

Tank Physical Integrity



CONFERENCIA ARPEL 2009

Desarrollo Sostenible

El rol de la industria de Petróleo y Gas en América Latina y el Caribe

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Tank Integrity Agenda

- 1 Objective
- 2 Reference Documents
- 3 Reasons to inspect
- 4 Internal inspection
- 5 External inspection
- 6 Risk Analysis

Tank Integrity Objective

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To establish general guidelines for the inspection of tanks and provide tools that allow to define the scope of repairs of storage tanks.

3

Tank Integrity Reference Documents

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- ✓ **API STD 650** "Welded Steel Tanks for Oil Storage"
- ✓ **API STD 653** "Tank Inspection, Repair, Alteration, and Reconstruction"
- ✓ **API RP 575** "Guidelines and Methods for Inspection of Existing Atmospheric and Low-pressure Storage Tanks"
- ✓ **API PUBL 353** "Managing Systems Integrity of Terminal and Tank Facilities Managing the Risk of Liquid Petroleum Releases"

4

Tank Integrity Reasons to inspect

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- Reduce the potential of failures and release of stored products.
- Keep safe operating conditions.
- Determine if there is any deterioration and if so, prevent or delay a greater deterioration.
- Perform repairs or determine if it is necessary to repair or replace a tank.
- Minimize the environmental impact.
- Comply with legal requirements.

5

Tank Integrity Internal Inspection

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Technology Used

- Magnetic Flux Leakage MFL / LFET
- Visual inspection - internal review
- Ultrasound
- Vacuum chamber
- Penetrating liquids, magnetizable particles
- Settlement measurement

The tools to apply in this type of inspections enable us to qualify specifically the status of the bottom sheets, roof, internal columns and their support, condition of membranes, etc., and to define repairs, verify deformations of tank bottom due to settlement, etc.

6

Tank Integrity Inspection of tank bottom with MFL

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Technique for quick scanning of large surfaces to determine corrosion in the near side (NS) and the far side (FS).

Coverage of up to 97% of tank bottom.

It provides information about location and relative severity.

The probability to detect isolated pitting is higher than that of ultrasonic tests.

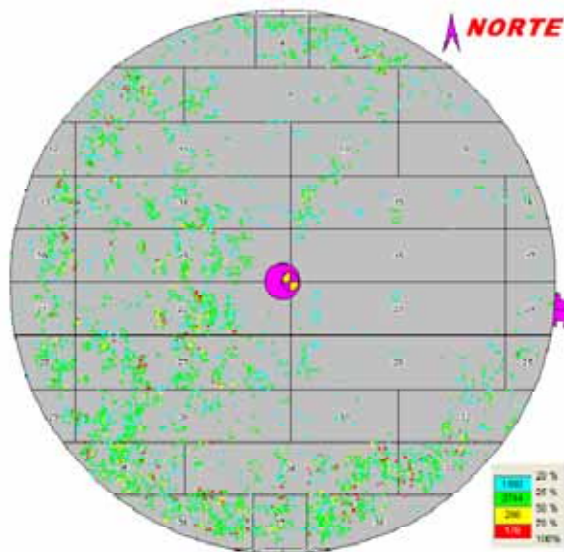
It is always necessary to carry out at least one crossed verification of the results of MFL with ultrasonic tests to rely on the depth assessment with MFL.

There is a considerable variability in the quality of these inspections. The experience shows that they can be highly effective when performed by duly trained and experienced operators using equipment with proper detection capability.

7

Tank Integrity Inspection of tank bottom with MFL

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8

Tank Integrity Evaluation of Settlement



Uniform settlement:

- Does not induce tension in the tank structure.
- May affect connections, pipes and attached appurtenances.

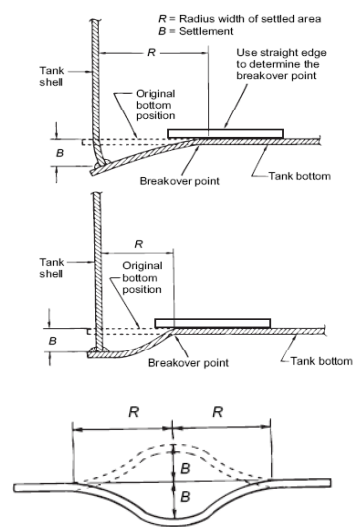
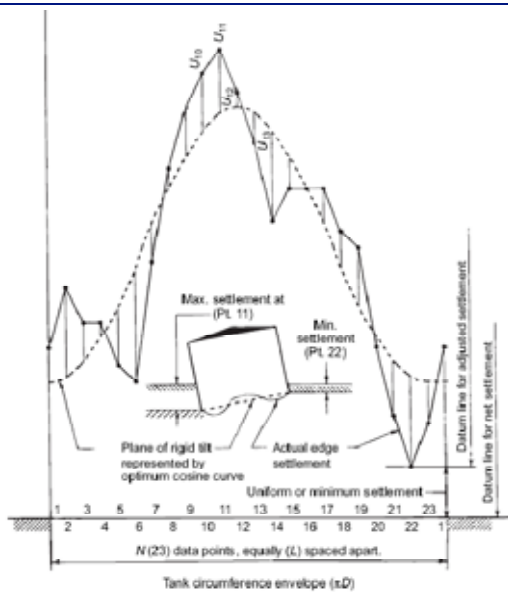
Plane tilt:

