SCIENTIFIC SUBSTANTIATION OF PROBLEMS AND METHODS OF IMPROVING TECHNOGENIC SAFETY OF HAZARDOUS PRODUCTION FACILITIES OF PIPELINE GAS TRANSPORTATION

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Risk management has become an integral component of pipeline transportation. Pipeline risk assessments are especially crucial for assessing the exact degree of the threats provided by pipelines delivering harmful chemicals to the public, as well as for ensuring the safety of pipeline operating personnel.

Gas pipelines are hazardous production facilities that are placed in a perpetually changing natural environment. Though conceptually simple, they are in actuality intricate, dynamic systems that operate in generally hostile contexts and confront a wide range of hazards to integrity. The precise prediction of pipeline service life is crucial in the management of pipeline assets in order to maximize maintenance and repair programs. Analyzing the kinematics and kinetics of numerous cycles of structural degradation, whether steel, concrete, or other materials, is the foundation for creating credible estimates of operational life. As a result, threats should be detected in a methodically planned manner while adhering to well-established standards and protocols. They must be recognized, including anything that can jeopardize personnel, the environment, or assets, as well as any expected occurrences and circumstances that could trigger emergency scenarios.

To limit the accident rate, the major aim throughout pipeline operation is to assure equipment reliability. The efficiency of gas transmission lines is vital for providing an uninterrupted and steady gas supply to clients.

The operational efficiency of storage tanks and pipelines should be focused on system diagnostics, which should make use of the largest risk assessment databases accessible in industrial operations. Data modeled in scientific laboratories, representing the patterns and 'behavior' of metal deformation, fracture toughness, and rupture, serves as the foundation for the safe assessment of residual resource appointment, dates for technical analysis or liquidation of emergency situations, and their consequences.

It is vital to analyze the nature and level of acceptable or major flaws in order to assure the availability of gas supply pipeline network operations. Fractures can form during processing or action. In the case of a critical fracture size, the pipe can rupture. It is also necessary to examine the risk of faults detected during the inspection and predict the pipeline's lifetime. The lifetime is impacted by a number of parameters, including fracture size, material qualities, and pressures. The lifespan of flaws in storage and transportation systems may be determined using these criteria [1].

It is vital to enhance methodologies for Stress-Strain State computation in order to secure the dependable operation of existing gas pipelines and the high-quality design of new ones [2]. The assessment of the Stress-Strain State of gas pipes in places exposed to hazardous natural and technology-related variables is one of the most efficient approaches for a technical diagnostic of gas pipelines. Timely information on present mechanical stresses in these sites enables action to be taken to avert emergency situations and to establish measuring methods for checking pipelines based on reported problems.

Components of risk assessment are relevant to all risks. Because industrial facilities are being assessed, it is necessary to first assess the risk of hazardous circumstances and then investigate the consequences of hazard implementation.

Pipeline transportation, particularly in the gas business, relies largely on modeling process analysis difficulties and improving gas transportation conditions. Mathematical modeling provides for the measurement of technical aspects of gas equipment without the necessity for industrial testing. Furthermore, in order to make scientifically accurate decisions, production and control systems demand the use of specific mathematical methodologies.

The broad description of the study challenge has been reduced in order to be resistant to any future failure mechanisms. There are numerous mitigation and support inspection solutions available [3]. They enable technical forecasting in the design, operation, and maintenance of complex engineering systems.

Effective risk evaluation is a study of complexity, giving an open, intelligible, and controlled integration of all imaginable pipeline-acting physical processes: external pressures, deterioration, cracking, human mistakes, material modifications, etc. The impact of such hazardous occurrences is defined as the type and quantity of hazardous impact caused by those events [4]. An incident is commonly used to describe mishaps (or mistakes) that result in unsafe situations, such as flammable material spilling, which ignites and exposes workers to fire/heat dangers, which end in internal damage or death. The assessment of these outcomes is done to estimate the breadth and degree of the danger (e.g., the number of people who will be affected and their likelihood of being harmed or killed).

