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PREDICTION OF ECO-GEODYNAMIC RISK FACTOR FOR HAZARDOUS FACILITIES OF MINING AND OIL-GAS COMPLEXES ON THE BASIS OF FUZZY SETS THEORY

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Abstract- Studies show that during the development of oil and gas fields, layer pressure decreases, sometimes stabilizes, and in some cases, on the contrary, increases. Thus, the dynamics of the layer pressure during the development of the field manifest oppositely to each other. It is clear from our research that this is due to the intensity of modern tectonic movements. In the first case, the energy consumption of the layer used to extract liquid is not regulated by the additional energy created by modern tectonic movements, in the second case the regulation is self-evident, while in the third case it is due to the fact that the pressure of natural energy on the extraction of layer is much higher. Until recently, damage to mining and oil gas facilities was supposed to be mainly technological. In very few cases, these accidents were reported to be related to man-made geodynamic processes (with the exception of accidents that occur directly in the source areas of strong earthquakes). Modern geodynamic factors emerged by the geological environment were not taken into account during the analysis of emergencies at environmentally hazardous sites. The purpose of the article is to predict the eco-geodynamic risk factor for dangerous objects of mining and oil and gas complexes based on the theory of fuzzy sets, taking into account the effect of modern geodynamic forces on the formation of deformation-stress state in rocks. During the research, it was determined that the parameters characterizing the intensity of modern tectonic movements (MTM) should be considered as a whole in the generation of effective stress. As a result of the research, a model providing prediction of Eco geodynamic risk factors was proposed and a fuzzy model training algorithm was developed based on statistical data.

Keywords: Geodynamic Hazard, Deformation of the Earth's Surface, Weakness of the Facility, Material Damage, Prediction, Computer Implementation of the Algorithm, Fuzzy Model.

1. INTRODUCTION

Stress and deformation processes occurring in rocks have been studied for a long time from the standpoint of engineering geology. The deformation occurring in the rocks is related to the effect of effective stress, that is, the effective stress absorbs the excess of pore pressure and creates conditions for the formation of deformation in the rocks. At that time, the effects of modern textonic movements on the creation of effective tension were not taken into account [1]. If the formation of stress and occurrence of deformation in rocks were due to the effect of geostatic pressure, then the stability of the porous pressure at this time could be maintained. Studies show that during the development of oil and gas fields, layer pressure decreases, sometimes stabilizes, and in some cases, on the contrary, increases. Thus, the dynamics of the layer pressure during the development of the field manifest oppositely to each other. It is clear from our research that this is due to the intensity of modern tectonic movements. In the first case, the energy consumption of the layer used to extract liquid is not regulated by the additional energy created by modern tectonic movements, in the second case the regulation is self-evident, while in the third case it is due to the fact that the pressure of natural energy on the extraction of layer is much higher [2].

Studies have shown that the long-term effects of external loads on the rocks gradually reduce their stability. Therefore, it has been scientifically substantiated that over time, the increase in stress and the occurrence of deformation can be explained by the influence of modern geodynamic movements. This can also be assessed as a primary criterion.

Until recently, damage to mining and oil gas facilities was supposed to be mainly technological. In very few cases, these accidents were reported to be related to man-made geodynamic processes (with the exception of accidents that occur directly in the source areas of strong earthquakes). Modern geodynamic factors emerged by the geological environment were not taken into account during the analysis of emergencies at environmentally hazardous sites [4, 6]. Plain (platform) areas, unlike mountainous areas, were considered stable and were defined as areas with low activity of modern surface deformations [8].

Recently, new information has been obtained about the current geodynamic condition of the earth interior. Thus, modern super intensive deformations occur at a rate of 50-70 mm per year on the earth surface. Given that the platform areas are human-dominated areas, the presence of a geodynamic risk factor in the fracture zones of the platform radically changes the level of environmental and social risk in these areas [3, 5].

