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Evaluation of pH and oxygen control contribution to mitigate the internal corrosion in iron-ore slurry pipeline

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ABRACO
ASSOCIAÇÃO BRASILEIRA DE CORROSÃO

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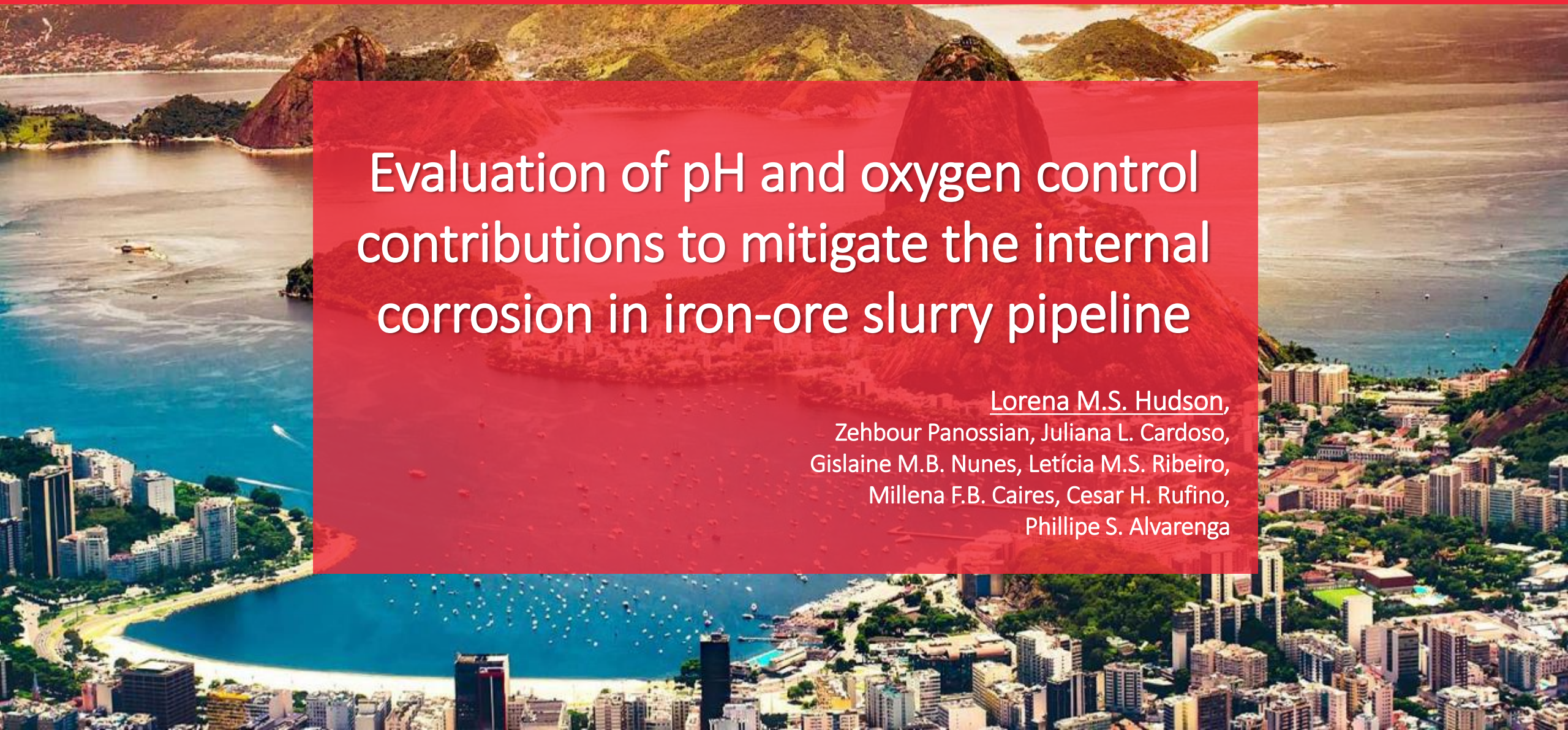
AMPP



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Summary

- Overview - **Slurry Pipeline Minas-Rio**
- Objective
- Methodology
  - Electrochemical tests
  - Injection of Na_2SO_3
  - Immersion tests
- Results
- Conclusion

Slurry Pipeline Minas-Rio

Figure 1 – Mine

Figure 2 - Plant

Figure 3 - Slurry Pipeline

Objective

- This paper aimed to evaluate the corrosivity of water injected into an iron-ore slurry pipeline and propose a cost-effective water treatment to ensure pipeline integrity

