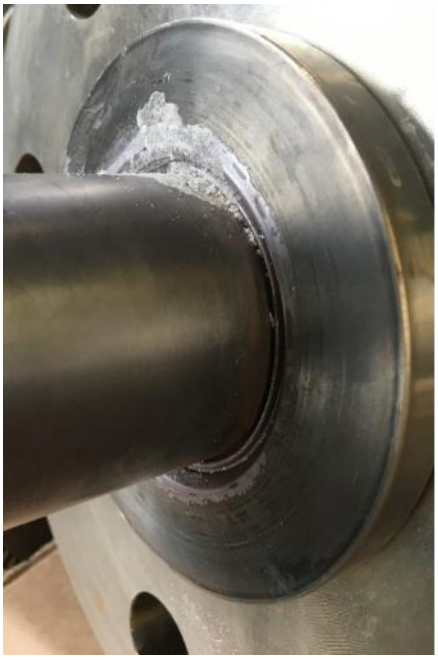
UREA Case Study:

Addressing Safety Risks and Enhancing Reliability:

Overcoming Challenges with Tantalum Lining and Extended type Diaphragm Seal



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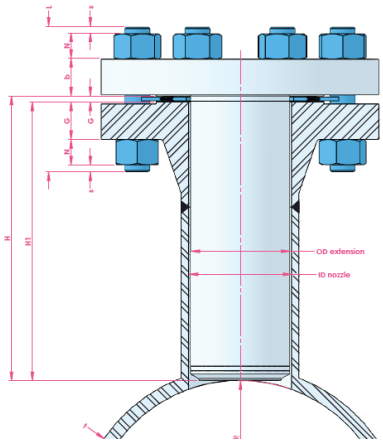
Badotherm

Introduction

As industry specialists in the design and manufacturing of diaphragm seal systems for UREA applications, we recognize the critical importance of addressing safety risks and reliability issues. This case study aims to inform market specialists about the potential risks associated with the use of tantalum linings or sleeves on extended type diaphragm seals in high-pressure synthesis sections of UREA plants. Join us as we explore a near miss safety incident, break down the disadvantages of this execution and highlight the superiority of zirconium material diaphragm seal as an alternative, and conclude with a call to embrace safer solutions. Together, we can foster a safer and more reliable UREA industry.

Extended type diaphragm seal with tantalum sleeve under scrutiny

Within the high-pressure landscape of urea synthesis, an alarming incident unfolded, shedding light on the inherent risks associated with extended type diaphragm seals containing tantalum lining. See below picture of a typical extended type diaphragm seal construction.



Several pressure measurements and level measurements in the high pressure urea synthesis section were equipped with extended type diaphragm seals containing a tantalum lining. Although the diaphragm seal system was still working properly, the materials below the tantalum sleeve were subject to corrosion leading to a high risk of loss of product containment. The corrosive process medium was protruding under the tantalum sleeve to the diaphragm seal body made of AISI 316 and the gasket area was heavily deformed and corroding where the tantalum sleeve was welded to the body. And the weld of the lining to the boxy at the angle between extension and body was heavily corroded.

Fortunately, this incident did not result in a shutdown or loss of product containment. However, its gravity underscores the urgency of reassessing the suitability of tantalum diaphragm seals in high-pressure UREA applications.

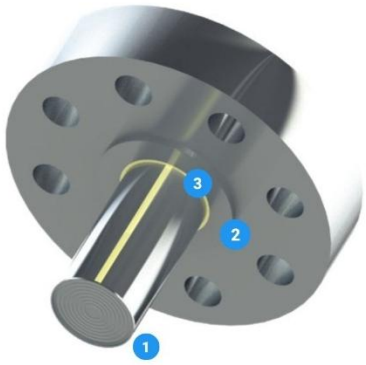
To ensure the utmost safety of personnel and the robustness of the UREA process, it is imperative that we confront the risks inherent in tantalum diaphragm seals and advocate for a more reliable alternative.

