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SIMULATION OF THE THERMAL IMPACT FROM A WELDING ARC ON A PIPELINE WALL WHEN REPAIRING A DEFECT TYPE "LOSS OF METAL"

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ANNOTATION: *The article discusses the issues of modeling the thermal effect of a welding arc on the wall of a pipeline during the repair of a defect such as "loss of metal".*
KEYWORDS: *Thermal impact, welding arc, pipeline, repair, defect, modeling, regression, optimization.*

Repairing corrosion damage to the wall of an oil pipeline using manual arc surfacing is labor-intensive and low-productivity. Replacing manual arc surfacing with mechanized flux-cored wire surfacing can significantly reduce the time spent on repair work. However, at present there is no data on assessing the thermal effect on the metal of the wall of an oil pipeline being repaired when surfacing with flux-cored wires.

Materials and methods: surfacing with flux-cored wires.

Key words: pipeline wall defects, flux-cored wire.

Currently, the most progressive method of restoring the load-bearing capacity of a pipeline wall is welding using electric arc surfacing. It has been established that the strength and load-bearing capacity of the metal of the repaired area depends on the magnitude of the thermal effect during surfacing and surface defects such as "loss of metal".

The amount of heat generated during surfacing is characterized by the effective thermal power. Also, one of the main characteristics of the thermal process during surfacing is the heat input, which shows the amount of thermal power related to the surfacing speed.

Currently, for welding defects such as "loss of metal", manual arc surfacing is regulated by regulatory documents. However, the use of RD leads to significant heat input into the metal of the pipeline being repaired due to an increase in heat input, leading to softening of the wall in this section, as evidenced by the data.

It is logical to assume that a decrease in heat input during surfacing leads to a decrease in the size of the heat-affected zone.

The analysis showed that the heat input can be achieved by using surfacing of flux-cored garden wires and a powder core, which has a "cooling" effect on the metal of the weld pool.

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The "cooling" effect on the weld pool is explained by the fact that when melting flux-cored wires, part of the thermal power is allocated to melt the powder core, which reduces the temperature effect on the base metal of the pipeline.

Therefore, it was suggested that the introduction of MPS surfacing when welding defects such as "loss of metal" will make it possible to increase the pressure when repairing an oil pipeline without stopping pumping.

However, this hypothesis requires more detailed elaboration and additional research. The results of the studies showed that replacing manual arc surfacing with mechanized flux-cored wires when repairing the wall of an oil pipeline can significantly reduce the thermal effect on the metal of the repaired section

We know that modeling is an indirect cognition of objective reality, which manifests itself in the form of an interconnected set of properties of the object of study, reflecting various aspects of its interaction with the external environment, existence and development. Modeling tasks include many problems related to both issues and interpretation of experimental data: establishing similarity conditions, conditions for extending the results of a single calculation - an analytical or physical-technical experiment performed under given parameters, to the results of other experiments, establishing the conditions under which generalizations of experimental and calculated data are possible, determining the technical, economic and environmental characteristics of the means under study. The concept of modeling is functional with the concept of information characterizing impacts, as well as changes in the state of the system that occur as a result of these impacts, determined in time and space. During the modeling process, it is sometimes more difficult to select the factors that influence the change in the optimization parameter. When conducting experiments, it is necessary to include in the research plan all factors that may influence the optimization parameter. An important requirement for factors is the impossibility of their interchangeability. systems defined in time and space.

We require that factors be quantified, although experiments are possible when some factors are presented qualitatively. After selecting the factors for each of them, it is necessary to establish the basic level and variation intervals. The development of any science, especially technical sciences, always begins with one or another experimental study, on the basis of a generalization of which a theory is developed.

When modeling the thermal effect of a welding arc on a pipeline wall during defect repair, it is necessary to determine a set of influencing factors

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$(x_1,x_2,\ldots,x_n)$. Further, based on the experiment, it is possible to construct a mathematical model (empirical function) characterized by the regression equation $y = f(x_1,x_2,\ldots,x_n)$, Where x_i (i=1,2,..,n) a set of factors, y – effective - factor (for example, thermal effect on metal or time spent on repair work on transformer substations) values y_n и x_1(i=1,2,..,n) They are measured during the experiment and during analysis they are already known.

However, their connection functions (f) are not known before experiment and must be found from experimental data, for example, by the least squares method. Typically, the dependence f(x1,x2,…,xn) is determined based on the following criterion:

$$F = \sum_{j=1}^{m} \left[y_j - f\left(x_1(j), x_{2(j),\ldots,} x_n(j)\right)\right]^2 \to \min$$

here yn xi are table values

yn xi (i=1,2,..,n)

After the calculations, the adequacy (compliance) of the equation is checked

y= f(x1,x2,…,xn) to experimental data.

Adequacy is usually checked using the Fisher criterion

$$F_ф = \frac{(m-1)\sum_{j=1}^{m}\left(y_j - y_j^*\right)^2}{(m-k)\sum_{j=1}^{m}\left(y_j - \bar{y}\right)^2}$$

Where m is the number of experiments (m>k), k is the number of coefficients in the regression equation, is the current value of y, is the calculated value of y, calculated from the regression equation by substituting experimental values into it x_j, т.е. $y_j^* = f\left(x_1(j), x_2(j), \ldots, x_n(j)\right)$ $\bar{y}$ -arithmetic mean value y.

The adequacy of the linear model can be accepted if the calculated value of the criterion Fisher $F_ф$ greater than its table value $F_{таб}$ for selected significance α (usually α chosen equal to 0.05)

Based on the resulting equation $y = f\left(x_1, x_{2,\ldots,} x_n\right)$ can analyze the influence of arguments on the resulting factor (for example, on the thermal effect on metal and TP) and we can optimize the process.

It has been established that when surfacing with flux-cored wires the following is observed:

-“cooling” effect leading to a decrease in heat input;

- reducing the intensity of heat input into the metal of the repaired area.

1. A hypothesis has been put forward about the possibility of increasing oil pressure during the repair of an oil pipeline by surfacing with flux-cored wires.

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