2. MATERIALS AND METHODS

Recently, reliable information has been obtained on the scale and level of the impact of geodynamic risk factors on mining and oil gas facilities. Thus, the activity of modern geodynamic movements is noted as a major factor complicating the development of oil, gas and other minerals, the construction of oil and gas pipelines, as well as the storage of hydrocarbons in underground storage [7]. It is clear that the technical condition of facilities in mining and oil gas fields depends to a large extent on the stress-strain state of the earth. Therefore, the geodynamic risk factor must be taken into account, among other factors, during the exploitation of oil wells and pipelines.

Knowing the features of modern geodynamic processes allows to take preventive measures to prevent possible accidents [9, 10]. It should be noted that over time, the formation of stress-strain in rocks in the seismic or weak seismic area and the occurrence of deformation are associated with the activation of the effects of modern geodynamic movements. This is a geodynamic risk factor that can be assessed as a primary criterion. The following formula can be used to assess the degree of geodynamic risk posed by natural and man-made factors [12].

$$R = P_1 \times P_2 \times C \tag{1}$$

where, P_1 is geodynamic hazard; P_2 is weakness of the facility; and C is total material damage.

Thus, in terms of environmental insurance, special attention should be paid to the areas where these facilities pose a socio-economic and environmental hazard, and it provides a methodological approach to forecasting the geodynamic risks associated with the facilities. All this gives grounds to take into account the eco-geodynamic risk factor in order to believe in increasing the protection of the population and mining and oil gas facilities, natural and man-made disasters and the environment.

As it can be seen from Equation (1), the value of the geodynamic risk for maximum damage is directly proportional to the probabilities P_1 and P_2. It is assumed that the probability P_1 of occurrence of the *SD* process is determined in a certain place on the earth’s surface (where a hazardous facility is located) and at a certain time (during the examination) on the basis of the Gephestos method and depends nonlinearly on the value of deformation [11]. Since this level of risk is formed under the impact of geodynamic processes, the larger the scale of deformation, the less likely it is to occur.

A logical conclusion can be drawn about the presence of various monotonically decreasing dependences between the occurrence probability of P_1 and the level of geodynamic processes (deformation -Δ) (Figure 1: $P_{1.1}$, $P_{1.2}$, $P_{1.3}$). It is clear that due to the impact of a geodynamic factor established by a special team of experts or competent authorities, the weakness probability of P_2 (from the point of view of an accident) of the facility being under consideration will be a monotonically increasing deformation function.

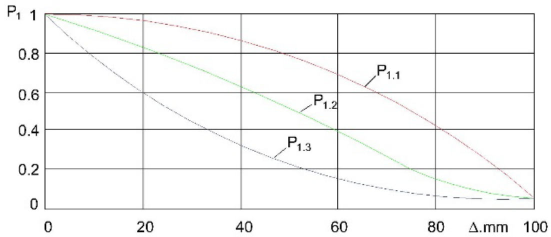

Figure 1. Probable versions of deformation factor formation [15]

In Figure 2, the probabilities of damage to facilities (when an accident occurs) with the appearance of the geodynamic factor were determined taking into account the changes in the probabilities P_1 and P_2 depending on the scale of deformation. The changes in these probabilities, i.e. risks (P_R), that is, for the versions being under consideration, are given in Figure 2. The maximum values of these risks are formed as follows.

$$P_{R_1} = P_{1.1} \times P_{2.1} = 0.54 \tag{2}$$

$$P_{R_2} = P_{1.3} \times P_{2.1} = 0.28 \tag{3}$$

$$P_{R_3} = P_{1.3} \times P_{2.3} = 0.11 \tag{4}$$

$$P_{R_4} = P_{1.1} \times P_{2.3} = 0.27 \tag{5}$$

$$P_{R_5} = P_{1.1} \times P_{2.2} = 0.28 \tag{6}$$

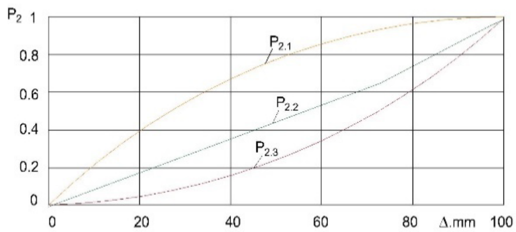

Figure 2. Probable versions of weakness of facilities (the occurrence of accidents) [20]

As it can be seen from Figure 3, the maximum risks for the versions being under consideration ($P_{1.1}$, $P_{1.2}$) vary from 0.11 to 0.54 and are 0.54 at an approximate value of Δ = 50 of deformation. In other words, the most probable loss or risk is $R_{max} = 0.54 \times C$, which can be at probability of 0.54.

