



**Original Article: PLANNING AND REDUCING COSTS IN GAS INDUSTRY WITH USING OF ECONOMETRIC MODEL**

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LLC "EUROTEK" company is an enterprise of gas reserves, which belongs to the category D. It is a small player in the market of hydrocarbons and depends on the condition of Gazprom. To date, the company has started to step to reduce their costs. One of the trends is a lowering of gas loss and gas condensate production and transportation from multiple well platform to gas preparing plant. This econometric model examined one of the options to reduce this replacement of main pipelines on pipe diameter less by which the gas flow rate should be increase. Experience shows that the losses directly depend on gas velocity which in turn depend on many factors such as the gas production, pressure and diameter.

$$\begin{cases} y_i = f_x(v_i) \\ v_i = f_x(Q_1; D; P_1) \end{cases} \quad (1)$$

Therefore, we calculate the costs by replacing the main pipeline on a smaller diameter and we can see how much cash will be save for the first year of operation (Table 1).

Construct linear regression equation of Y (gas losses) depending on X<sub>1</sub> (gas velocity), X<sub>2</sub> (wellhead pressure) and X<sub>3</sub> (pipe diameter) by using Statistica, then we will get equation:

$$Y=996.436-553.031X_1-4.75X_2-0.005X_3, \quad (2)$$

Make the factor selection using the Stepwise procedure of regression analysis. Exclude the variable of pipe diameter based on Student's test.

Get the next equation

$$Y=996.195-553.005X_1-4.749X_2, \quad (3)$$

$$R^2=0.948401$$

At the significant level in 13% the variable of pressure is statistically significant, the variable of velocity is statistically significant on the level in 1%.

Gas velocity depend on pipe diameter consequently pick up diameter to minimize gas losses. To this effect, we must solve the optimization task.

$$\begin{cases} y \rightarrow \min \\ 9.8 \leq d \leq 15.7 \end{cases} \quad (3)$$

To use the equation for determination of gas velocity in tube 9.8 sm and 15.6 sm.

$$w = 0.01247 \frac{Q \cdot 0.98 \cdot (273 + T)}{P^2 \cdot d}, \quad (4)$$

The received results of velocity substitute for X<sub>1</sub> in equation

$$Y=996.195-553.005X_1-4.749X_2, \quad (5)$$

and determine losses. Determine more effectively diameter for different gas value (Table 2).

From the table 2 we can see that pipe diameter equal 9.8 sm. is more appropriate to use. This diameter provide the water lifting by less gas production with the same velocity. Also this pipe is more inexpensive in cost and transport than pipe with diameter equal 15.6 sm.

To calculate losses by using tube 9.8sm instead of 25.7 sm we will get next results of gas velocity and gas losses.

Calculate charge by using tube with diameter 257 mm. and costs if will replace on tube with diameter 98 mm (Tables 4 and 5).

Lost profit = Total Sum (25.6 sm) - Total sum (9.8 sm)

Lost profit = 22544211-3383080= 19161131 rub.

Lost profit is 19 million rubles per year.

Actual gas losses, th. m<sup>3</sup>

Table 1

Year	Month	Y	X <sub>1</sub>	X <sub>1</sub>	X <sub>3</sub>	X <sub>4</sub>
		Gas losses, th.m <sup>3</sup>	v (gas velocity), m/s	Volume, th.m <sup>3</sup> /hour	P (wellhead pressure), kgs/sm <sup>2</sup>	D (pipe diameter), sm
Line 1	April	304.62	0.228	15000	110	20.1
	May	368.891	0.256	15000	104	20.1
	June	227.21	0.535	32000	105	20.1
	July	243.131	0.525	32000	106	20.1
	August	153.558	0.773	48000	107	20.1
	September	37.076	0.802	48000	105	20.1
	October	45.408	0.787	48000	106	20.1
	November	44.87	0.758	48000	108	20.1
	December	10.005	0.802	48000	105	20.1
	January	10.646	0.834	48000	103	20.1
	February	16.631	0.903	52000	103	20.1
	March	16.924	0.886	50000	102	20.1
Line 2	April	401.9	0.216	15000	110	25.70
	May	393.59	0.231	16000	104	25.70
	June	266.4	0.461	32000	105	25.70
	July	266.4	0.461	32000	106	25.70
	August	242.06	0.505	35000	107	25.70
	September	234.32	0.519	36000	105	25.70
	October	226.58	0.533	37000	106	25.70
	November	202.24	0.577	40000	108	25.70
	December	194.5	0.591	41000	105	25.70
	January	138.64	0.692	48000	103	25.70
	February	106.57	0.75	52000	103	25.70
	March	42.97	0.865	60000	102	25.70

