

Productivity Index of Marcellus Shale and Oriskany Formations

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Introduction

The formations in Pennsylvania provide a substantial amount of productivity of natural gas. Pennsylvania has two unique and highly important areas of interest which are the Marcellus Shale and Oriskany formations. These formations are in elevated terrain which contain various mountain ranges and other geologic formations. The Marcellus Shale, identified as an unconventional reservoir, is known to produce high quantities of natural gas and is the in the Appalachian Basin [1]. The Oriskany formation, on the contrary, is not necessarily the highest producing formation according to field data. However, it is also located in the Appalachian Basin [2]. Through understanding the formations and productivity, the potential of the formations can be maximized.

Objective

Determine the cumulative production regarding the Oriskany and Marcellus Shale formations and evaluate the formations, as well as their productivity indices.

Materials and Method

In order to effectively identify the productivity of the formations, field data from multiple gas wells were analyzed to gather various aspects regarding gas and oil production, geographic location, as well as other critical well information such as well type, measured depth, horizontal drilling distances, reservoir formations, and well status. To calculate pressure, a general equation was used given the following relationship:

$$\text{Pressure} = (\text{Depth} \times 0.433)$$

If a horizontal well was drilled, then the Depth becomes the following:

$$\text{Depth} = (\text{Measured Depth} - \text{Horizontal Distance})$$

Once this pressure was obtained, the productivity index was calculated using the following equation:

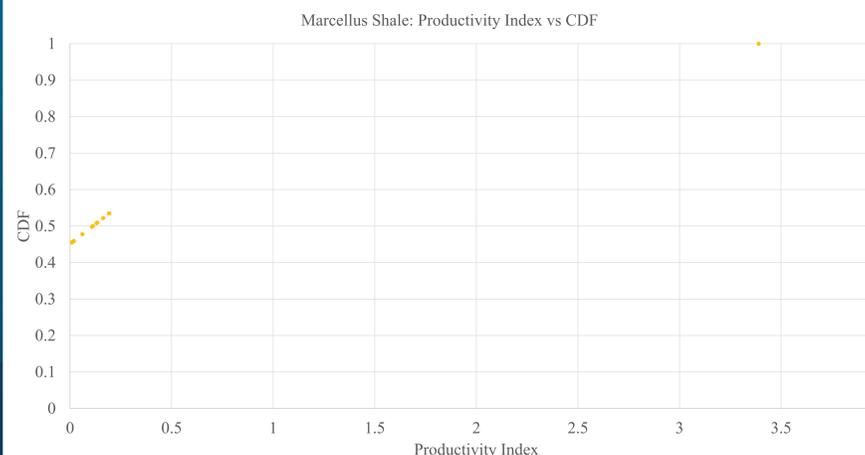
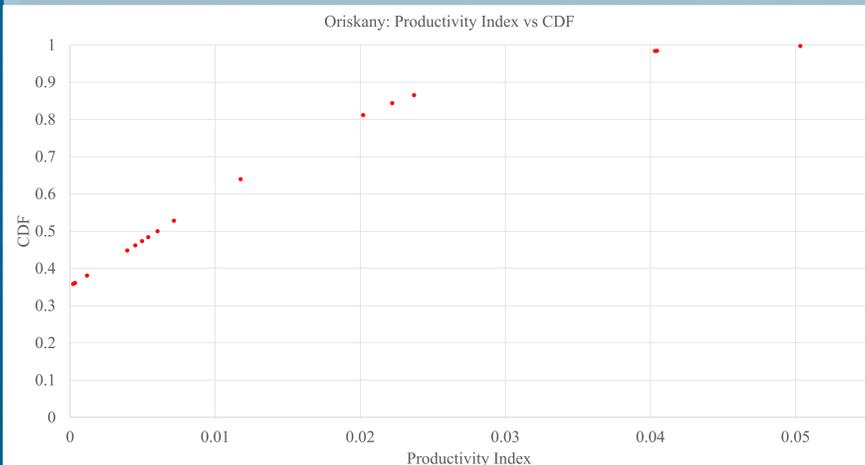
$$\text{Productivity Index} = [(\text{Production}) / (\text{Pressure}^2)]$$

In addition to the well production data, articles were used to obtain further information on the Marcellus and Oriskany formations. Using the database information, critical analysis was conducted to investigate the qualities of the formations regarding production.

Results

Based on the data collected and the calculations performed, the Marcellus Shale productivity index ranges from 0.045 to 3.38, while the Oriskany productivity index ranges from 0.0002 to 0.0503. Overall, the Oriskany formations have a lower productivity index, indicating that less natural gas is being produced when compared to the Marcellus Shale. The factors that are contributing to the productivity index are the measured depths, and cumulative production. The Oriskany formations are producing smaller amounts of natural gas at higher pressures, resulting in a low index. The Marcellus Shale formations are at high pressures; however, they are producing an extremely large amount of natural gas, thus yielding a higher index. The Marcellus formations that performed the best, according to the Enverus database, were near Lycoming, Pennsylvania. Another factor that should be considered is that most of the Marcellus Shale wells examined were drilled horizontally, not vertically. The horizontal wells, based on the data, drastically increased the production of natural gas. All the Oriskany and other miscellaneous formations were drilled vertically and produced less natural gas.

The amount of time in which the wells were producing natural gas is also significant. The Marcellus Shale wells were producing between 100 and 125 months while the Oriskany formations were producing between 2 and 280 months. The Marcellus Shale wells appeared to be more consistent for the production period where as the Oriskany formations had sporadic production time frames.



Conclusions

The Marcellus Shale and Oriskany formations both present a great deal of promise, however, vary greatly in productivity. Marcellus Shale is a large producer of natural gas when drilled horizontally and can produce a large quantity of gas in a reasonable time period. The Oriskany formation is not an ideal producer of gas and is not consistent with its production periods. It has been shown to have problems with effective production [3]. Given the cumulative distribution function diagrams, the Oriskany has a high probability of producing at a lower index, where the Marcellus Shale is more likely to produce at a higher index. The highest index, which is least likely for Oriskany formations, is more likely for the Marcellus Shale formations.

This not only represents that Marcellus Shale is more reliable and has a higher index but demonstrates that the Marcellus Shale is economically beneficial. More gas is being recovered within a consistent time frame with a favorable and probable productivity index.

References

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