	A	B	C	D	E
Gilbert, W. (1954)	10	0.546	1.89	1	0
Owolabi *et al*, (1991)	35.72	0.289	1.83	1	0
Okon *et al*, (2015)	5.1474	0.5048	1.7093	1	0
New Model	1244.5	0.192	-0.07302	-0.241	0.07817

In the general form of choke performance equation, the following resulting equations can be written using the model constants in Table 3.1 above.

For Gilbert Model; (1954)

$$P_{wh} = \frac{10\ (GOR)^{0.546}\ Q_l}{D_{64}^{1.89}}\ \text{, psig} \tag{3.3}$$

For Owolabi et al; (1991)

$$P_{wh} = \frac{35.75(GOR)^{0.289}\ Q_l}{D_{64}^{1.83}}\ \text{, psig} \tag{3.4}$$

For Okon et al; (2015)

$$P_{wh} = \frac{5.147\ (GOR)^{0.5048}\ Q_l}{D_{64}^{1.7093}}\ \text{, psig} \tag{3.5}$$

Proposed New Model;

$$P_{wh} = \frac{1244.5\ (GOR)^{0.192}\ Q_L^{-0.241}\ (BSW)^{0.07817}}{D_{64}^{-0.07302}}\ \text{, psig} \tag{3.6}$$

In Figure 3.7 below, the plot of flow rate versus choke size is plotted for each of the model. The results show that the new model is within acceptable range. Throughout the tested choke size, the new model showed better agreement with those of the previous Niger Delta correlations which are the (Owolabi *et al*, 1991) & (Okon *et al*, 2015) Despite the fact that the new model does not follow the conservative form of the Gilbert base model, it has clearly demonstrated an acceptable performance to the other models when validated with actual field data.

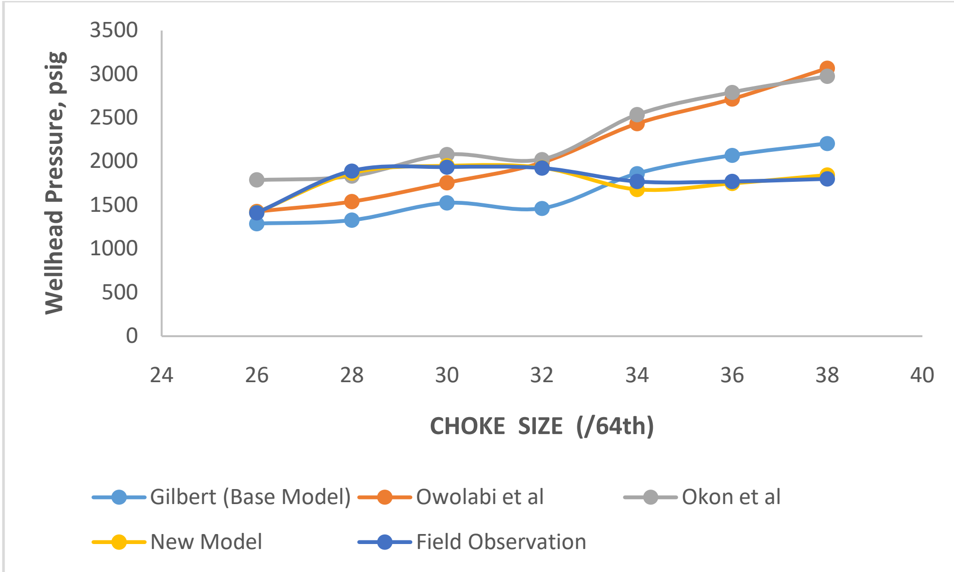

Figure 3.6: Model Validation using Flow Rate versus Choke Size

Figure 3.6 shows a similar trend in terms of the accuracy of our new model. Besides the new model developed, it can be seen that the models showed remarkable deviation from the data collected from Field X. As has been noted previous, the remarkable difference between the proposed new model and the existing models is based on the fact that the new model incorporated the effect of basic sediments and water as a percentage of total production from the well.

At lower pressures, the BSW components are not readily transported through the tubing system and may result to accumulation in the wellbore. However, as pressure increases, the lifting capacity of the total well system also increases and BSW are produced along the well fluids. In severe situations, this can remarkably impair the overall production capacity of the well as shown by relatively smaller flow rates at higher pressures of the new model. This observation is supported by Figure 3.6. Above Pwh = 932psig, there was a larger deviation of previous models from the actual field test. Another possible reason for this is the fact that this model introduced in this study is specifically directed to a particular field in the Niger Delta with remarkable %BSW produced along the well fluids.

