

CHAPTER 1

INTRODUCTION

One of the assumptions that early pressure test analyses were based on was that the reservoir is single layered, homogeneous and isotropic. As evidenced from logs, sub-surface cores, and surface out-crops, a formation is far from this ideal case. However, the ideal equations continue to be the basic tool for analysing reservoirs with some inhomogeneity; this is especially so for pressures taken during the 'early transient' periods when "average" permeabilities are obtained.

Here in Trinidad, it was often found that the pressure behaviour during the 'late transient' and 'semi-steady state' periods did not conform to the ideal and this led to a closer examination of the reservoir rock properties and the basic assumptions of single layer flow. At TRINMAR, our logs indicated that some producing wells did not produce from a single reservoir but from several isolated sands or layers having different properties.

As far back as 1953, Tempelaar-Lietz (Ref.1) investigated multi-layered reservoirs. Using a

material balance approach under semi-steady state flow conditions, he gave an approximate treatment of the characteristics of a bounded reservoir composed of two layers of equal thickness with different permeabilities. His treatment was not applicable for the prediction of pressure build-up behavior. Lefkowitz et al. (Ref.2) in 1959, presented an analytical solution for the two-layered reservoir. His approach was much more rigorous than that of Tempelaar-Lietz and concluded that in a draw-down survey, the semi-steady state period was similar to that of Tempelaar-Lietz (Ref.1) but the early transient period varied somewhat. Several authors like Cobb et al (Ref.3), Raghavan et al. (Ref.4), Kazemi (Ref.5), and Earlougher et al. (Ref.6) have investigated and discussed aspects of two-layered reservoirs. Only Kazemi (Ref.5) and Earlougher (Ref.6) using a simulation approach, have investigated reservoirs with more than two layers. The author is not aware of any literature that provides analytically developed equations for the three-layered reservoirs although Lefkowitz et al. (Ref.2) presented some results for such a reservoir.

The main objective of this paper is to develop drawdown and build-up pressure equations for three-

layered reservoirs using an analytical approach similar to that of Lefkowitz et al. (Ref. 2). A second objective is to interpret the various changes in the drawdown and build-up curves when the reservoir parameters are varied.