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Evaluating Productivity Index in a Gas Well Using Regression Analysis

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Abstract

In this study, a new approach is introduced to augment existing correlations for the analysis of Productivity Index of a gas well. The Modified Isochronal test method is used in this analysis. The Productivity Index trend of the gas well is evaluated from the test data. Regression Analysis is used to develop a correlation, which is then used to evaluate andforecast future Productivity Index trend. The back pressure equation of the Simplified Analysis method is also used to examine the test data. The Inflow Performance Relationship data generated is compared with that generated from Regression Analysis. In the Regression Analysis, using pseudo-pressure approach evaluates productivity index of the gas well more accurately than the pressure-squared approach. The bottom-hole pressure method using the pressure-squared approach under Regression Analysis generated a better estimate of IPR data, than any other method.The Productivity Index values evaluated from the Regression Analysis are quite approximate and can be used to establish a deliverability equation for the gas well.

Keywords – Pradactivity Index, Gas Well, Regression analysis.

Introductions

The optimum production capacity of a gas well can be determined from a measure of the Inflow Performance Relationship (IPR) or the Productivity Index (PI).

Evaluating the Productivity Index involves measurement of the pressure differential at the sand face, which measures only the resistance of the sand or producing formation to yield fluid, and does not take into account the resistance of the flowing string. It therefore reflects the true relative ability of the well to produce.

The Productivity Index as a concept is very useful for describing the relative potential of a well. It combines all rock and fluid properties, as well as geometrical considerations, into a single constant, thus making it unnecessary to consider these properties individually.

Flow equations

The basic equation, on which all flow equations are based, is Darcy's Law for radial flow is given by:

$$v = \frac{q}{A_r} = \frac{k}{\mu}\frac{\partial p}{\partial r} \quad (1)$$

The gas flow equation for pseudo steady-state condition, in terms of real gas pseudopressure is given by:

$$q_g = \frac{kh(\overline{\psi}_r - \psi_{wf})}{1422T\left[\ln\left(\frac{r_e}{r_w}\right) - 0.75\right]} \quad (2)$$

With skin and turbulence effects,

$$q_g = \frac{kh(\overline{\psi}_r - \psi_{wf})}{1422T\left[\ln\left(\frac{r_e}{r_w}\right) - 0.75 + s + Dq_g\right]} \quad (3)$$

The gas flow equation for pseudo steady-state condition, in terms of pressure-squared is given by:

$$q_g = \frac{kh(\overline{p}_r^2 - p_{wf}^2)}{1422T\overline{\mu}\overline{z}\left[\ln\left(\frac{r_e}{r_w}\right) - 0.75\right]} \quad (4)$$

With skin and turbulence effects,

$$q_g = \frac{kh(\overline{p}_r^2 - p_{wf}^2)}{1422T\overline{\mu}\overline{z}\left[\ln\left(\frac{r_e}{r_w}\right) - 0.75 + s + Dq_g\right]} \quad (5)$$

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This method is only limited to pressures below 2000 psi.

Productivity index

The ratio of the rate of production, expressed in STB/day for liquid flow, to the pressure drawdown at the midpoint of the producing interval, is called the productivity index (Craft B. C. and M. F. Hawkins, 1991). Expressed mathematically, it is given as:

$$PI = J = \frac{q}{(\bar{p}_r - p_{wf})} \qquad (6)$$

Generally, equations of either pseudo steady-state or steady-state conditions could be re-arranged to estimate productivity index (J).

For pseudosteady-state condition, in terms of pressure-squared:

$$J = \frac{q_g}{(\bar{p}_r^2 - p_{wf}^2)} = \frac{kh}{1422T\bar{\mu}\bar{z}\left[\ln\left(\frac{r_e}{r_w}\right) - 0.75 + s + Dq_g\right]} \qquad (7)$$

In terms of pseudopressure function,

$$J = \frac{q_g}{[m(\bar{p}_r) - m(p_{wf})]} = \frac{kh}{1422T\left[\ln\left(\frac{r_e}{r_w}\right) - 0.75 + s + Dq_g\right]} \qquad (8)$$

Well deliverability

The conventional backpressuretest, isochronal test, and modified isochronal test have been used to predict the deliverability of gas wells.The theory behind the Deliverability test is based on the pseudo-steady-state flow equation (Beggs H. Dale, 1984). Data recorded during a modified isochronal test is given in Table 1.

Table 1. Flow history

Test (hrs)	Q_g, Mscf/day	p_{wf}, psia	ψ_{wf}, psi^2/cp	Period
-	0	2757	416.6×10^6	Initial shut-in
12	12.75	2092	257.2×10^6	Flow 1
12	0	2737	411.6×10^6	Shut-in
12	16.87	1739	183.2×10^6	Flow 2
12	0	2719	407×10^6	Shut-in
12	20.14	1419	124.8×10^6	Flow 3
25.33	0	2715	406×10^6	Shut-in
11.67	24	932	55.2×10^6	Flow 4
48	22.7	878	49.1×10^6	Extended flow
90	0	2707	403.9×10^6	Final shut-in

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Pressure-squared correlation
The following table is prepared:

Table 2. PI for Pressure-squared					
p_{ws},	**p_{wf},**	**$(p_{ws}^2 - p_{wf}^2)$,**	**Q_g,**	**PI,**	**p_{wf}^2**
(psi)	**(psi)**	**(psi^2)**	**(Mscf/day)**	**(Mscf/d/psi^2)**	**(psi^2)**
2757	2092	3224585	12.75	3.95×10^{-6}	4376464
2737	1739	4467048	16.87	3.78×10^{-6}	3024121
2719	1419	5379400	20.14	3.74×10^{-6}	2013561
2715	932	6502601	24	3.69×10^{-6}	868624

A graph of PI vs. $p_{wf}^2$is plotted on a Cartesian scale as shown in fig 1. Regression Analysis is used to generate a correlation for the graph, whereby PI is a function of p_{wf}^2.