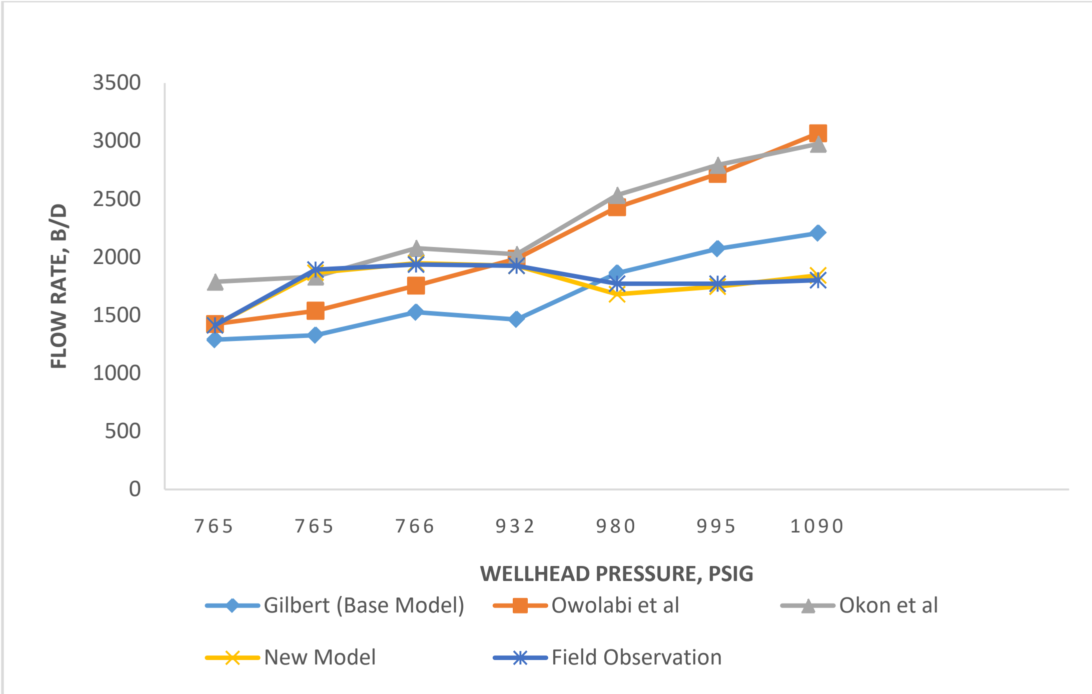

Figure 3.7: Model Validation using Flow Rate versus Wellhead Pressure

From the ongoing analysis, it has been shown that besides the basic structure of the new model, the major difference is in its ability to account for the presence of BSWs. The Figure 3.8 below raises some concern for further investigation on the impact of BSWs components on choke performance. However, the results clearly show that the presence of sediments will be most remarkable in the choice of choke size. The previous models showed that at choke sizes less than or equal to 32/64-in, there be high pressure at the wellhead which could be overestimated by the existing models if applied to this same field. However, at higher choke sizes, the reverse is the case.

Despite some deviations in the trend pattern, we can easily establish that at choke sizes less than 32/64-in, the models are sufficiently close enough. This has further validated the new model proposed in this work and the associated previous assumptions stated in chapter 3. This observation is clearly due to the fact that at smaller choke sizes beyond the optimal diameter, the BSW components are not readily transport and co-produced or at least its co-production is remarkably impeded.

It is worth noting that the new model introduced in this work (Equation 3.6) is an adapted form of the generally choke performance equation. The introduction of the new term, "BSW" in the equation remarkably alters the basic structure of the model. However, the regression results show it is accurate and could be trusted for further predictions.

Figure 3.8: Model Validation using Wellhead Pressure versus Choke Size.

4 Conclusion and Recommendations

4.1 Conclusion

Based on the research carried out in this study the following conclusions were drawn;

i. The liquid flow rate is directly proportional to the four independent variables (Gas oil Ratio, Well head Pressure, Choke size and Basic Sediment and Water)

ii. The optimal choke size of 30-in yielded the optimal production rates that resulted to Ql = 1936STB, GOR = 541.5scf/STB, Pwh = 766psig and BSW of 0.23%. Beyond this choke size, Ql gradually declines with increasing GOR, Pwh and BSW respectively.

iii. The choke size has a significant effect on Oil production rate and the pressure at which the other production facilities installed alongside the choke during production performance test analysis is operating at, also has effect on the Oil production rate (production performance rate).

iv. The model developed which shows the relationship between flowrate Q_L and other variables such as GOR, BSW, ΔP and choke size (CD) was validated with the base Gilbert model and the (Owolabi *et al*, 1991) & (Okon *et al*, 2015) models and the results showed good agreement with field observation but deviated remarkably from the earlier models. This does not outrightly mean that the existing models are not adequate. It only implies that they are inadequate for this particular field or those other fields with similar features. This study therefore encourages the wider application of this new model that could account for the presence of BSWs components to enhance accuracy of predicted choke performance.

4.2 Recommendations

i. This research involved the analysis of 7 chokes, so further studies should cover wider range of choke sizes to establish a more standardize study.

ii. The pressures of the other production facilities were altered for each choke size. Further studies can be done with pressures maintained and results obtain to further validate the study.

iii. The new model proposed in this study were based on data from a particular field. It is therefore recommended to try it out with other fields to see understand better the limitations of its wider application.

4.3 Contributions to Knowledge

This study which aims at analyzing the effects of well head choke sizes for liquid flowrate performance has contributed to knowledge in the following ways:

i. Promotes and encourages the drive to go into fluid production in the Oil and Gas sector regardless of the flow regime by enabling the production engineer know the right choke size to select at safe operating pressure.

ii. This study enables us understand that unregulated production can pose high risk as reservoir damage or production problems such as water or gas coning and early water break-through, while selecting the right choke size will regulate production and optimize fluid flow rate as well as protect surface equipment.

iii. Eradication of rigorous calculations, knowledge of correlations and models, and tedious procedures while operating in the activities of Oil and Gas industry to meet the world's energy demands.

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