Comparison of gas initial in place calculation using MBAL and Artificial Intelligence methods

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Abstract. Oil and gas industry are an industry with a high cost and high risk, artificial intelligence will help the work of humans to minimize the risk of accidents, reduce processing time and improve corporate profits. So, the work becomes more efficient. The aims of the study give information that the artificial intelligence help the work to evaluate the initial gas in place on reservoir and comparison the results between software and manual Material Balance (MBAL). Additional research is needed to know the type of reservoir and drive mechanism. The method used is the research on reservoir RGN, the data used are based on real data in field. This research uses artificial intelligence MBAL software and calculation with manual MBAL. Based on the analysis, the result of reservoir type dry gas reservoir with drive mechanism is depletion drive. Calculation initial gas in place using artificial intelligence MBAL software, get the initial gas in place result of 50661,3MMscf. And calculation using manual MBAL, get the initial gas in place result of 50063,59MMscf. There is a difference in the results of the initial gas content in place of 597.4 MMscf. Based on the analysis, there are differences in the results between using artificial intelligence and manual MBAL.

1. Introduction
Indonesia's natural resources of oil and gas are still the main natural resources in the energy sector, oil and gas consumption in Indonesia is increasing every year, the higher the consumption makes the more oil and gas needed by Indonesia, it encourages the government to produce hydrocarbons effective and efficient considering that oil and gas are non-renewable energy. In this case, of course, the calculation of the initial gas in place is very important in the basic development and operational decisions of a reservoir which is crucial in financing and other commercial arrangements [1].

In evaluating accurate results are needed, so that later planning can be developed in a field, the more accurate the results obtained will be better, the selection of the right method will affect the accuracy of the final results. Many methods are used to calculate initial gas in place, the method used is based on data available in the field. Besides that, the calculation process also affects the accuracy of the final results, rounding numbers and limitations in the accuracy of reading graph values affect the final result. Then with the development of the oil and gas industry raises artificial intelligence to overcome these problems [2].

With the development of the oil and gas industry, it is necessary to complete work quickly, accurately and efficiently. Then the development of artificial intelligence in the oil and gas industry was carried out to make this happen. In the calculation of initial gas in place there is artificial intelligence, namely software MBAL, the software will help workers to calculate initial gas in place with various methods.
according to the availability of field data. With this intelligence helping workers to be more efficient and effective with better results, this will be discussed in this paper.

2. Methodology
The evaluation method of the original gas in place calculation is done by quantitative evaluation research methods, quantitative methods in the form of numerical calculations based on the theoretical foundation and available data, to provide a general description of the research background and as a material for discussion of research results. Data obtained through literature studies are well testing data, daily production, reservoir fluid analysis data, structural maps and petrophysical analysis. The data is used in this study, the better and complete data obtained, the more accurate the initial gas in place results will be. The other data is based on data processing [3,4].

Analysis of reservoir type and drive mechanism is important, because the type of reservoir and drive mechanism affect the calculation method to be used [5]. The calculation of the initial gas in place were carried out with two methods, using artificial intelligence software MBAL and manual calculation using the MatBal method, to know the different results and accuracy form the results.

![Research work scheme](image)

**Figure 1.** Research work scheme.

Gas initial in place calculation using the material balance method with P/Z vs. Gp, based on the analysis of pressure and production data, plot between P/Z and Gp, the line equation will estimate the initial gas in place at the P / Z = 0, from the plot will get results the original gas in place [6]. The conventional format of the gas material balance equation is the simple straight line plot of p/Z vs cumulative gas production (Gp) which can be extrapolated to zero p/Z to obtain G [7].

Then comparing the results of the original gas in place using the MBAL software, software MBAL is artificial intelligence to estimate the initial gas content in place by calculating mass equilibrium, MBAL software using analytical methods, nonlinear regression based on decreasing reservoir pressure...
against cumulative production. Some data are needed such as reservoir pressure, reservoir temperature, gas production data, water production data, and reservoir fluid PVT data [8].

After obtaining the initial gas in place based on artificial intelligence and the MatBal manual, the results were compared, whether the values showed the same results, and analyzed if there were differences in results, so that the results can be concluded by the most accurate method.

3. Result and discussion
In this study, we will discuss the determination of reservoir type, thrust power and calculation of initial gas content using the MBAL method and the MBAL software. At first it is necessary to analyze the reservoir type based on PVT data [9]. The data includes the composition of gas constituents in the reservoir.