Table 1. Mathematical probability of risks

Δ, mm	P_{max}	P_{min}	P_{max}	P_{min}	P_1	P_2	P_3	P_4	P_5
	1	1	0	0	0	0	0	0	0
10	0.963	0.8	0.212	0.025	0.204	0.024	0.02	0.169	0.048
20	0.912	0.65	0.375	0.062	0.342	0.056	0.04	0.244	0.1056
30	0.862	0.525	0.500	0.125	0.431	0.107	0.065	0.262	0.1875
40	0.800	0.412	0.625	0.200	0.500	0.16	0.082	0.257	0.2535
50	0.725	0.312	0.737	0.287	0.534	0.208	0.089	0.230	0.260
60	0.637	0.237	0.8	0.375	0.509	0.239	0.089	0.189	0.2584
70	0.537	0.187	0.862	0.500	0.462	0.268	0.093	0.161	0.1817
80	0.400	0.125	0.925	0.65	0.37	0.26	0.081	0.116	0.088
90	0.212	0.062	0.962	0.812	0.204	0.172	0.05	0.059	0.076
100	0.05	0.05	1	1	0.05	0.05	0.05	0.05	0.07

As it can be seen from the analysis, the level of eco-geodynamic risk is relatively low for the other versions being under consideration, and this varies at the range (0.11-0.28). However, it should be noted that no matter how possible the causes of this risk, their prospects should not be excluded [21].

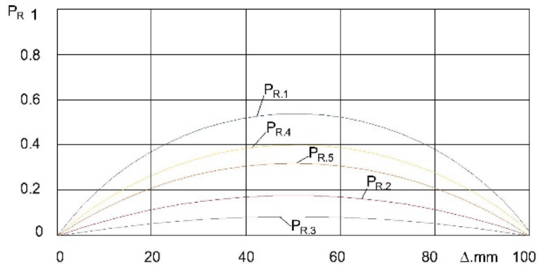

Figure 3. Probable versions of the risk of damage to facilities [8]

Thus, from the point of view of environmental insurance, the risks leading to a potential major socio-economic and environmental threat and being associated with the earth's surface where these facilities are located, deserve special attention. A methodological approach to predicting eco-geodynamic risks associated with these facilities is presented. All this provides a basis for taking into account the geodynamic risk factor in order to believe in the protection of the population from natural and human-made disasters and increase the potential of socio-economic and environmental protection facilities [22, 23]. The purpose of the study is to predict the dependence of the ecological-geodynamic risk factor on the ecological-geodynamic hazard in the places where they are located when laying oil and gas pipelines.

3. RESULTS

Now let us predict the state of eco-geodynamic risk factor which can cause accidents at facilities on the basis of fuzzy sets theory for hazardous facilities. In this case, the dependence of the eco-geodynamic risk factor on eco-geodynamic hazard, the factors weakening the facility and total material damage ratio will form a mutual prediction function.

$$Y(R) = f(\triangle, P_1, P_2, C) \quad (7)$$

Based on the obtained static data (given in table) and the function (7), let us construct a mathematical model with fuzzy logic elements to determine the effect on the risk of the system, the parameters of continuous operation of the system

Table of the changes in P_{max} and P_{min} probabilities depending on the scale of deformation

- Problem Solving: The following algorithm is proposed to solve the problem in the proposed way:

1. Determining the number of input and output linguistic variables. Determining the set of values – the number of terms for each linguistic variable;
2. Determining the names of linguistic variables and their terms (membership)
3. Determining the type and universality of the membership function for the terms of linguistic variables:
4. Determining the structure of logical rules as "If ... Then",

Deformation was accepted as input linguistic variables, eco-geodynamic hazard as the weakness of the facility, indicators reflecting the total material damage, efficiency as an output linguistic variable.