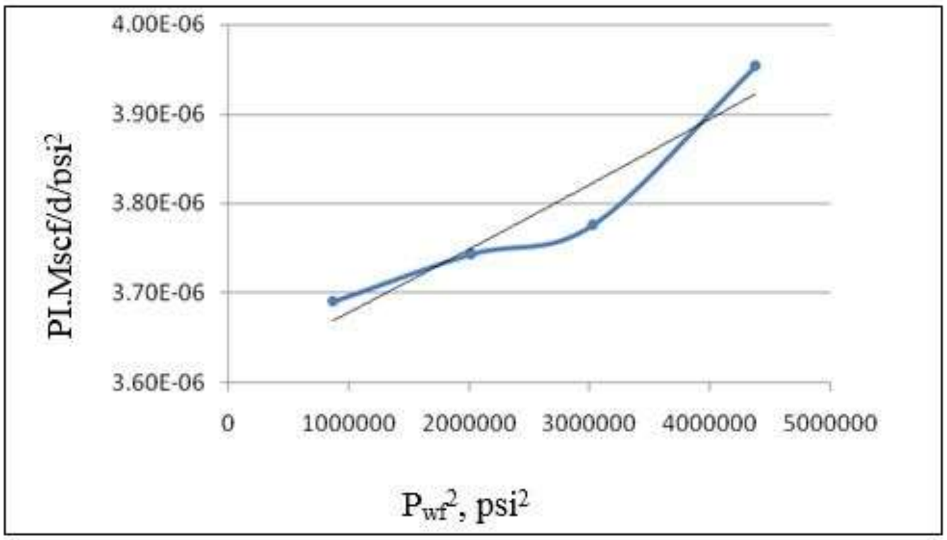

Fig. 1.PI and Pressure-squared

The regression line equation is given as:

$$PI = 3.6093 \times 10^{-6} e^{1.9x10^{-8} p_{wf}^2} \quad (9) \quad R^2 = 0.9061$$

The trend of Productivity Index of the gas well is evaluated by assuming various values of the square of the bottom-hole flowing pressure. The values are substituted into Equation 9.

Table 3. PI Trend for Pressure-squared			
p_{wf}	**p_{wf}^2,**	**PI (Test Data)**	**PI (Regression Analysis)**
(psi)	**(psi^2)**	**(Mscf/d/psi^2)**	**(Mscf/d/psi^2)**
2757	7601049		4.17×10^{-6}
2500	6250000		4.06×10^{-6}
2300	5290000		3.99×10^{-6}
2092	4376464	3.95×10^{-6}	3.92×10^{-6}
1739	3024121	3.78×10^{-6}	3.82×10^{-6}
1419	2013561	3.74×10^{-6}	3.75×10^{-6}
932	868624	3.69×10^{-6}	3.67×10^{-6}
500	250000		3.63×10^{-6}
0	0		3.61×10^{-6}

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The trend of the Productivity Index of the gas well is as shown in fig 2.

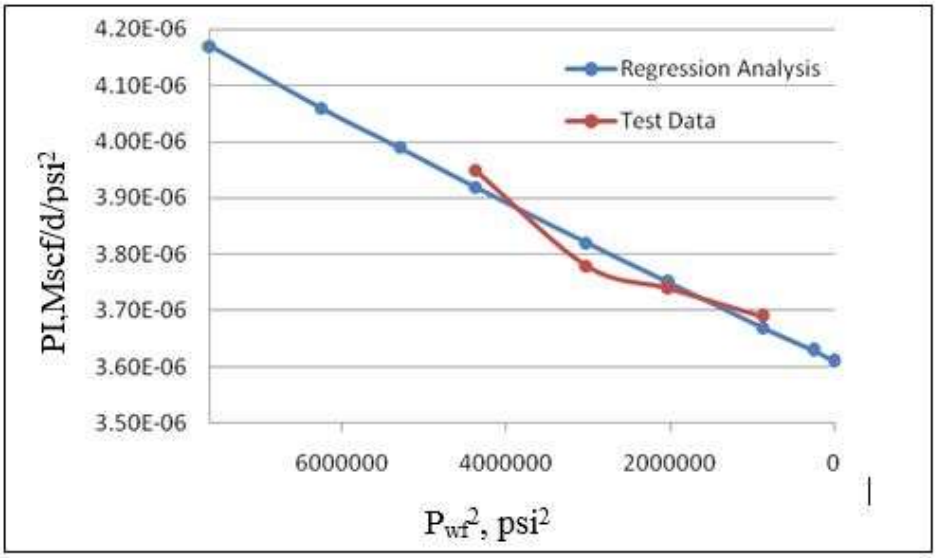

Fig. 2.PI Trend and Pressure-squared

The deliverability equation is given as:

$$q_g = PI(\bar{p}_r^2 - p_{wf}^2)$$

Table 4. IPR Data for Pressure-squared

p_{wf}, psia	p_{wf}^2, psi^2	PI, Mscf/d/psi^2	$(\bar{p}_r^2 - p_{wf}^2)$, psi^2	Q_g, Mscf/day
2757	7601049	-	0	0
2500	6250000	4.06×10^{-6}	1351049	5.49
2000	4000000	3.89×10^{-6}	3601049	14.01
1500	2250000	3.77×10^{-6}	5351049	20.17
1000	1000000	3.68×10^{-6}	6601049	24.29
500	250000	3.63×10^{-6}	7351049	26.68
0	0	3.61×10^{-6}	7601049	27.44