Materials and Methodology

- Water sample from the reservoir: pH of 7.7
- Tube sample API 5L X80
- Electrochemical tests:
  - OCP → Linear polarization measurements (R_p) to estimate the corrosion rate (ASTM G102).
  - After OCP monitoring, anodic potentiodynamic polarizations to verify active/passive behaviour
  - pH evaluated: 7.7, 10.5, 11.0, 11.5, 12.0 and 12.5

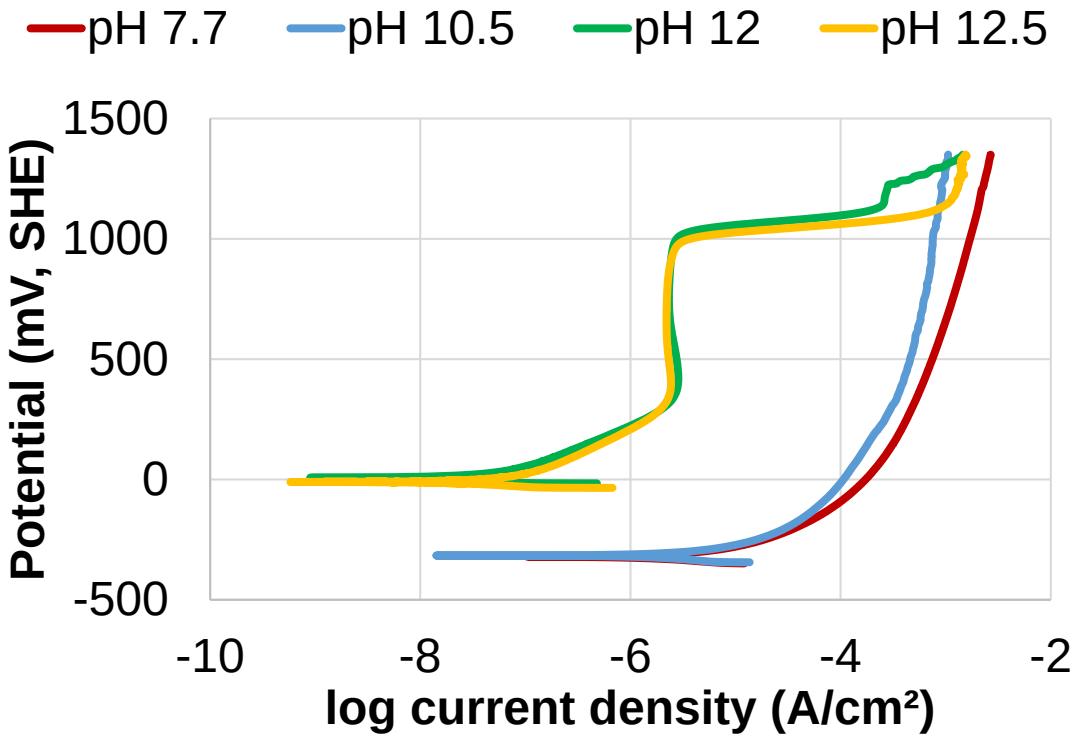
Materials and Methodology

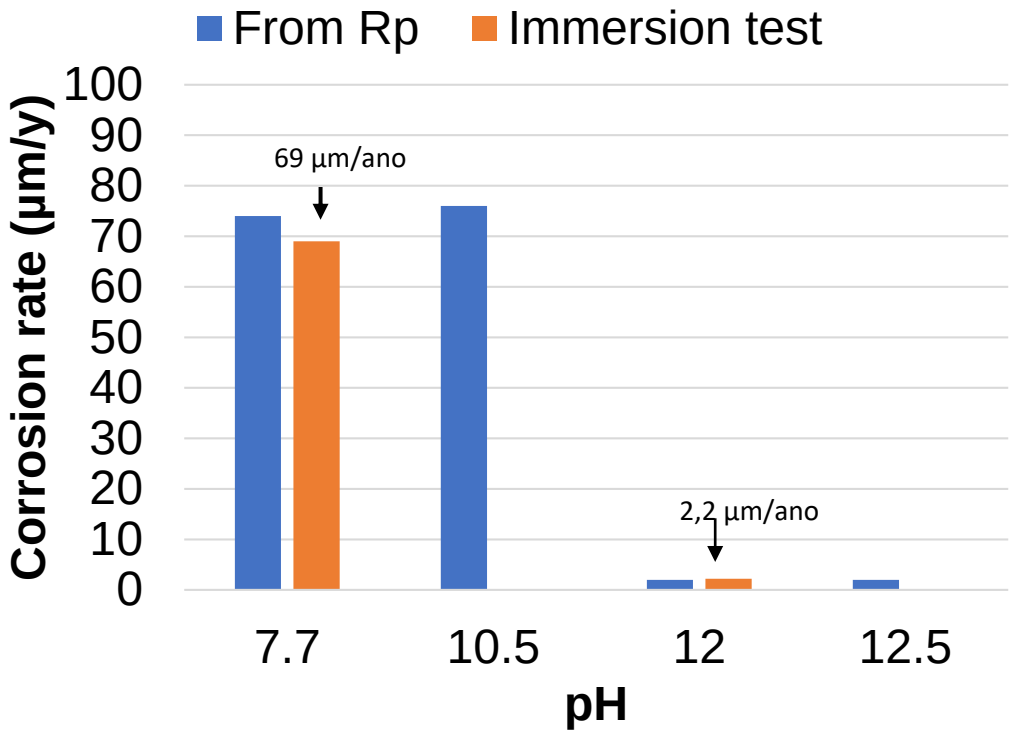
- Immersion tests:
  - 30 days (ASTM G31)
  - API 5L X80
  - Water sample from the reservoir: pH of 7.7
  - Reservoir-water pH adjusted to 12.0 without and with Na_2SO_3

