IPG 2023
INTERNATIONAL PIPELINE GEOTECHNICAL CONFERENCE
November 23rd - 24th
Bogotá Plaza Hotel. Bogotá D.C. - Colombia

Under the auspices of:
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ASSOCIATION OF OIL, GAS AND RENEWABLE ENERGY COMPANIES OF LATIN AMERICA AND THE CARIBBEAN

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6TH INTERNATIONAL PIPELINE GEOTECHNICAL CONFERENCE IPG 2023

IPG2023-0008

ABSTRACT IPG 2023 - CASE STUDY ON ARC-SHAPED DEFORMATION IN A BURIED GAS PIPELINE IN SOFT SOIL IN THE COASTAL REGION OF STATE OF SÃO PAULO, BRAZIL

Thiago da Costa Santos
Petrobras Transporte S.A. - Transpetro
São Vicente, Brazil

Wanderley Camargo Russo Junior
Petrobras Transporte S.A. - Transpetro
São Vicente, Brazil

Anderson Pacheco
Petrobras Transporte S.A. - Transpetro
São Vicente, Brazil

William Soares Tomaz
Petrobras Transporte S.A. - Transpetro
São Vicente, Brazil

João Duarte Guimarães Neto
Petrobras Transporte S.A. - Transpetro
São Vicente, Brazil

Vinicius Carvalho Peixoto
Petrobras Transporte S.A. - Transpetro
São Vicente, Brazil

João Mauricio Homsi Goulart
Petrobras Transporte S.A. - Transpetro
São Vicente, Brazil

Pedro Victor Serra Mascarenhas
Petrobras Transporte S.A. - Transpetro
São Vicente, Brazil

ABSTRACT

This paper presents a case study of a 16-inch gas pipeline located in the coastal region of São Vicente, SP, Brazil, which experienced deformations due to the displacement of soft soil. The pipeline crosses an area characterized by unstable soils exhibiting low strength, permeability, and high deformability. Consequently, the soil movement induced deformations and lateral bending stresses in the pipeline, forming a deformation arch with a maximum deflection of approximately 4 meters over a length of nearly 100 meters.

The identification of this deformation in the shape of the arc was carried out through angular mapping, employing the temporal comparison of inertial pigs' passages. To validate the pipeline's location and depth, field campaigns were conducted using both direct and indirect methods, including geotechnical analysis, documentary geomorphological analysis, topographic surveys, and geotechnical investigations.

Indirect analyses were performed to assess the pipeline's deformation and soil stresses, utilizing deformation analysis methods prescribed by the API-1117 standards and deformability criteria from the Canadian CSA Z662 standard. Field inspections were executed in areas exhibiting higher theoretical stress concentrations to evaluate the integrity of these critical locations.

The investigation revealed that the excessive soil movement, known as the Tschebotarioff effects, was caused by a subgrade reinforcement project for a railway situated over 30 meters away from the pipeline. The soil composition in the investigated area comprised a layer of soft organic clay, where the pipeline was buried, overlain by a layer of silty sandy alteration soil, and underlying bedrock.

Inspections conducted on the pipeline steel indicated no damages, failures, defects, or loss of thickness. Integrity analyses demonstrated that, despite the significant movement, the compressive deformations remained within the safety limits prescribed by the relevant standards, ensuring the pipeline's integrity under those specific conditions.

This study highlights the importance of monitoring third-party construction activities near pipelines, conducting periodic inspections employing inertial and geometric pigs in regions susceptible to geotechnical movements, implementing methodologies for movement identification, and utilizing GIS systems for geotechnical data analysis. Furthermore, it emphasizes the utility of standards in analyzing pipeline movement due to soil conditions, including the Tschebotarioff effects, and the significance of geotechnical instrumentation as a risk management tool.

Keywords: case study, soil movement, lateral bending stresses, third-party construction, inertial pigs, Tschebotarioff effects.