Pseudopressure correlation

The following table is prepared:

Table 5. PI for Pseudopressure

ψ_{ws} psi^2/cp	ψ_{wf} psi^2/cp	$(\bar{\psi}_{ws} - \psi_{wf})$ psi^2/cp	Q_g, (Mscf/day)	PI, (Mscf/d/psi^2/cp)
416.6×10^6	257.2×10^6	159.4×10^6	12.75	8.00×10^{-8}
411.6×10^6	183.2×10^6	228.4×10^6	16.87	7.39×10^{-8}
407×10^6	124.8×10^6	282.2×10^6	20.14	7.14×10^{-8}
406×10^6	55.2×10^6	350.8×10^6	24	6.84×10^{-8}

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A graph of PI vs. ψ_{wf} is plotted on a Cartesian scale as shown in fig 3. Regression Analysis is used to generate a correlation for the graph, whereby PI is a function of ψ_{wf}.

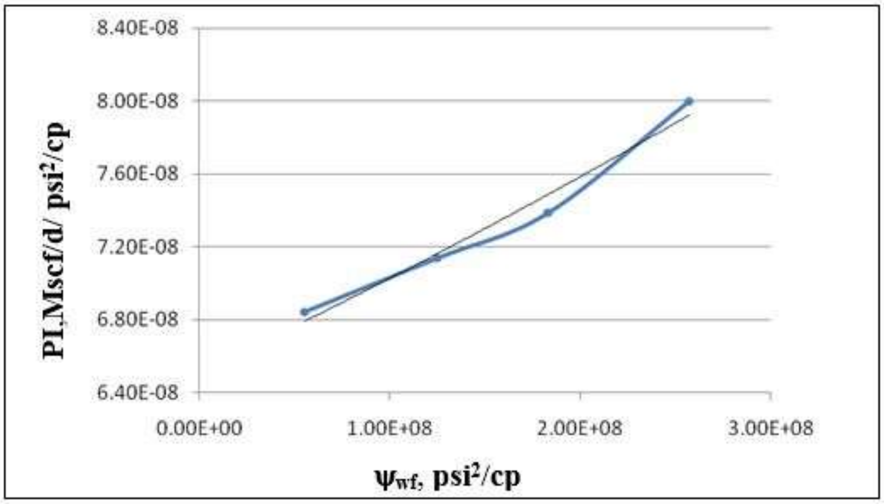

Fig. 3.PI and Pseudopressure

The regression line equation is given as:

$$PI = 6.5129 \times 10^{-8} e^{7.61x10^{-10}\psi_{wf}} \qquad (10) \quad R^2 = 0.9733$$

The trend of Productivity Index of the gas well is evaluated by assuming various values of the flowing pseudopressure. The values are substituted into Equation 10.

Table 6. PI Trend for Pseudopressure

p_{wf}	ψ_{wf}	PI (Test Data)	PI (Regression Analysis)
(psi)	psi²/cp	(Mscf/d/psi²/cp)	(Mscf/d/psi²/cp)
2757	416.6×10^6		8.94×10^{-8}
2500	352.6×10^6		8.52×10^{-8}
2300	304.7×10^6		8.21×10^{-8}
2092	257.2×10^6	8.00×10^{-8}	7.92×10^{-8}
1739	183.2×10^6	7.39×10^{-8}	7.49×10^{-8}
1419	124.8×10^6	7.14×10^{-8}	7.16×10^{-8}
932	55.2×10^6	6.84×10^{-8}	6.79×10^{-8}
500	16.1×10^6		6.59×10^{-8}
0	0		6.51×10^{-8}

The trend of the Productivity Index of the gas well is as shown in fig 4.

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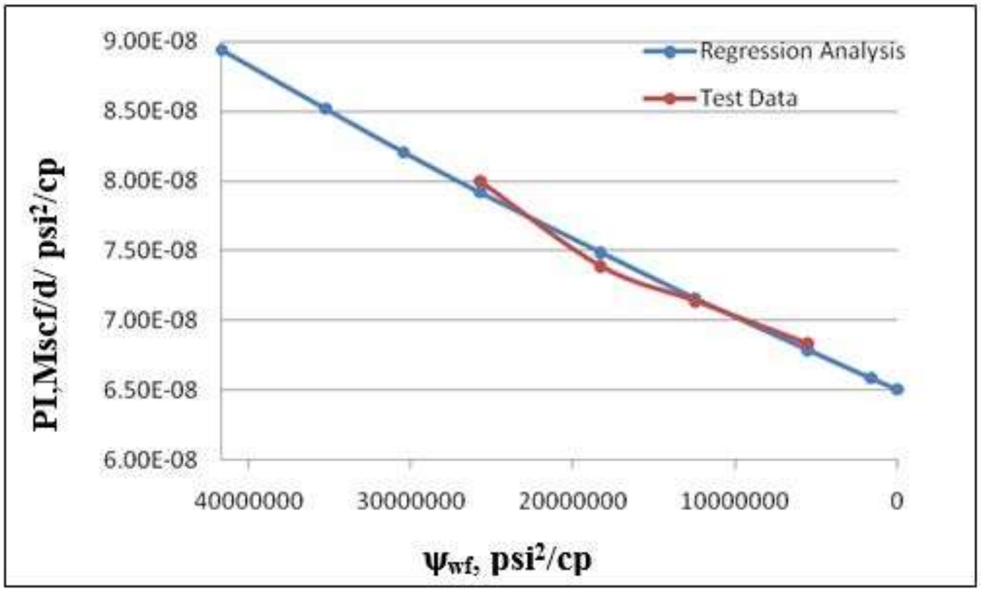