Table 1 presents mainly input linguistic variables:

P_1 is eco-geodynamic hazard → (<less, normal, more>) (1)

P_2 is the weakness of the object → (<less, normal, more>) (2)

C is total material damage → (<less, normal, more>, [0-1]) (3)

Output linguistic variable eco-geodynamic risk (R) = (<good, normal, bad>) (1)

Modeling on the basis of logical rules was carried out using a fuzzy logic mathematical apparatus in accordance with the proposed algorithm [13, 14, 18, 15, 20]. The triangular membership function was used to describe the values (terms) of the input and output linguistic variables. Computer implementation of the algorithm was carried out in MATLAB environment (fuzzy output system-editor-Fuzzy Inference System Editor) [16, 17, 19, 21] and the results were obtained. The obtained results are presented in Figures 4-5.

As we know, 70 mm underground deformations caused by the rotation of the earth around its axis cause damage to underground objects. underground transportation of oil and gas pipelines is at great risk at this time. The potential risks vary depending on the depth of deformation. Changes in the range of 70 mm will cause damage to those belts or objects. Fuzzy probabilities of damage to objects (in the event of an accident) with the appearance of the geodynamic factor, taking into account the change of the probabilities P_1 and P_2 depending on the magnitude of the deformation determined on the basis of set theory.

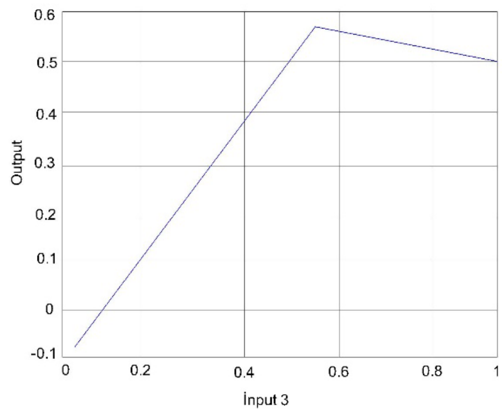

Figure 4. Results obtained from MATLAB package

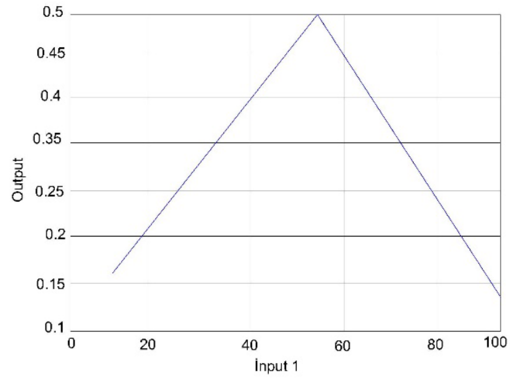

Figure 5. Results obtained from MATLAB package

The changes in these probabilities, i.e. risks (P_R), i.e., for the versions considered, are given in Figure 5. The maximum values of these risks are formed as follows. As can be seen from Figure 1, the maximum risks for the considered versions (($P_{1.1}$, $P_{1.2}$) vary from 0.212 to 0.962 and are 0.862 at the approximate value of deformation Δ=70. In other words, the most likely the loss or risk is R_{max} = 0.862, which can be at a minimum probability of 0.500. Results obtained by the theory of fuzzy sets it accurately determines the probability of risk of 20 percent in relation to the results calculated by mathematical probabilities. So that, in Figure 2, the probabilities of damage to facilities (when an accident occurs) with the appearance of the geodynamic factor were determined taking into account the changes in the probabilities P_1 and P_2 depending on the scale of deformation. The changes in these probabilities, i.e. risks (P_R), that is, for the versions being under consideration, are given in Figure 2. The maximum values of these risks are formed as follows.