- Rotation of the tank in a tilted plane
- Liquid level increase and consequent increase in circumferential tension.
- Difficulty for operation of floating roofs
- Affects the tank connections

Differential settlement: (settlement outside the plane)

- Settlement of edge generating lack of roundness in the upper part of the tank
- It induces tensions in the union between the bottom and the shell
- Difficulty for operation of floating roofs
- Affects the tank connections

Tank Integrity Evaluation of Settlement

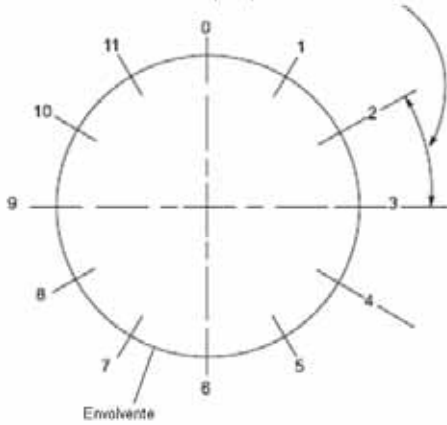


Tank Integrity
Evaluation of Settlement



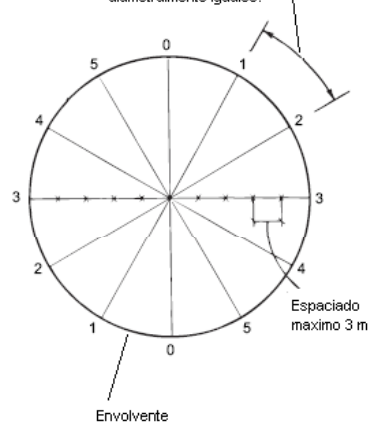
Measurement of Settlement in Tank Shell

Máximo espaciado 9,5 m alrededor de la circunferencia. Al menos 4 líneas de medición equi-espaciadas diametralmente.

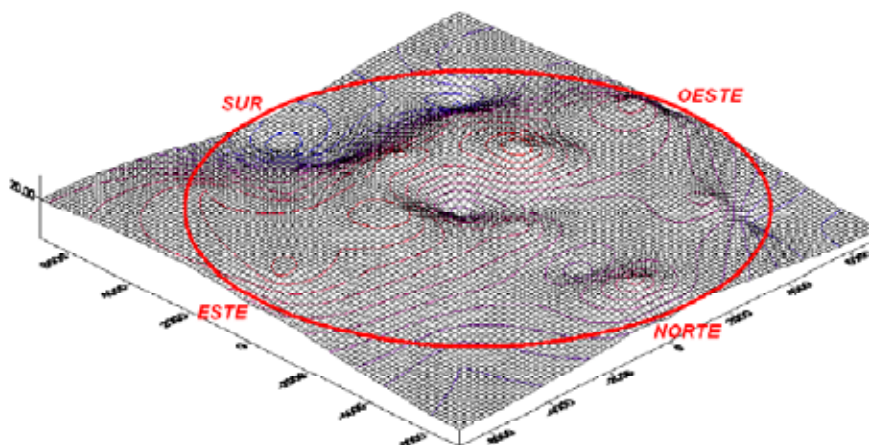


Measurement of Settlement in Tank Bottom

Máximo 9,5 m alrededor de la circunferencia. Debe haber al menos 4 líneas de medición espaciadas diametralmente iguales.



Tank Integrity
Evaluation of Settlement



Tank Integrity Inspection Methodologies

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13

Tank Integrity External Inspection

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Technology Used

- Acoustic Emission
- Ultrasonic (1st flange and roof)
- Visual Inspection

The tools to apply in this case enable the classification of the structural conditions of the tank.

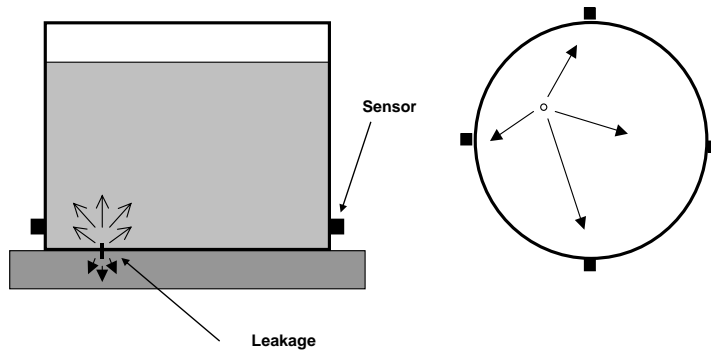
This allows to define tank opening strategies decreasing their non-operational time.