Fig. 4.PI Trend and Pseudopressure

The deliverability equation is given as:

$$q_g = PI(\bar{\psi}_r - \psi_{wf})$$

Table 7. IPR Data for Pseudopressure				
p_{wf}	ψ_{wf}	**PI**	$(\bar{\psi}_r - \psi_{wf})$	Q_g,
(psi)	**(psi²/cp)**	**(Mscf/d/psi²/cp)**	**psi²/cp**	**Mscf/day**
2757	416.6 x 10^6	-	0	0
2500	352.6 x 10^6	8.52x10^{-8}	6.40x10^7	5.45
2000	237.1 x 10^6	7.80x10^{-8}	17.95x10^7	14.00
1500	138.7 x 10^6	7.24x10^{-8}	27.79x10^7	20.12
1000	63.4 x 10^6	6.84x10^{-8}	35.32x10^7	24.16
500	16.1 x 10^6	6.59x10^{-8}	40.05x10^7	26.39
0	0	6.51x10^{-8}	41.66x10^7	27.12

Bottom-hole Pressure correlation

a) Pressure-squared Approach

The following table is prepared:

Table 8. PI for BHP (Pressure-squared Approach)				
p_{ws},	p_{wf},	$(p_{ws}^2 - p_{wf}^2)$,	Q_g,	**PI,**
(psi)	**(psi)**	**(psi²)**	**(Mscf/day)**	**(Mscf/d/psi²)**
2757	2092	3224585	12.75	3.95 x 10^{-6}
2737	1739	4467048	16.87	3.78 x 10^{-6}
2719	1419	5379400	20.14	3.74 x 10^{-6}
2715	932	6502601	24	3.69 x 10^{-6}

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A graph of PI vs. $p_{wf}$is plotted on a Cartesian scale as shown in fig 5. Regression Analysis is used to generate a correlation for the graph, whereby PI is a function of p_{wf}.

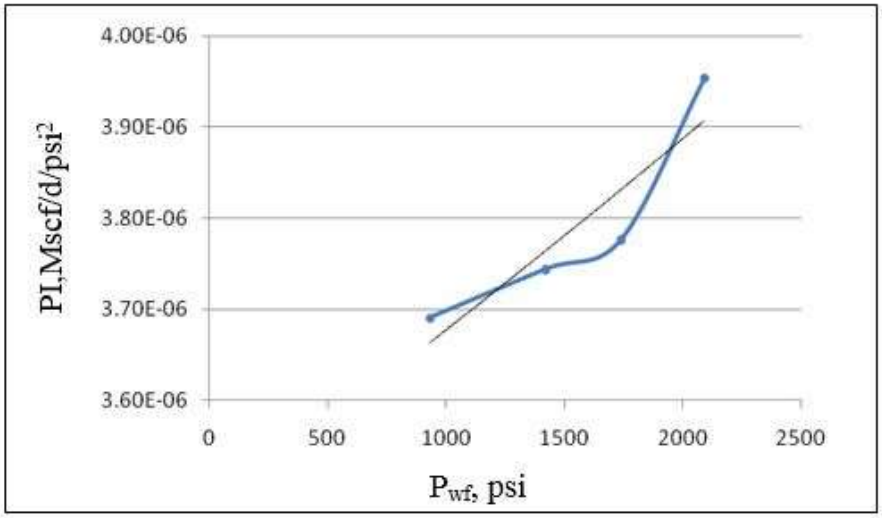

Fig. 5.PI and BHP (Pressure-squared Approach)

The regression line equation is given as:

$$PI = 3.4796 \times 10^{-6} e^{5.53x10^{-5} p_{wf}} \qquad (11) \quad R^2 = 0.8372$$

The trend of Productivity Index of the gas well is evaluated by assuming various values of the bottom-hole flowing pressure. The values are substituted into Equation 11.

Table 9. PI Trend for BHP (Pressure-squared Approach)

p_{wf} (psi)	PI (Test Data) ($Mscf/d/psi^2$)	PI (Regression Analysis) ($Mscf/d/psi^2$)
2757		4.05×10^{-6}
2500		4.00×10^{-6}
2300		3.95×10^{-6}
2092	3.95×10^{-6}	3.91×10^{-6}
1739	3.78×10^{-6}	3.83×10^{-6}
1419	3.74×10^{-6}	3.76×10^{-6}
932	3.69×10^{-6}	3.66×10^{-6}
500		3.58×10^{-6}
0		3.48×10^{-6}

The trend of the Productivity Index of the gas well is as shown in fig 6.