To estimate the danger connected with a facility, the effects and frequency of the many detrimental scenarios must be assessed. The optimal risk-evaluation technique is to discover large risk factors by analyzing and integrating a number of smaller variables, which are typically available through operator reports or public-domain databases. The basic issue that continues to arise is a lack of trustworthy data that enables for proper evaluation of hazardous material discharge from these pipelines as well as evaluation of pipeline risk. Risks to individuals and public services, business losses, and the environment are constantly monitored near pipeline infrastructure. When data is available and the intricacy of the technique permits it, risk is quantified quantitatively utilizing extensive frequency and impact analysis. Quantitative risk assessment utilizes a systematic mathematical approach to forecast risk from hazard sources while taking effects and frequency into consideration.

The development of algorithms for risk analysis and monitoring, as well as the production of adverse event scenarios, is based on the computation of the operational parameters of hazardous industrial facilities: 'strength $R\sigma(\tau)$ – rigidity $R\delta(\tau)$ – stability $R\lambda(\tau)$ – resource $RN\tau(\tau)$ – reliability $PQR(\tau)$ – survivability $Lld(\tau)$ – safety $S(\tau)$ – risk $R(\tau)$ – protectability $Z\kappa(\tau)$'. At all phases of their life cycle, all parameters are functions of time.

Pipeline failure mechanisms and integrity evaluation are key components in providing pipeline safety and risk reduction. Gas transmission systems that are well-maintained and managed can be safer and have a lower environmental effect than other types of transportation if a comprehensive pipeline process management system that is based on international best practices for providing protection and risk control is applied.

Modern assessments of the strength and resources of complex engineering systems present a new way for managing their performance. This can be done through the scientifically documented application of linear and nonlinear deformation and fracture techniques, risk analysis, resource justification for safe operation, and accident avoidance.

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MECHANICAL PROPERTIES OF MAGNESIUM ALLOY FOR MEDICAL APPLICATIONS AFTER DEFORMATION TREATMENT

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There is an increasing emphasis on the development of new materials for medical applications, especially to the group of biodegradable materials. There are various biodegradable materials, but they do not meet several requirements, namely speed of resorption in the body, level of mechanical properties and biocompatibility [1-3]. The magnesium-based group of metallic materials is best suited to biocompatibility. However, these alloys have too high ~~a~~ resorption rate, which limits their widespread use in medicine [2]. In addition, magnesium alloys have low mechanical properties, which prevents their use for load-bearing applications [1].

To improve the physical and mechanical properties the researchers apply various severe plastic deformation techniques [4], which can improve the strength characteristics of magnesium alloys by refining the grain structure without significantly changing the rate of bioresorption. The rate of bioresorption can be significantly reduced by rare earth element doping of magnesium alloys using such rare earth elements as yttrium, cesium, neodymium, zirconium. Thus, the purpose of this work is to study the structure and mechanical properties of magnesium alloys based on Mg-Y-Nd system during strain treatment.

The object of the study was an alloy of the Mg-Y-Nd system alloy. The alloy was obtained by direct permanent-mold casting. The alloy was studied in extruded and recrystallised states. The extruded state of the samples was obtained by reverse pressing at a speed of 0.5 mm/s at 350 °C billet and extruder walls temperature. The recrystallized state in the alloy was obtained by annealing at 510 °C for 6 hours in argon followed by cooling in air. In two states the samples had the form of rods with diameter of 16 mm.

The elemental composition of the alloy (Mg 94.0 wt.%; Y 3.5 wt.%; Nd 2.5 wt.%) was determined by EDS analysis on a LEO EVO 50 scanning electron microscope. Vickers microhardness (Duramin-5 microhardness tester, Denmark), yield tensile strength $\sigma_{0,2}$, ultimate tensile strength σ_B and elongation at break δ (Instron 8801 testing machine, UK) at 0.002 s^{-1} were selected as mechanical properties. The microstructure of alloy samples was investigated by optical microscopy in longitudinal sections of the samples.

Microstructure images of the alloy are shown in Figure 1. In the extruded state, grains of the main magnesium phase with an average size of 14±7 μm can be observed all over the surface of the slip. Under high magnification (Figure 1c) the structure consists of two types of structural elements: grains with an average size of 14±7 μm, and smaller grains with an average size of 1 μm, which form "bands". In the case of recrystallized state of the alloy the microstructure is represented only by equiaxed grains having average size up to 35±20 μm.