As it can be seen from Figure 3, the maximum risks for the versions being under consideration ($P_{1.1}$, $P_{1.2}$) vary from 0.11 to 0.54 and are 0.54 at an approximate value of Δ = 50 of deformation. In other words, the most probable loss or risk is $R_{max} = 0.54 \times C$, which can be at probability of 0.54. As it can be seen from the analysis, the level of eco-geodynamic risk is relatively low for the other versions being under consideration, and this varies at the range (0.11-0.28). However, it should be noted that no matter how possible the causes of this risk, their prospects should not be excluded.

A comparative analysis of the above-mentioned results will show us that the predictions made by the theory of fuzzy sets are a more perfect method for evaluating the eco-dynamic risks and the exact determination of the probability of accidents.

4. CONCLUSIONS

1. In the research work, the state of the eco-geodynamic risk factor that may cause accidents in objects was predicted based on the theory of fuzzy sets for dangerous objects.
2. The parameters characterizing the intensity of modern tectonic movements (MTM) in the generation of effective stress should be taken into account as a whole.
3. A model providing the prediction of eco geodynamic risk factors was proposed and an algorithm for teaching a fuzzy model based on statistical data was developed.
4. From the point of view of environmental insurance, the risks related to the surface of the earth where these objects are located, which cause a potentially great socioeconomic and ecological danger, deserve special attention. A methodological approach to forecasting eco-geodynamic risks related to these objects was presented. All this will create a basis for considering the geodynamic risk factor in order to believe in the protection of the population from natural and man-made disasters, to increase the potential of socio-economic and environmental protection facilities.
5. Results obtained by the theory of fuzzy sets it accurately determines the probability of risk of 20 percent in relation to the results calculated by mathematical probabilities.

REFERENCES

[1] Z.J. Afandiyeva, "Modern Geodynamic Processes and the Relationship of Changes in the Physical Properties of Rocks", The VIII International Conference New Opinions in Earth Sciences, Vol. 1, pp. 417-420, Moscow, Russia, 2007.

[2] O.D. Huseynzade, Z.J. Afandiyeva, "Mathematical Modeling of the Degree of the Impact of Modern Geodynamic Processes on Reservoir Stratum", Mining and Geological Journal, No. 3-4, Issue 15-16, pp. 13-16, 2008.

[3] A.A. Bederov, Y.O. Kuzmin, "Modern Abnormal Geodynamics Subsoil Factor of Environmental and Insurance Risk", Insurance, No. 3, pp. 28-33, 1997.

[4] Y.O. Kuzmin, "Modern Super-Intensive Deformations of the Earth's Surface in the Zones of Platform Faults-Geological Study and Use of Mineral Resources", Scientific and Technical Collection, Teoinformmark, No. 4, pp. 43-53, 1996.

[5] N.N. Melnikov, A.I. Kalashnik, N.A. Kalashnik, "Technogenic Geodynamic Processes in the Development of Oil and Gas Deposits in the Barents Sea Shelf", Bulletin of MSTU, Vol. 12, No. 4, pp. 601-608, 2009.

[6] Y.O. Kuzmin, "Modern Super Intensive Deformations of the Earth's Surface in Zones of Platform Faults", Geological Study and Use of Mineral Resources: Scientific Technical Collection, Theoinformmark, Vol. 4, Moscow, Russia, 1996, pp. 43-53", Geoinformmark, p. 55,