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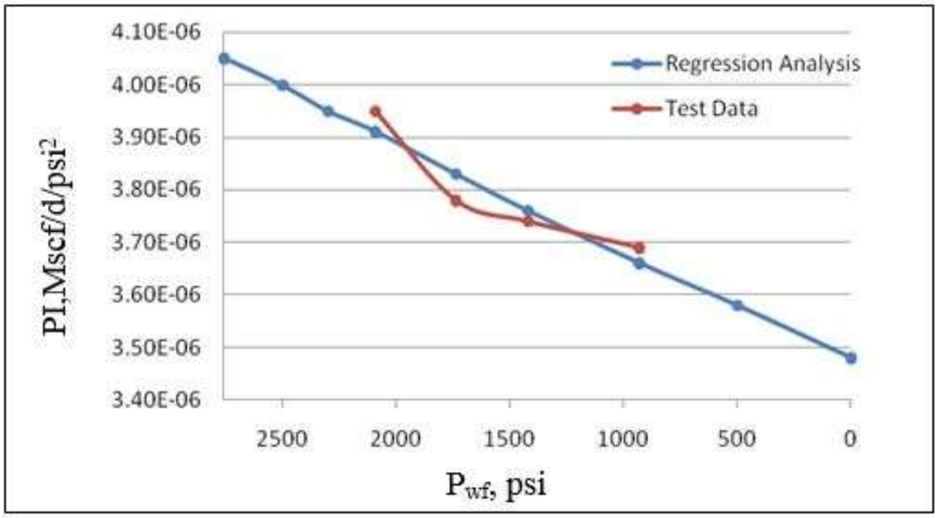

Fig. 6.PI Trend and BHP (Pressure-squared Approach)

The deliverability equation is given as:

$$q_g = PI(\bar{p}_r^2 - p_{wf}^2)$$

Table 10. IPR Data for BHP (Pressure-squared Approach)				
p_{wf}, psia	**p_{wf}^2, psi^2**	**PI, Mscf/d/psi^2**	**$(\bar{p}_r^2 - p_{wf}^2)$, psi^2**	**Q_g, Mscf/day**
2757	7601049	-	0	0
2500	6250000	4.00x10^{-6}	1351049	5.40
2000	4000000	3.89x10^{-6}	3601049	14.01
1500	2250000	3.78x10^{-6}	5351049	20.23
1000	1000000	3.68x10^{-6}	6601049	24.29
500	250000	3.58x10^{-6}	7351049	26.32
0	0	3.48x10^{-6}	7601049	26.45

b) Pseudopressure Approach

The following table is prepared:

Table 11. PI for BHP (Pseudopressure Approach)					
ψ_{ws}	**ψ_{wf}**	**$(\bar{\psi}_{ws} - \psi_{wf})$**	**Q_g,**	**PI,**	**p_{wf},**
(psi^2/cp)	**(psi^2/cp)**	**(psi^2/cp)**	**(Mscf/d)**	**(Mscf/d/psi^2/cp)**	**(psi)**
416.6 x 10^6	257.2 x 10^6	159.4 x 10^6	12.75	8.00 x 10^{-8}	2092
411.6 x 10^6	183.2 x 10^6	228.4 x 10^6	16.87	7.39 x 10^{-8}	1739
407 x 10^6	124.8 x 10^6	282.2 x 10^6	20.14	7.14 x 10^{-8}	1419
406 x 10^6	55.2 x 10^6	350.8 x 10^6	24	6.84 x 10^{-8}	932

A graph of PI vs. $p_{wf}$is plotted on a Cartesian scale as shown in fig 7. Regression Analysis is used to generate a correlation for the graph, whereby PI is a function of p_{wf}.

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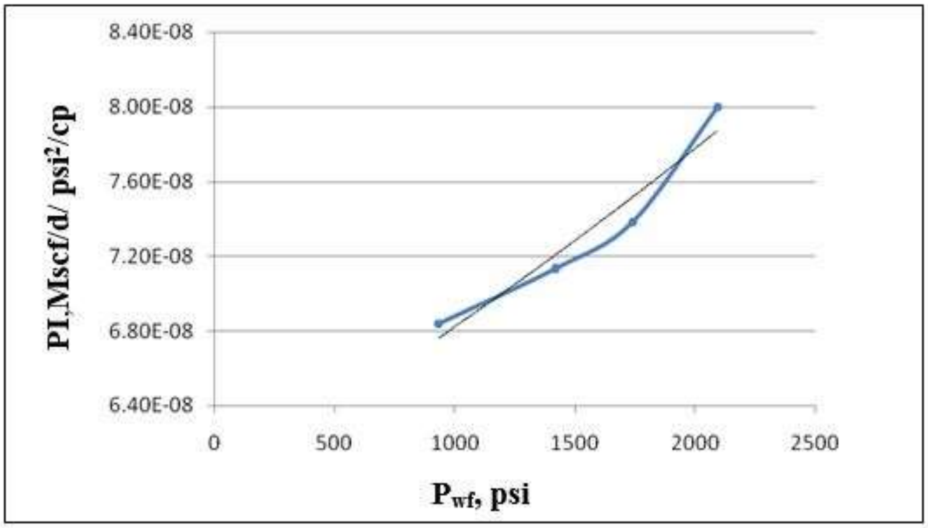

Fig. 7.PI and BHP (Pseudopressure Approach)

The regression line equation is given as:

$$PI = 5.9923 \times 10^{-8} e^{1.3x10^{-4} p_{wf}} \qquad (12) \quad R^2 = 0.9397$$

The trend of Productivity Index of the gas well is evaluated by assuming various values of the bottom-hole flowing pressure. The values are substituted into Equation 12.

Table 12. PI Trend for BHP (Pseudopressure Approach)

p_{wf}	PI (Test Data)	PI (Regression Analysis)
(psi)	(Mscf/d/psi^2/cp)	(Mscf/d/psi^2/cp)
2757		8.58×10^{-8}
2500		8.29×10^{-8}
2300		8.08×10^{-8}
2092	8.00×10^{-8}	7.87×10^{-8}
1739	7.39×10^{-8}	7.51×10^{-8}
1419	7.14×10^{-8}	7.21×10^{-8}
932	6.84×10^{-8}	6.76×10^{-8}
500		6.40×10^{-8}
0		6.00×10^{-8}

The trend of the Productivity Index of the gas well is as shown in fig 8.

