Chapter 5

Conclusions and Recommendations

- From Sudan Oilfields, 212 datasets were collected for bubble point pressure evaluation.
- The bubble point pressure data were correlated to gas solubility, oil gravity, gas gravity and temperature.
- Six *common empirical correlations of bubble point pressure* Standing, Glaso, AL-Marhoun, Petroski-Farshed, Hanafy and Vasquez-Beggs were applied for the all datasets the final result of prediction was evaluated using statistical analysis.
- The statistical analysis results showed that Vaquez-Beggs and Standing correlations have lowest relative root of mean squared error (RRMSE) of 0.40935 and 0.422927 respectively and correlation coefficient R^2 of 0.8324 and 0.821133 respectively.
- New development model using polynomial neural network PNN (one of group method of data handling GMDH) was created for Sudan Crude Oil using 70% of the datasets (151 dataset) as a train data for neurons network and had correlation coefficient R^2 of 0.957243.
- The new developed model was a function of the gas solubility, oil gravity of the crude oils (API gravity) and gas specific gravity. The new developed model is:

$$\mathbf{P_b} = \mathbf{0.5574} * \mathbf{A} + \mathbf{0.4511} * \mathbf{B} \qquad (5-1)$$

$$A = 179.24 + 24.9318 * R_s - 0.02703 * R_s^2 - 0.0001035 * R_s^3 + 3.4328E-8 * R_s^4 - 46.62 * R_s * \gamma_g + 0.1360 * R_s^2 * \gamma_g + 6.2364E-5 * R_s^3 * \gamma_g + 23.5435 * R_s * \gamma_g^2 - 0.0939 * R_s^2 * \gamma_g^2 - 42.4064 * \gamma_g^4$$

$$B = 25.3128 * R_s - 0.0934 * R_s^2 + 3.3602E-8 * R_s^4 - 0.6338 * R_s * API + 0.00434 * R_s^2 * API - 1.3543E-6 * R_s^3 * API - 3.43598E-5 * R_s^2 API^2 + 7.6619E-5 * API^4$$

Where:

R_s= gas solubility

API=oil gravity in API degree

γ_g =gas gravity

- The new developed model was tested and validated with 30% of the datasets (61 dataset) to check their prediction performance with correlation coefficient R^2 0.959330.
- In this study, the new model has been evaluated against the best common empirical correlations using test data (Vasquez-Beggs and Standing correlation). It found that the new model has highest correlation coefficient R^2 and lowest relative root of mean squared error (RRMSE)
- In *this research we highly recommend to* use the new developed model for predicting bubble point pressure of Sudan crude oil as useful and effective correlation.
- *This study recommends* for using the new developed model to solve many of petroleum reservoir engineering problems such as material balance calculations, analysis of well performance, reservoir simulation, and production engineering calculations.
- *This research recommends* also using the new developed model as a QC method in the PVT laboratory for Sudan crude oil.
- There is a lack of studies in Sudan on this area of researches for Sudan crude oils. *This study suggests* repeating this study using either more experimental data or new tool.