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COSTS SHARING ON CONTROL STATE OF PIPELINE TRANSPORT SYSTEMS

Igor Tararychkin , Gregory Nechayev , Maxim Slobodyanyuk

Volodymyr Dahl East-Ukrainian National University, Lugansk, Ukraine

Summary. The principle of the selective approach to a task of distribution expenses on realization of the control a technical condition linear elements pipeline transport systems is formulated. The level of expenses on performance control operations should be connected to a role of separate elements system in transport process.

Key words: system, pipeline, transport, control, expense.

INTRODUCTION

Pipeline transportation systems are intended for delivering liquid or gaseous products to customers in various sectors of economical activity [5,8,10-13,16]. As the damage or destruction of such objects can be related to environmental pollution and cause an extensive material damage, so the control of their reliability and the technical state is an actual problem [2-4,9,14,15].

ANALYSIS OF LAST RESEARCHING AND PUBLICATIONS

There are different approaches to the problem of costs sharing on controlling the technical state of linear elements of transport systems. Thus the most effective is the scheme under which the costs on the element state control are proportional to the extent of risk related to its operation [1,6,7,18-21].

It means that the most important pipelines of the system should be controlled more often than the pipelines, the role of which in the process of the system functioning is insignificant .

In accordance with provisions of work [17], a measure of risk is a dimensionless quantity, which is determined as:

$$\sqrt{\mathrm{R}} = \sqrt{(1-\mathrm{p})\cdot\Phi}\ .$$

It depends on the reliability of the pipeline p and the transit coefficient Φ, which represents a share of the product generated by the source and passing through the pipeline in unit time.

GOAL OF RESEARCHING

The purpose of the present job is the formulation principles of the selective approach to a task distribution expenses on realization control of a technical condition linear elements pipeline transport systems.

MATERIALS AND RESULRS OF RESEARCHING

If a part of the pipeline system consists of *n* line elements, in accordance with the proposed approach the total unit costs on control of its state are determined as follows:

$$\Theta_{\Sigma} = z_0 \sum_{i=1}^{n} l_i \cdot D_i \cdot \sqrt{R_i} \cdot$$

where: z_0 - the average costs on the state control of the pipe surface area in unit time;

l_i and D_i - the length and diameter of the i - pipeline system.

The share of unit costs for the i - element:

$$\vartheta_i = \frac{l_i \cdot D_i \cdot \sqrt{R_i}}{\sum_{i=1}^{n} l_i \cdot D_i \cdot \sqrt{R_i}} . \quad (1)$$

The value ϑ_i characterizes the share of costs on the state control of the i - element in the scale of the whole transport system. This scheme of costs should be regarded as rational, if the share of costs on the state control of linear elements of the transport system is distributed according to the dependence (1).

Different level of costs on the technical state control of pipelines system also includes different volumes of control operations. In this case, the recommended level of control depends on the value and determined in accordance with the data in the table. 1.

In general case the usage of four levels is provided. The consecutive transition from the baseline level to the peak one should be accompanied by the control extension over the volume, frequency, increasing reliability, etc.

Table 1. **The recommended levels of technical state control of transport systems pipelines**

Level of technical state control	Baseline	Advanced	Strengthened	Peak
Share of costs per unit ϑ_i	less 0,125	0,125... 0,25	0,25... 0,5	0,5... 1,0