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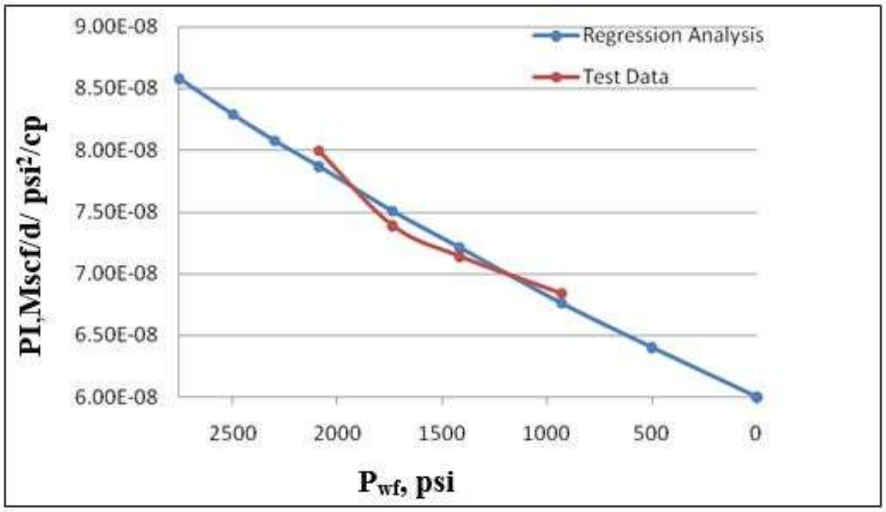

Fig. 8.PI Trend and BHP (Pseudopressure Approach)

The deliverability equation is given as:

$$q_g = PI(\overline{\psi}_r - \psi_{wf})$$

Table 13. IPR Data for BHP (Pseudopressure Approach)				
p_{wf}	**ψ_{wf}**	**PI**	**$(\overline{\psi}_r - \psi_{wf})$**	**Q_g,**
(psi)	**(psi^2/cp)**	**(Mscf/d/ psi^2/cp)**	**psi^2/cp**	**Mscf/day**
2757	416.6 x 10^6	8.58×10^{-8}	0	0
2500	352.6 x 10^6	8.29×10^{-8}	6.40×10^7	5.31
2000	237.1 x 10^6	7.77×10^{-8}	17.95×10^7	13.95
1500	138.7 x 10^6	7.28×10^{-8}	27.79×10^7	20.23
1000	63.4 x 10^6	6.82×10^{-8}	35.32×10^7	24.09
500	16.1 x 10^6	6.40×10^{-8}	40.05×10^7	25.63
0	0	6.00×10^{-8}	41.66×10^7	25.0

Simplified Analysis
The following table is prepared:

Table 14. Modified Isochronal Test Data			
p_{ws} psi	p_{wf} psi	$(p_{ws}^2 - p_{wf}^2)$ psi^2	q_g Mscf/d
2757	2092	3224585	12.75
2737	1739	4467048	16.87
2719	1419	5379400	20.14
2715	932	6502601	24
2715	878	6600341	22.7 (Stabilized)

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A graph of $(p_{ws}^2 - p_{wf}^2)$ vs. q_g is plotted on a log-log scale as shown in fig 9. A straight line is drawn through the four points to determine the slope and a second line parallel to the first is drawn through the stabilized point.

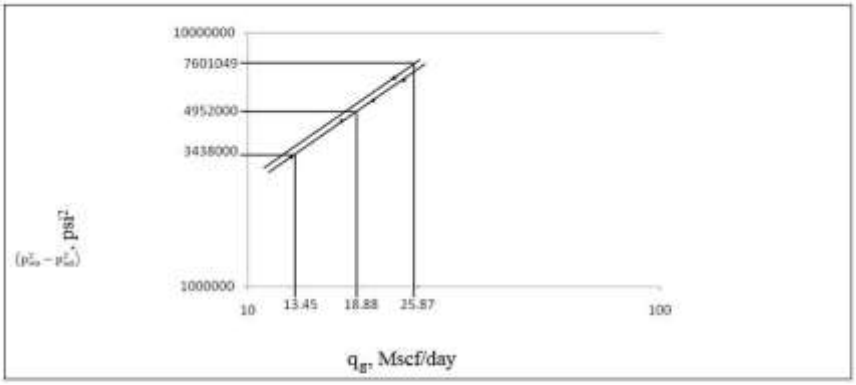

Fig. 9. Modified Isochronal Test

Using any two points on the straight line, the exponent, n, is calculated thus:

$$n = \frac{\log 18.88 - \log 13.45}{\log 4952000 - \log 3438000} = 0.93$$

The performance coefficient C is determined using the coordinate of the stabilized point:

$$C = \frac{22.7}{(6600341)^{0.93}} = 1.0324 \times 10^{-5} \text{Mscf/psi}^2$$

The deliverability equation is given as:

$$q_g = 1.0324 \times 10^{-5} (\bar{p}_r^2 - p_{wf}^2)^{0.93}$$

Table 15. Back-Pressure IPR Data			
p_{wf}, psia	**p_{wf}^2, psi^2**	**$(\bar{p}_r^2 - p_{wf}^2)$, psi^2**	**Q_g, Mscf/d**
2757	7601049	0	0
2500	6250000	1351049	5.19
2000	4000000	3601049	12.92
1500	2250000	5351049	18.68
1000	1000000	6601049	22.70
500	250000	7351049	25.09
0	0	7601049	25.89

Results and discussion

The productivity index values as calculated from the test data are compared with the values calculated from the various Regression Analysis approach.