Materials and Methodology

- Injection of Na_2SO_3
  - Na_2SO_3 used to reduce the oxygen level to 0 ppm
  - For each electrochemical or immersion test, the oxygen concentration was measured with a Digimed DM-40P sensor
  - The stoichiometric amount of Na_2SO_3
  - After reaching the target oxygen level, the pH of the test solution was adjusted to the target pH of the test

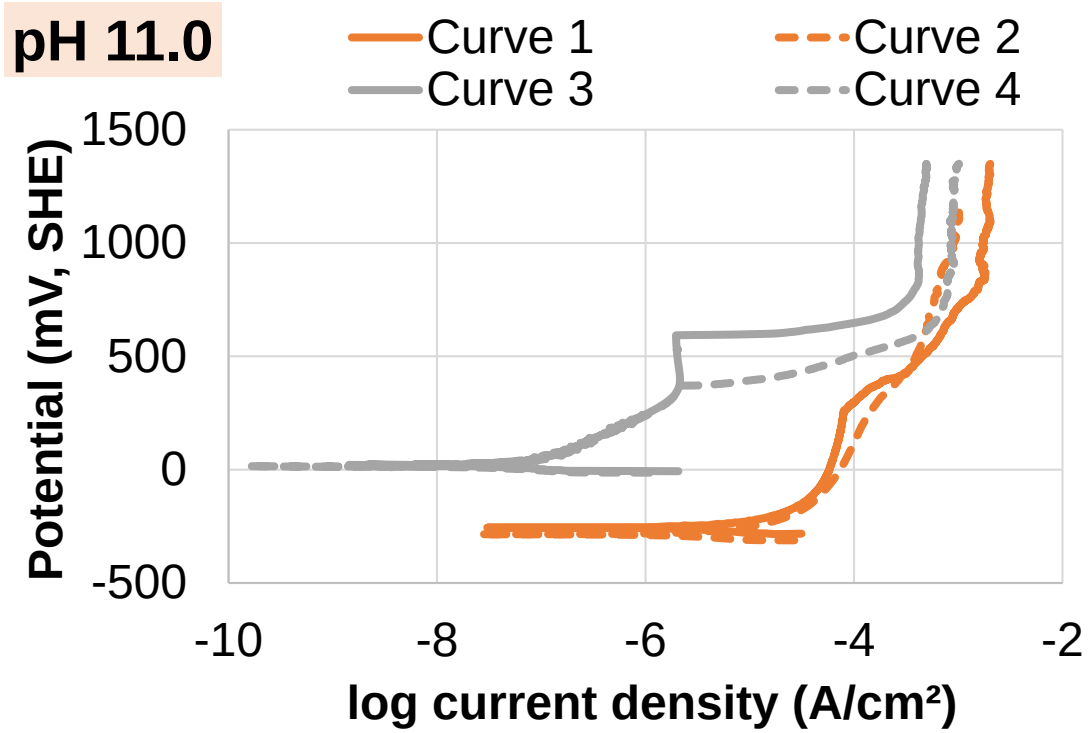
Results and discussion

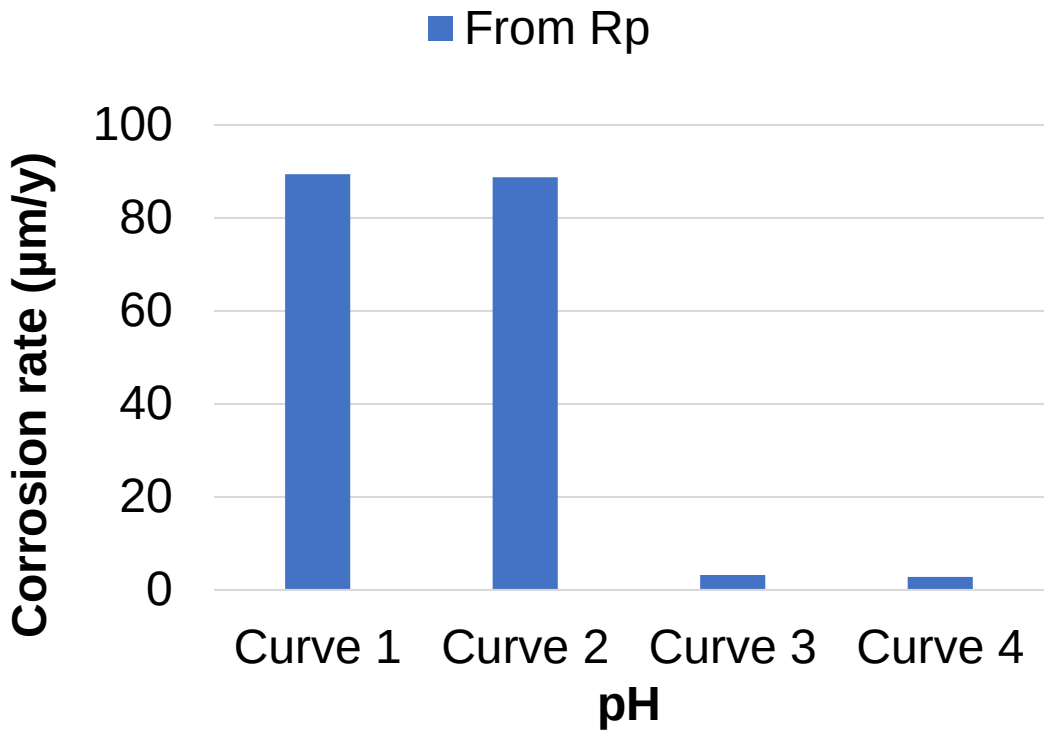




Anodic polarization curves and corrosion rate obtained from polarization resistance in the reservoir water at pH 7.7, 10.5, 12.0, and 12.5 and immersion tests at pH 7.7 and 12.0 (all tests **without Na_2SO_3**)

