), but it fails to determine the exact shape of the free surface in the vicinity of well surface. It has long been thought that authors' Equations (5) and (6) give exact values for pressure head at the base but, it was subsequently proved to be incorrect (Babbit and Caldwell, 1948 and Kashef; Toulonkian and Fadum 1952). There is no doubt now that the base pressure values should always be less than those obtained from Dupit's equations except at  $r_w$  and  $r_e$ .

Many attempts have been made to determine the exact free surface in a steady state conditions of a well, out of which the work of Kirkham (1964) and Kashef (1965) are worth noting. Kirkham devised a rigorous mathematical solution whereas Kashef tried to make it simple. Taking Kashef's work as the basis, the writers attempt to point out the errors in the exact free surface and base pressure.

For the comparative study, solved example by Kashef's method (1965) has been considered in which  $r_w=0.61$  m (2 ft),  $r_e=31.72$  m (104 ft),  $h_w=0$  and  $h_e=21.72$  m (71.2 ft). Figure 1 shows the percentage error in free surface by Dupit's equation, on the basis of the exact free surface devised by Kashef which is on higher side. It can be observed from the figure that the exact free surface deviates more than 5 percent from that by Dupit's equation for a radius  $r=9.76$  m (32 ft). This deviation reaches the value as much as 50 percent at  $r=1.22$  m (4 ft). In such cases, how far will it be true to use the value of  $L_e$  (i.e.,  $L$ ) in design, obtained by the authors from Dupit's equation ?

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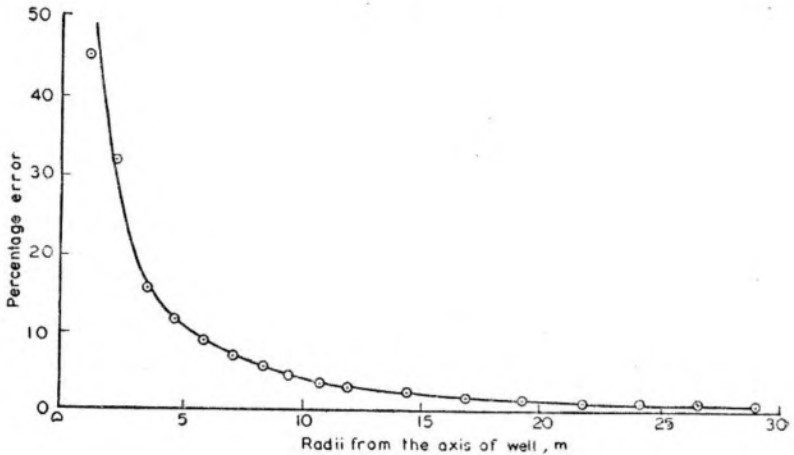


FIGURE 1.

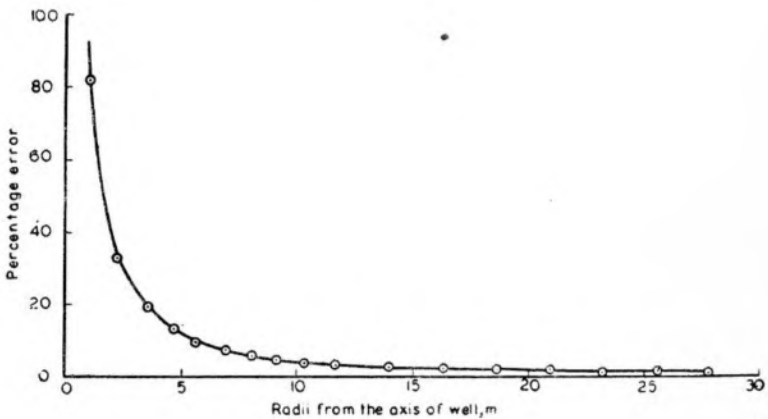


FIGURE 2.

Figure 2 shows the percentage error in the base pressure obtained by Dupit's equation on the basis of base pressure obtained by Kashef. This figure also shows the same order of error at a radius  $r=9.76$  m (32 ft) and near the well surface it is much high.

### References

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