Result of the Productivity Index calculations using the pressure-squared approach is given in Table 16.

Table 16. PI Comparison for Pressure-squared Approach			
Productivity Index, Mscf/d/psi^2			
pressure	**Test Data**	**Pressure-squared**	**Bottom-hole Pressure**
2092	3.95×10^{-6}	3.92×10^{-6}	3.91×10^{-6}
1739	3.78×10^{-6}	3.82×10^{-6}	3.83×10^{-6}
1419	3.74×10^{-6}	3.75×10^{-6}	3.76×10^{-6}
932	3.69×10^{-6}	3.67×10^{-6}	3.66×10^{-6}
	-	0.66%	0.92%

A graphical representation of the pressure-squared approach of Productivity Index evaluation is as shown in Fig. 10.

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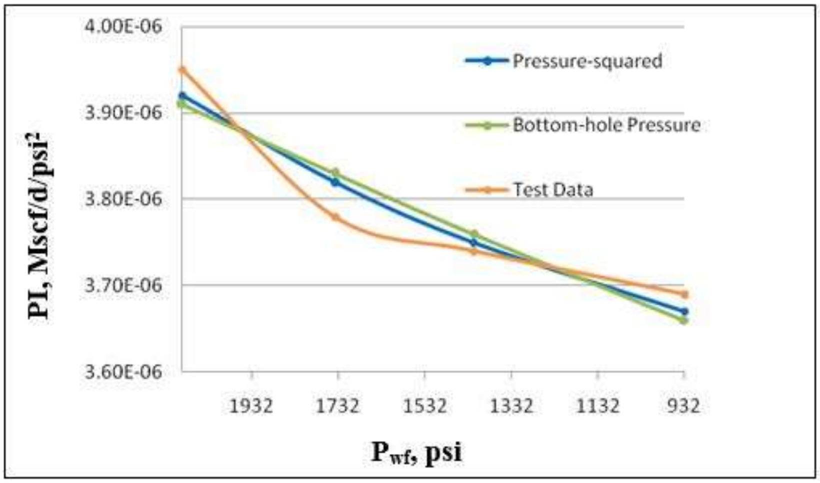

Fig. 10. PI Comparison for Pressure-squared Approach

Figure 10 compares graphically the accuracy of each PI evaluation method with thatcalculated from the test data. Results indicate that the pressure-squared approach generated the PI data with an absolute average error of 0.66% as compared with0.92%for the bottom-hole pressure method using the pressure-squared approach.

Summary in percentage error of the PI values evaluated from the Regression Analysis using the pressure-squared approach, as compared with the values from the test data is presented in Table 17.

Table 17. PI Percentage Error (Pressure-squared Approach)

Productivity Index, Mscf/d/psi^2				
Test Data	**Pressure-squared**		**Bottom-hole Pressure**	
PI	**PI**	**%Error**	**PI**	**%Error**
3.95 x 10^{-6}	3.92 x 10^{-6}	0.76	3.91 x 10^{-6}	1.01
3.78 x 10^{-6}	3.82 x 10^{-6}	1.06	3.83 x 10^{-6}	1.32
3.74 x 10^{-6}	3.75 x 10^{-6}	0.27	3.76 x 10^{-6}	0.54
3.69 x 10^{-6}	3.67 x 10^{-6}	0.54	3.66 x 10^{-6}	0.81

Result of the Productivity Index calculations using the pseudopressure approach is given in Table 18.

Table 18. PI Comparison for Pseudopressure Approach

Productivity Index, Mscf/d/psi^2/cp			
pressure	**Test Data**	**Pseudopressure**	**Bottom-hole Pressure**
2092	8.00 x 10^{-8}	7.92 x 10^{-8}	7.87 x 10^{-8}
1739	7.39 x 10^{-8}	7.49 x 10^{-8}	7.51 x 10^{-8}
1419	7.14 x 10^{-8}	7.16 x 10^{-8}	7.21 x 10^{-8}
932	6.84 x 10^{-8}	6.79 x 10^{-8}	6.76 x 10^{-8}
	-	0.84%	1.35%

A graphical representation of the pseudopressure approach of Productivity Index evaluation is as shown in Fig. 11.

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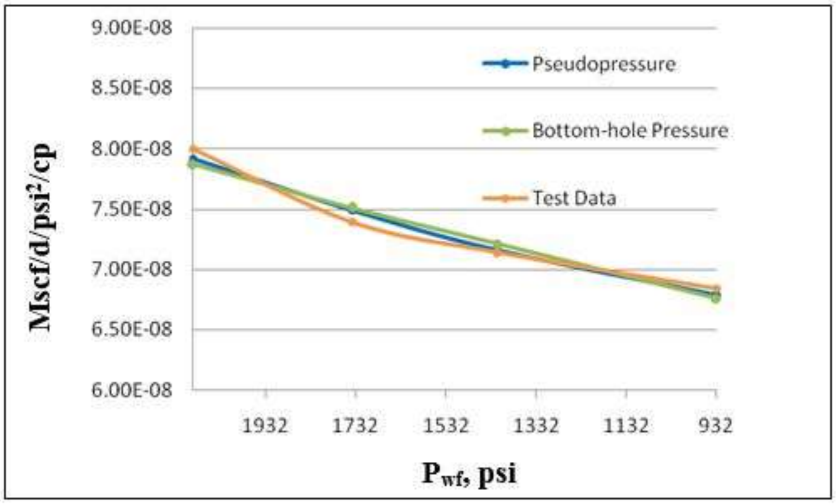

Fig. 11. PI Comparison for Pseudopressure Approach

Figure 11 compares graphically the accuracy of each PI evaluation method with thatcalculated from the test data. Results indicate that the pseudopressure approach generated the PI data with an absolute average error of 0.84% as compared with1.35%for the bottom-hole pressure method using the pseudopressure approach.