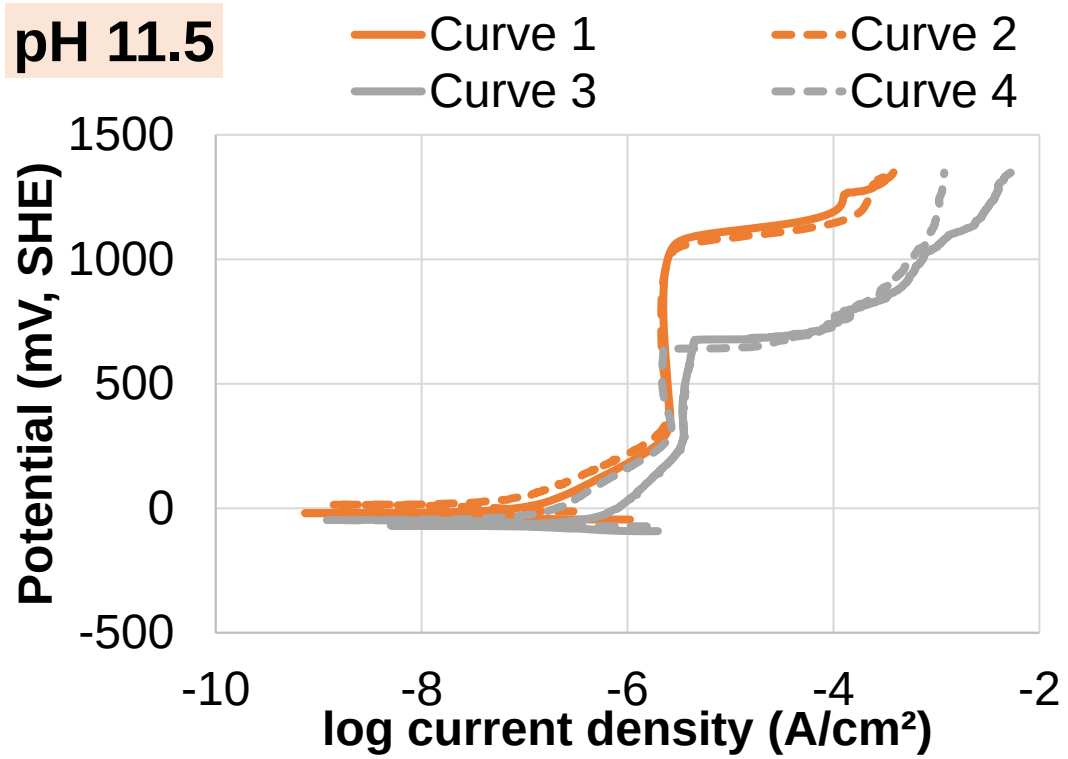
Results and discussion

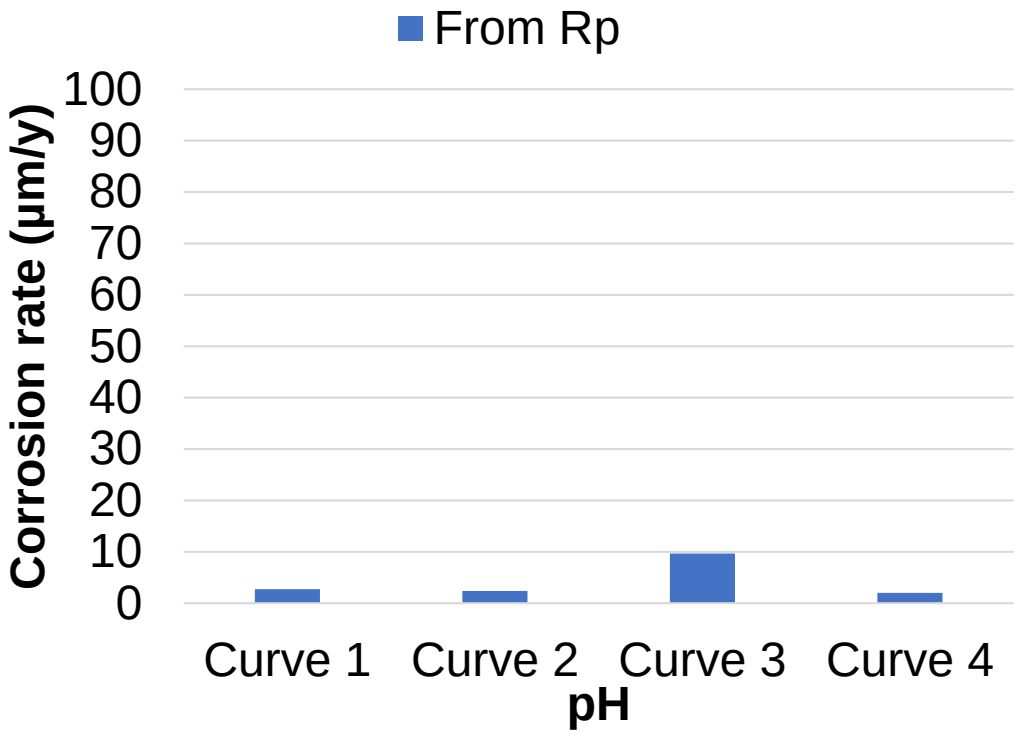




Anodic polarization curves and corrosion rate obtained from polarization resistance in the reservoir water at pH 11.0 (tests **without Na_2SO_3**)