![Figure 2. Phase behavior diagram.](image)

Based on the phase behavior diagram at figure 2 obtained pressure and temperature conditions from the analysis of reservoir fluid data. Line changes in reservoir conditions and lines of changes in reservoir conditions to the surface indicate that the line is outside of the phase diagram, then the type of reservoir is obtained as dry gas reservoir, based on the existing literature theory [10].

Analysis of drive mechanism figure 3. Results of analysis drive mechanism based on existing data shows the reservoir have a depletion drive mechanism. Based on the picture below shows the dominance of the color in blue which indicates the depletion drive.

![Figure 3. Drive mechanism.](image)
In the initial gas in place calculation based on manual MBAL and artificial intelligence. This study uses the same method, based on the P/Z vs. Gp graph, because the availability of data that supports the use of this method, and supported by the type reservoir and drive mechanism that meets the requirements / Z vs. Gp graph is used to calculate the initial gas in place where the drive mechanism is dominated by depletion drive [11]. A “normally pressured” gas reservoir is defined as a gas reservoir with an initial pressure gradient ranging from 0.4γ-0.50 psi/ft. The P/Z analysis for a volumetric, “normally pressured” gas reservoir is applied using the assumption of a constant reservoir pore volume over the life of the reservoir [12].

![Figure 4. P/Z vs Gp graph use manual MBAL.](image)

![Figure 5. P/Z vs Gp graph use Artificial Intelligence.](image)

4. Conclusion
Based on a comparative study of the calculation of the initial gas in place using the manual MBAL 50063.59 MMscf and based on the analysis of the MBAL software 50661.3 MMscf. There is a difference in results between manual and artificial intelligence, this difference is due to the different level of accuracy between manual and artificial intelligence, so that calculations with artificial intelligence have a higher level of accuracy of results.
References

[1] J Ross 2001 Guidelines for the Evaluation of Petroleum Reserves and Resources Society of Petroleum Engineers, Richardson, U.S.A.

[2] S Memon and A Zameer 2012 To Develop the Optimum Field Development Plan for Condensate Wells Using Integrated Production Modeling (IPM) SPE Damman, Saudi Arabia 1–12.

[3] T Ahmed 2010 Reservoir Engineering Handbook Fourth Edition (Fourth Edi) Gulf Professional Publishing, Oxford, U.K.

[4] S Gerami, A Sadeghi and M Masihi 2010 New Technique for Calculation of Well Deliverability in Gas Condensate Reservoir SPE Manama, Bahrain.

[5] S Haddad, E Proano, and Patel 2004 A Method to Diagnose Depletion, Skin, kh and Drive Mechanism Effects Using Reservoir Monitoring Data SPE Houston, Texas, U.S.A.

[6] S Zavaleta, D S Cruz, P Marcelo and R M Michael 2018 Estimation of OGIP in a Water-Drive Gas Reservoir Coupling Dynamic Material Balance and Fetkovich Aquifer Model SPE Trinidad and Tobago.

[7] S Moghadam, O Jeje and L Mattar 2011 Advance Gas Material Balance in Simplified Format Journal of Canadian Petroleum Technology SPE Paper 139428 90 – 98.

[8] Petroleum Experts 2010 Integrated Production Modeling Petroleum Experts Ltd, Edinborough, Scotland, U.K.

[9] W D Mccain Jr 1990 The Properties of Petroleum Fluids 2nd Ed PennWell Books, Tulsa, PennWell Publishing Company Tulsa, Oklahoma.

[10] M N Khan, H M Bilal, M Shoaib and A A Manzoor 2012 Fluid Characterization of a Retrograde Gas Condensate Reservoir for the Simulation Study SPE Islamabad, Pakistan.

[11] R Onolehemhen, S Isehunwa, and S Salufu 2016 Development of Recovery Factor Model For Water Drive and Depletion Drive Reservoirs in The Niger Delta SPE Lagos, Nigeria.

[12] I O Obielum, P U Giegbefumwen and P O Ogbeide 2015 AP/Z plot for estimating original gas in place in a geo-pressured gas reservoir by the use of a modified material balance equation SPE Nigeria Annual International Conference and Exhibition. Society of Petroleum Engineers.