Summary in percentage error of the PI values evaluated from the Regression Analysis using the pseudopressure approach, as compared with the values from the test data is presented in Table 19.

Table 19. PI Percentage Error (Pseudopressure Approach)

Productivity Index, Mscf/d/psi²/cp				
Test Data	**Pseudopressure**		**Bottom-hole Pressure**	
PI	**PI**	**%Error**	**PI**	**%Error**
8.00×10^{-8}	7.92×10^{-8}	1.00	7.87×10^{-8}	1.63
7.39×10^{-8}	7.49×10^{-8}	1.35	7.51×10^{-8}	1.62
7.14×10^{-8}	7.16×10^{-8}	0.28	7.21×10^{-8}	0.98
6.84×10^{-8}	6.79×10^{-8}	0.73	6.76×10^{-8}	1.17

Graphical analysis show that the Productivity Index values from the pressure-squared approach do not curve fit with the values calculated from the test data. In contrast, the Productivity Index values calculated from the pseudopressure approach curve fitted to the values calculated from the test data.

Inflow Performance Relationship

The gas flow rates as calculated by the Back-pressure method are compared with the gas flow rates calculated from the various Productivity Index methods, using Regression Analysis. Results of the IPR calculations are given in Table 20.

Table 20. IPR Comparison

Gas Flow Rate, Mscf/day					
		Pseudopressure App.		**Pressure-squared App.**	
pressure	**Backpressure**	**ψ**	**P_{wf}**	**P^2**	**P_{wf}**
2757	0	0	0	0	0
2500	5.19	5.45	5.31	5.49	5.40
2000	12.92	14.00	13.95	14.01	14.01
1500	18.68	20.12	20.23	20.17	20.23
1000	22.70	24.16	24.09	24.29	24.29

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500	25.09	26.39	25.63	26.68	26.32
0	25.89	27.12	25.0	27.44	26.45
	-	6.24%	5.05%	6.92%	5.81%

A graphical representation of the various Inflow performance curves is given in Fig. 12.

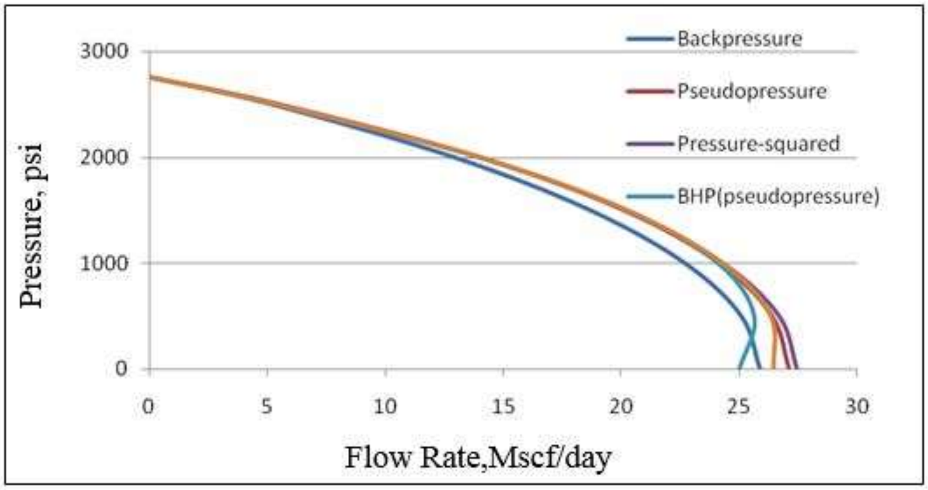

Fig. 12.IPR for all methods

Figure 12 compares graphically the performance of each method with that of the back-pressure method. Results indicate that the pseudopressure method of productivity index generated the IPR data with an absolute average error of 6.24% as compared with 6.92%for the pressure-squared method, 5.05% for the bottom-hole pressure (pseudopressure approach) and 5.81% for the bottom-hole pressure (pressure-squared approach).
The percentage error in generating the absolute open flow potential (AOFP) is 4.75% for pseudopressure method, 5.99%for the pressure-squared method, 3.44%for the bottom-hole pressure (pseudopressure approach) and 2.16% for the bottom-hole pressure (pressure-squared approach).

Conclusion

The following conclusions may be drawn from this study:

1. In the Regression Analysis, using pseudopressure approach evaluates productivity index of the gas well more accurately than the pressure-squared approach.

2. In the Regression Analysis, the bottom-hole pressure method using the pressure-squared approach generates a better estimate of IPR data, than any other method.

3. The bottom-hole pressure method using the pressure-squared approach is effectively used to estimate the absolute open flow potential of the well, giving a better approximation.

4. There seems to be an existing correlation between the productivity index value generated and the bottom hole flowing pressure, as evaluated using the Regression Analysis.

5. There seems to be an existing correlation between the productivity index value generated and the pseudopressure and pressure-squared forms of the flowing pressure, as evaluated using the Regression Analysis.

6. The Productivity Index values evaluated from the Regression Analysis are quite approximate and can be used to establish a deliverability equation for the gas well.

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