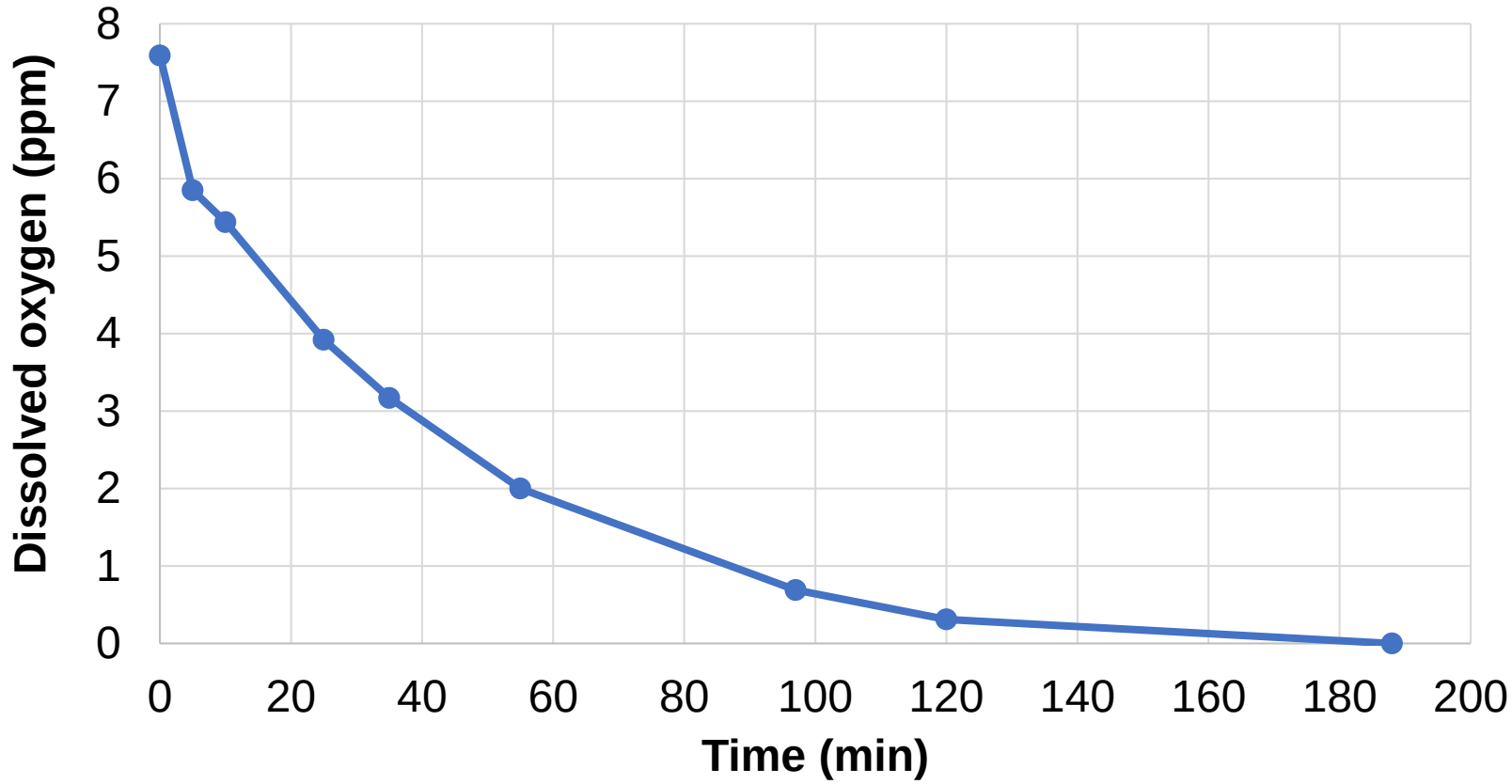
Results and discussion





Anodic polarization curves and corrosion rate obtained from polarization resistance in the reservoir water at pH 11.5 (tests without Na_2SO_3)

