# CHAPTER V

# CONCLUSIONS AND RECOMMENDATIONS

This chapter presents the conclusions of the parameters that can be evaluated using wireline formation test under the capacity of the tool and in particular reservoir scenarios as well as the recommendations for future works.

## 5.1 Conclusions

In this study, a simulator was used to simulate the performance of pressure response of the reservoir when tested with a wireline formation tool. Different scenarios were simulated to study the pressure behavior. A single layer system and a two-layer system with different permeabilities between layers were studied.

Initially, a single layer homogenous reservoir was simulated. Different test durations, probe positions, and formation permeabilities were studied. The objective of this set of studies is to verify the result generated by the simulator.

Then, a two-layer system with different permeabilities between layers was studied. Similar to a single layer reservoir, the probe position was also studied.

From results shown in Chapter 4, it can be concluded for a single layer reservoir as follow:

1. Wireline formation test can be an alternative method to evaluate the permeability in reservoirs with moderate permeabilities. If the permeability is too low, WFT needs to be conducted for a long period of time. If the permeability is too high, WFT may not provide any information since the pressure drop is too small to measure. Increasing the flow rate as much as possible is the best way to mitigate this problem.
2. The test should be conducted at the middle of the reservoir. If the probe is moved away from that location, the hemispherical flow will be present. The

estimated permeability from the hemispherical flow regime is less accurate than that when the probe is at the middle of the formation.

3. WFT yields the estimate of permeability with acceptable range of error.

For a multilayer reservoir, the conclusions from the results in Chapter 4 are;

1. If the test is conducted in a low permeability layer and near the top or bottom boundary, the estimated spherical and horizontal permeabilities obtained from the test are close to those of the low permeable zone and comparable with the estimated value from the test conducted in a single layer reservoir. In addition, the high permeability layer acts as a constant pressure boundary, contributing fluid into the low permeable zone.
2. If the test is conducted in a low permeability layer and near the interface between a two-layer reservoir, two spherical permeabilities can be obtained from the test. The first one is estimated permeability contributing from low permeable zone. The second one is the harmonic mean of the two-layer system. Furthermore, the negative unit slope which indicates the change in mobility ratio is present between the two spherical flows. In addition, if the probe is extremely close to the interface between a two layers, the estimated spherical permeability is the geometric mean of the two-layer system.
3. If the test is conducted in a high permeability layer and extremely close to the interface between the two layers, the estimated spherical and horizontal permeabilities are the arithmetic mean of the two layers, which are the theoretical averaged permeabilities of the parallel formation. But if the probe was moved further away from the middle of the reservoir, the estimated spherical and horizontal permeabilities are representative of the high permeability layer and comparable with the estimated value from the test conducted in a single layer reservoir.
4. If the test is conducted at any probe position in a very high permeability layer, the pressure response is similar to that from the test conducted in a single very high permeability layer, that is, minimal change can be detected. Due to small pressure drop, the derivative plot at late times is scattering and it is hard to identify any flow regime.

5. In summery, the test should be conducted in the higher permeable zone and close to the interface between the two layers in order to get the averaged permeability that can represent the entire reservoir.

## 5.2 Recommendations

As a recommendation for further study on this subject, the effect of vertical to horizontal permeability ( $k_z/k_{xy}$ ) should be examined. Cases with different layer thicknesses and the systems with more than two layers should be investigated to see whether the pressure response from wireline formation test can be usefully interpreted. Also, layered formation which is very close or next to aquifer should be examined to see the effect of constant pressure from aquifer.