14

Tank Integrity Acoustic Emission Evaluation



- Detection of active leakages at tank bottom
- Detection of cracks in propagation

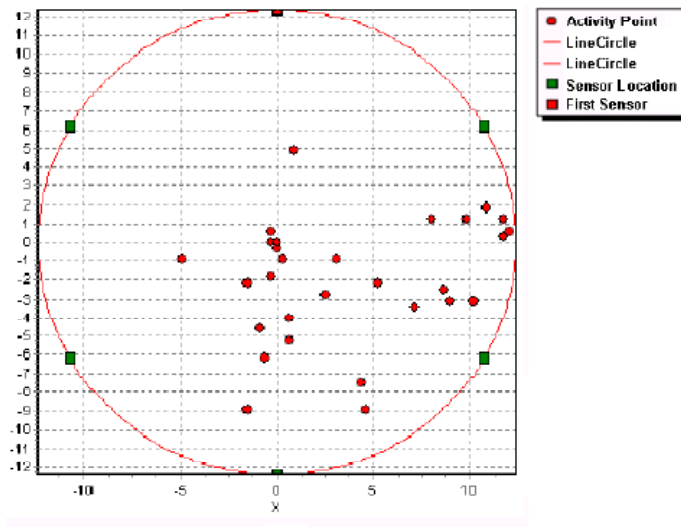


15

Tank Integrity Acoustic Emission Evaluation



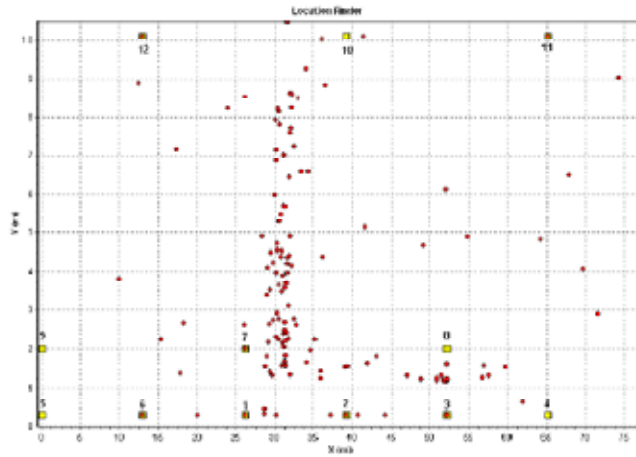
Activity Distribution



16

Tank Integrity Acoustic Emission Evaluation

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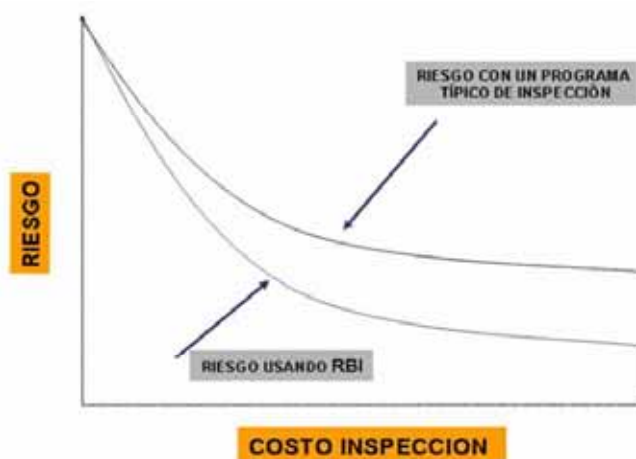


La actividad registrada aquí entre el sensor 1 y 2 esta asociada a la pérdida de agua a través de la cañería de incendio de espuma. La misma no está relacionada con la integridad estructural de la envolvente.

17

Tank Integrity - Risk Assessment

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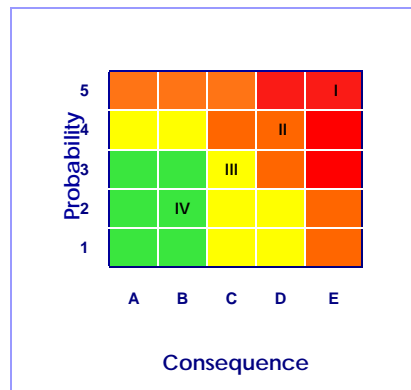


Al implantar un Programa de RBI, los Equipos se mantienen con un Nivel de Riesgo mínimo y se determina la frecuencia de Inspección óptima para cada uno de estos.

18

Tank Integrity - Risk Assessment

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I = High Risk
II = High Risk
III = Medium Risk
IV = Low Risk

Risk = probability x consequence

19

Tank Integrity - Risk Assessment

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Scenarios of product leakage risk

- Leakage through the bottom
- Leakage through the shell
- Leakage through the piping system
- Overfilling

20

Tank Integrity - Risk Assessment

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- ✓ Tool to prioritize and define inspection plans
- ✓ Optimization of resources
- ✓ Detection of relevant elements regarding equipment integrity
- ✓ Integration of different working groups

21

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Thank you for your attention

22