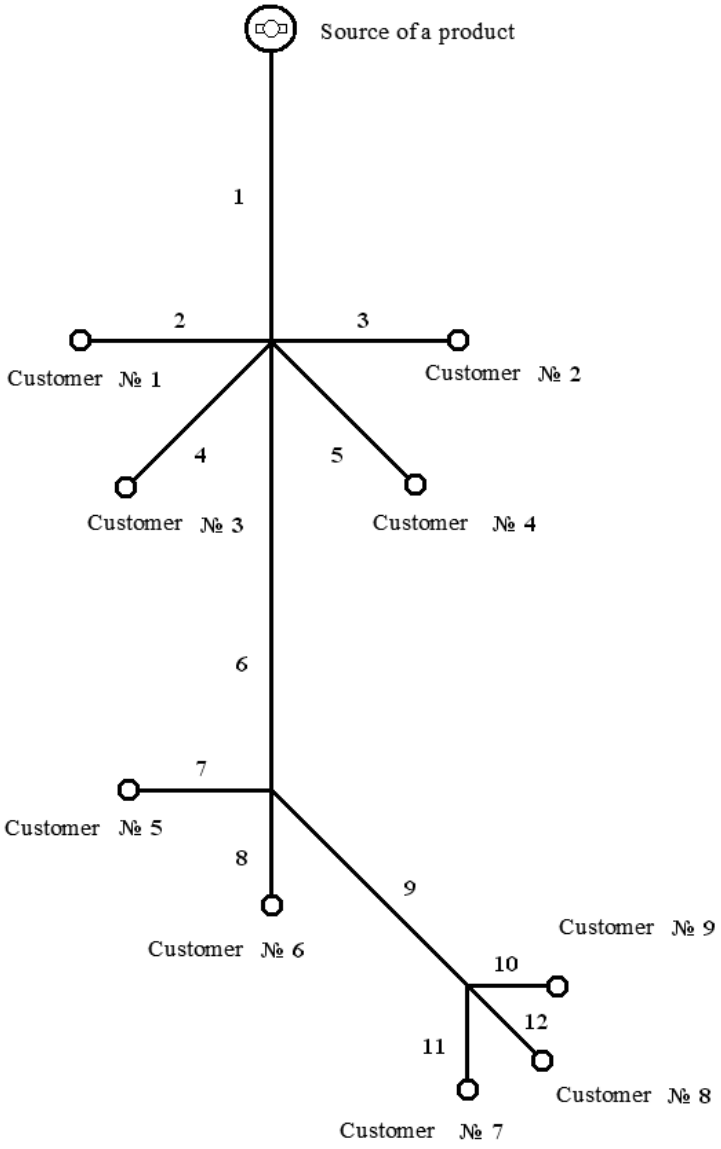

Fig. 1. Calculation scheme of pipeline transport system

Determination of the recommended control level for all the pipelines of the system can be performed having the information about their reliability, diameter, length and values of transit coefficients.

The initial data for calculation of such a system are given in the table 2. Here are given the values ϑ_i set by relation (1). The results of the calculations can be represented in graphical form, by placing all the elements in order of decreasing values.

Table 2. **Calculated characteristics of the pipeline system**

Number of element i	Length of pipeline l_i, m	Diameter of pipeline D_i, m	Reliability of pipeline p_i	Transit coefficient Φ_i	The share of unit costs ϑ_i
1	70	0,325	0,992	1,0	0,364
2	25	0,159	0,980	0,08	0,028
3	25	0,159	0,980	0,08	0,028
4	40	0,159	0,985	0,08	0,039
5	60	0,273	0,990	0,68	0,242
6	40	0,159	0,985	0,08	0,039
7	25	0,168	0,991	0,08	0,020
8	20	0,168	0,991	0,1	0,018
9	40	0,219	0,984	0,5	0,140
10	20	0,159	0,989	0,2	0,027
11	20	0,159	0,989	0,2	0,027
12	25	0,159	0,986	0,1	0,027

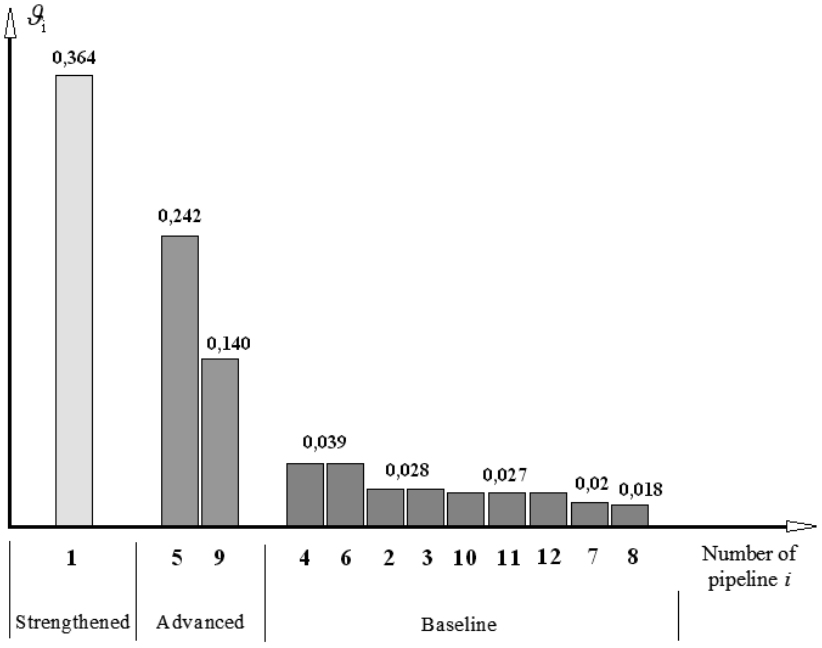

Fig. 2. Diagram of the costs sharing and recommended levels of state control of pipelines transport system

This kind of rank diagram is shown in pic. 2 and gives opportunity to estimate the recommended ratio of costs on control of the technical state of various pipelines of the system.

In accordance with the received data the group of pipelines with the strengthened level of control includes one element (pipeline № 1), with the expanded level includes two elements (pipelines № 5 and № 9). All other pipelines belong to the group with the baseline control.

Thus, distribution of resources in accordance with the presented column diagram allows to create a rational scheme of costs on the technical state control of the elements of the analyzed transport system.

CONCLUSIONS

The rational scheme of costs sharing on the technical state control of the transport system can be provided if the costs sharing on the state control of individual pipelines is approximately proportional to their diameter, length and extent of risk which is related to their functioning.

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РАСПРЕДЕЛЕНИЕ ЗАТРАТ НА КОНТРОЛЬ СОСТОЯНИЯ ТРУБОПРОВОДОВ ТРАНСПОРТНЫХ СИСТЕМ

Игорь Тарарычкин, Грегорий Нечаев, Максим Слободянюк

Аннотация. Сформулирован принцип избирательного подхода к распределению затрат на контроль технического состояния линейных элементов трубопроводных транспортных систем. Уровень затрат на выполнение контрольных операций должен быть пропорционален той роли, которую играют отдельные элементы системы в транспортном процессе.

Ключевые слова: системы, трубопровод, транспорт, контроль, затраты.