Table 2

Gas losses by using pipe diameter equal 9.8 sm and 15.6 sm

y <sub>i</sub> (gas losses), th.m3	v (gas velocity), m/s	Volume, th.m3/hour	P (wellhead pressure), kgs/sm <sup>2</sup>	D (pipe diameter), sm
	(X <sub>1</sub> )	(X <sub>2</sub> )	(X <sub>3</sub> )	(X <sub>4</sub> )
377.001648	0.261	11000	100	15.6
337.736376	0.332	14000	100	15.6
297.918072	0.404	17000	100	15.6
258.6528	0.475	20000	100	15.6
219.387528	0.546	23000	100	15.6
180.122256	0.617	26000	100	15.6
140.303952	0.689	29000	100	15.6
101.03868	0.76	32000	100	15.6
61.773408	0.831	35000	100	15.6
22.508136	0.902	38000	100	15.6
0	0.974	41000	100	15.6
0	1.045	44000	100	15.6
291.281688	0.416	11000	100	9.8
228.789072	0.529	14000	100	9.8
165.743424	0.643	17000	100	9.8
103.250808	0.756	20000	100	9.8
40.758192	0.869	23000	100	9.8
0	0.983	26000	100	9.8
0	1.096	29000	100	9.8
0	1.21	32000	100	9.8
0	1.323	35000	100	9.8
0	1.437	38000	100	9.8
0	1.55	41000	100	9.8
0	1.663	44000	100	9.8

Table 3

Gas losses by using tube 98mm. instead tube 257mm by actual gas production, th.m3

$Y_i$ (Gas losses), th. m <sup>3</sup>	v (gas velocity), m/s	Volume, th.m3/hour	P (wellhead pressure), kgs/sm <sup>2</sup>	D (pipe diameter), sm
214,4	0,469	15000	110	9,8
193,2	0,559	16000	104	9,8
0	1,097	32000	105	9,8
0	1,077	32000	106	9,8
0	1,156	35000	107	9,8
0	1,234	36000	105	9,8
0	1,245	37000	106	9,8
0	1,296	40000	108	9,8
0	1,406	41000	105	9,8
0	1,71	48000	103	9,8
0	1,853	52000	103	9,8
0	2,18	60000	102	9,8

Table 4

Costs by using tube 257 mm

Pipe diameter, mm	Gas cost, \$	Gas losses, th. m <sup>3</sup>	Gas losses cost, rub.	Charge for burned gas, rub.	Tax, rub.
257	7500	401,9	3014250	40190	281330
		393,59	2951925	39359	275513
		266,4	1998000	26640	186480
		266,4	1998000	26640	186480
		242,06	1815450	24206	169442
		234,32	1757400	23432	164024
		226,58	1699350	22658	158606
		202,24	1516800	20224	141568
		194,5	1458750	19450	136150
		138,64	1039800	13864	97048
		106,57	799275	10657	74599
		42,97	322275	4297	30079
Sum		2716,2	20371275	271617	1901319
Total		Rub	22544211		

Table 5

## Costs by using tube 98 mm

Pipe diameter, mm	Gas cost, \$	Gas losses, th. m <sup>3</sup>	Gas losses cost, \$	Charge for burned gas, rub.	Tax, rub.
9,8	7500	214,4	1608000	21440	150080
		193,2	1449000	19320	135240
		0	0	0	0
		0	0	0	0
		0	0	0	0
		0	0	0	0
		0	0	0	0
		0	0	0	0
		0	0	0	0
		0	0	0	0
		0	0	0	0
		0	0	0	0
Sum		407,6	3057000	40760	285320
Total			3383080		