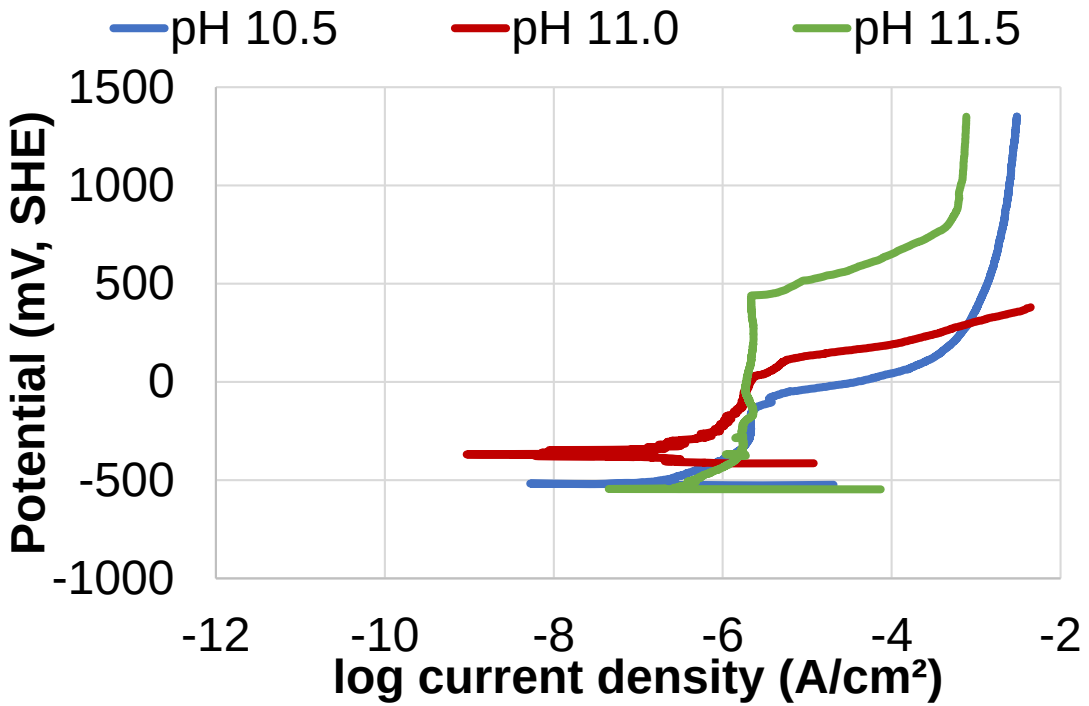
Results and discussion

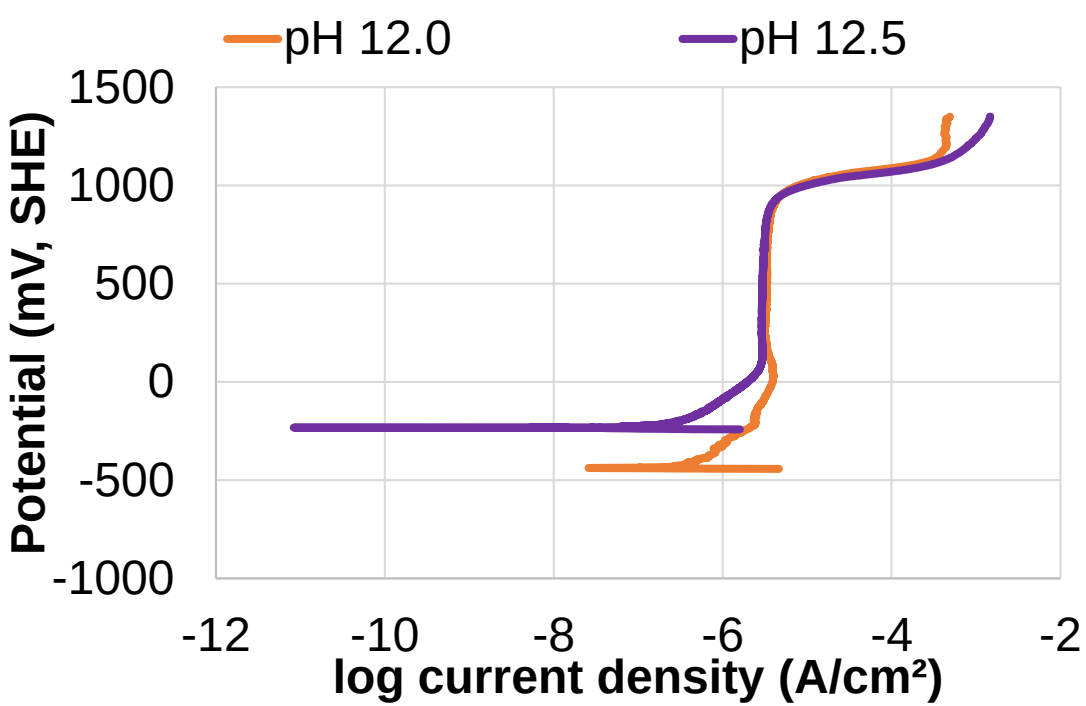


Dissolved oxygen versus time measurements in reservoir water with Na_2SO_3

Results and discussion

with Na_2SO_3

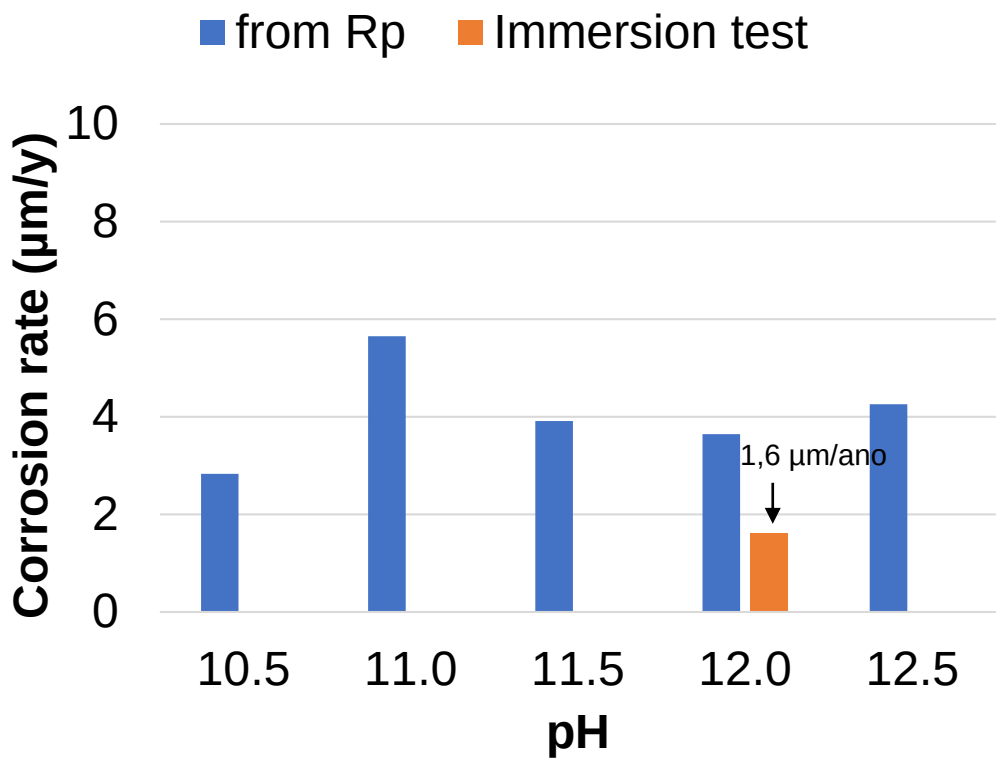




Anodic polarization curves in reservoir water with Na_2SO_3 at pH 10.5, 11.0, 11.5, 12.0, and 12.5, **with Na_2SO_3**

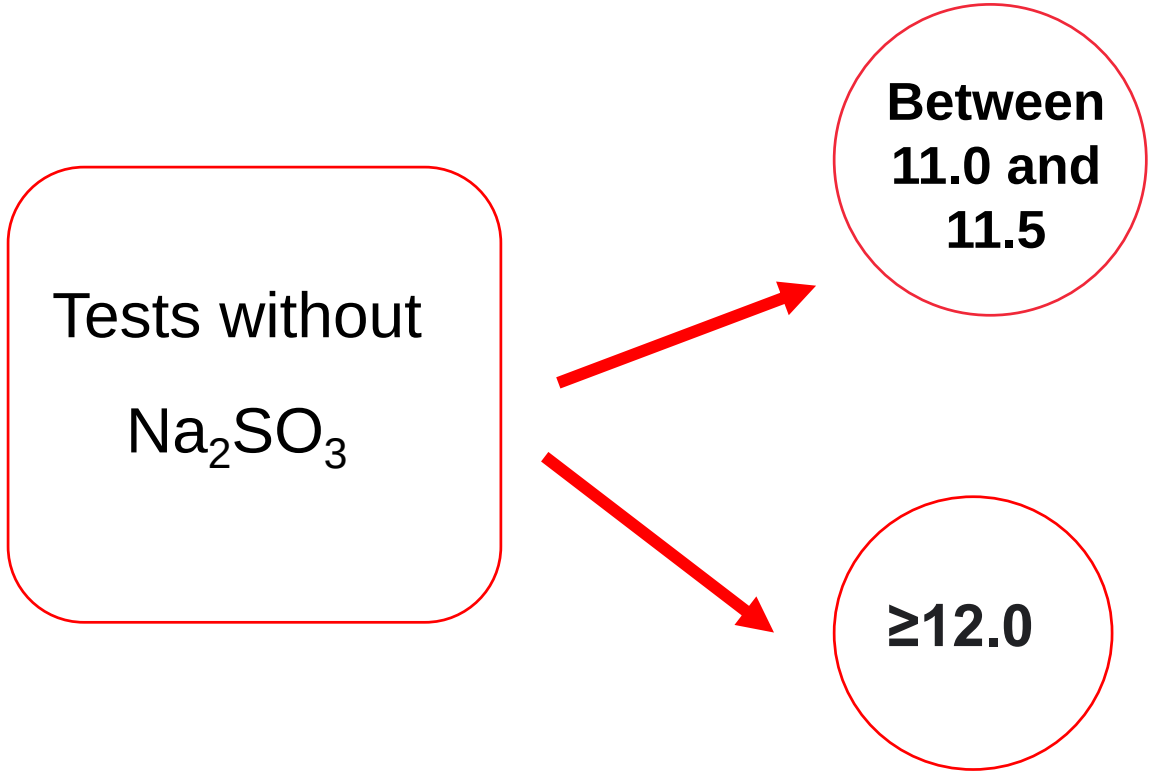
Results and discussion

with Na_2SO_3



Corrosion rate obtained from polarization resistance in reservoir water **with Na_2SO_3** at pH 10.5, 11.0, 11.5, 12.0, and 12.5 and immersion test at pH 12.0

Discussion



- Breakdown of the passive layer
- Considering that there may be adverse conditions in the pipeline, such as the formation of crevices under the deposits or some discontinuity in the material (**inclusions**, mechanical damage, welded joints), the probability of corrosion is high.

- Safer treatment

Discussion

Tests with Na_2SO_3

- Possibility limited by the time
- Effective action
- Impossible to wait 2 hours in the plant

Conclusion

- Control the corrosivity: Correction of the pH and addition of Na_2SO_3.

- pH 12.0 e 12.5 without and with the addition of Na_2SO_3 in a sufficient to consume the dissolved oxygen.

- **The most cost-effective option is to correct the pH of the reservoir water at least at pH 12.0.**

Thank you for attention!

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