1e Without Borders, Vol. 3, pp. 398-410, Innsbruck, Austria, 1996.
[7] G.G Ismailov, Z.J. Efendieva, M.M. Muradov, "On the Assessment of Eco-Geodynamic Risk in Oil and Gas and Mining Facilities", Geo-Technological Problems of Oil, Gas and Chemistry, Vol. 8, No. 1, pp. 272-281, 2007.
[8] A.N. Scherbakov, M.V. Shumeiko, A.A. Bederov, Y.O. Kuzmin, "Insurance Aspect of the Modern Anomalous Geodynamics of Subsoil", Insurance, No. 10, pp. 11-14, 2006.
[9] A.N. Scherbakov, A.A. Bederov, Y.O. Kuzmin, "Methodological Approach to Risk Assessment in Environmental Insurance Using the Sample of Geodynamic Risk (Abnormal Deformation) of the Earth's Surface", Problems of the Environment and Natural Resources, No. 7 pp. 46-51, 2007.
[10] V.E. Khain, E.N. Khalilov, "Tideless Variations of Gravity before Strong Distant Earthquakes", Science Without Borders, Vol. 2, ICSD/IAS H and E, pp. 319-339, Innsbruck, Austria, 2006.
[11] L.A. Zadeh, "Outline of a New Approach to the Analysis of Complex Systems and Decision Processes", Trans. Systems, Man. and Cybernetics, Vol. 3, Issue 1, pp. 28-44, 1973.
[12] L.A. Zadeh, "The Concept of a Linguistic Variable and its Application to Approximate Reasoning", American Elsevier Publishing Company, Vol. 8, Issue 3, pp. 199-249, New York, USA, 1974.
[13] O. Castillo, P. Melin, "A New Fuzzy Inference System for Reasoning with Multiple Differential Equations for Modeling Complex Dynamical Systems", The CIMCA'99, IOS Press, pp. 224-229, Vienna, Austria, 1999.
[14] A.V. Leonenkov, "Fuzzy Modeling in MATLAB Environment", Fuzzy TECH, p. 736, St. Petersburg, Russia, 2005. https://cchgeu.ru/science/nauchnye-izdaniya/vestnik-voronezhskogo-gosudarstvennogo-tekhnicheskogo-universiteta-/fayly/vypuski/14_4.pdf
[15] V. Dyakonov, V. Kruglov, "Mathematical Expansion Packages of MATLAB: A Special Reference", pp. 480, Sankt Petersburg, 2001.
[16] D. Dubois, H. Prade, "Fuzzy Sets and Systems: Theory and Applications", Bulletin of the American Mathematical Society, Vol. 7, No. 3, p. 411, New York, USA, 1980.
[17] I. Hasanov, I. Abbasov, A. Gurbanov, "Stress-Deformed State of a Packing Ring with Eccentric Holes", The Latvian Academy of Sciences, Section B, Vol. 74, No. 4, Issue 727, pp. 287-292, 2020.
[18] M. Babanli, R. Mekhtiyev, N. Gurbanov, J. Aslanov, Yu. Tanriverdiev, "Cracks in Hybrid Fiber Metal Laminated Nanocomposites under Uniaxial Tension", Journal of Applied Mechanics and Technical Physics, Vol. 63, pp. 876-883, USA,2022.
[19] J.N Aslanov, A.B. Sultanova, "Forecasting of Improved Straightforward Valves Technical Condition using Fuzzy Inference Models", IFAC-Papers Online, Vol. 51, Issue 30, 2018. www.sciencedirect.com/science/article/pii/S2405896318329070
[20] J.N. Aslanov, K.S. Mammadov, N.A. Zeynalov, G.A. Hamidova, "Increasing Ball Valve Workability by Changing the Design of its Hermetic Elements", International Journal on Technical and Physical Problems of Engineering (IJTPE), Issue 55, Vol. 15, No. 2, pp. 214-220, June 2023.
[21] J.N. Aslanov, K.S. Mammadov, N.A. Zeynalov, "Selection of Structural Materials for Improved Liner Motion Gate Valves Based on Friction Correlation Method", International Journal of Advanced Technology and Engineering Exploration, Issue 9, Vol. 87, pp. 155-166, 2022. www.accentsjournals.org/paperInfo.php?journalPaperId=1394&countPaper=1714
[22] J.N. Aslanov, A.H Ahmadov, Z.E. Eyvazova G.A Hamidova, L.R. Ibayeva, "Harmonic Analysis of Loading Characteristics Research of Pump Jack", International Journal on Technical and Physical Problems of Engineering (IJTPE), Issue 54, Vol. 15, No. 1, pp. 110-115, March 2023.
[23] J.N. Aslanov, A.B. Sultanova, Z.S. Huseynli, F.F. Mustafayev, "Determination of Radial Strains in Sealing Elements with Rubber Matrix Based on Fuzzy Sets, Lecture Notes in Networks and Systems", Conference Material, 362 LNNS, pp. 765-773, Dorval, Canada, 2022.

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