Examining tantalum Lining Disadvantages in UREA processes

In many UREA applications, especially the high pressure synthesis phase, the preferred materials in terms of corrosion resistance are tantalum and zirconium. In many of these applications, the diaphragm seals used are typically of the extended type (see picture 1) to make the measurement flush to the process. Since there is no solid material available in tantalum to make the extension from, this type of seals is commonly made by means of a 316SS body covered with a tantalum sleeve. This sleeve is put over the extended type seal and welded to the tantalum diaphragm but also welded to the 316SS flange body. Whilst the material itself indeed shows no signs of corrosion, nor the welds between tantalum diaphragm and sleeve, the issue arises where the sleeve is welded to the body of the seal.

See below the example drawing of typical construction of a extended type diaphragm seal component with a tantalum sleeve or lining. In this design there are typically 3 crucial welds:

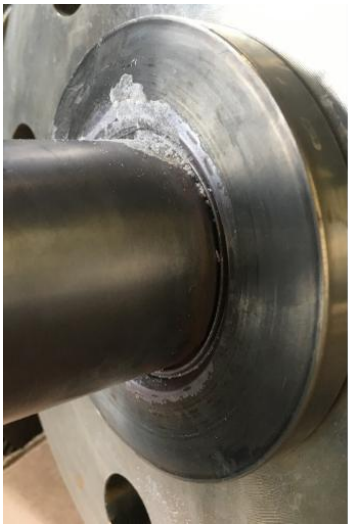
1. Weld between the tantalum sleeve and the tantalum diaphragm
2. Weld of the tantalum sleeve at the end of the raised face, welded to the body (non-wetted)
3. Weld of the tantalum sleeve to the flange body in 316SS



Picture 1: Drawing of extended type diaphragm seal component with a tantalum sleeve or lining.

To provide a comprehensive understanding of the challenges associated with tantalum diaphragm seals in high-pressure UREA applications, we will meticulously examine the observed issues through a selection of illustrative pictures. These visuals offer precise depictions of the encountered problems, shedding light on the potential risks and consequences.

Overview 1: Corrosion of Weld Between Tantalum Lining and AISI 316 body



These pictures showcase the corrosive impact on the weld between the tantalum lining and the AISI 316 stainless steel body material. The corrosion poses a significant concern as it creates a potential leakage point for the process medium. Furthermore, particles within the tantalum sleeve can compromise accurate measurements and contribute to internal corrosion.

Overview 2: Particles Behind the Tantalum Sleeve

In these images, we observe particles that have made their way behind the tantalum sleeve. These particles likely entered from the gasket area and travelled towards the diaphragm. Their presence not only hampers measurement accuracy but also increases the risk of corrosion from within the sleeve.

Overview 3: Heavy Deformation of Tantalum Lining and Loss of Adhesion

The third picture highlights the alarming deformation of the tantalum lining, particularly in the gasket area. The extensive deformation raises concerns about the diaphragm seal's integrity and performance. Moreover, the outer portion of the lining shows signs of detachment, indicating further potential vulnerabilities.

These pictures vividly depict the tangible issues observed with tantalum diaphragm seals. The corrosion, particle intrusion, and deformation pose significant risks to the overall operation and safety of UREA processes. It is imperative that industry experts take note of these visual cues and consider alternative solutions to mitigate these risks effectively.

The Solution: no dissimilar material welds – full body Zirconium or Safurex®

To mitigate the earlier described risks and ensure long-lasting, robust performance, our company recommends the use of extended type diaphragm seals with no dissimilar welded. Hence we propose full body zirconium or Safurex® diaphragm seal systems. Unlike tantalum sleeves, the full body zirconium solution offered by Badotherm proves highly reliability. These diaphragm seals have been known to operate seamlessly for over 5 years without issues. During major plant shutdowns, if the diaphragm is undamaged upon careful disassembly, it can be inspected, calibrated, and reused. In case of diaphragm damage, a full refurbishment can be performed, reusing the zirconium body and cover flange while replacing the filling and diaphragm, resulting in substantial cost savings.

Let’s sum up the advantages of the Badotherm, specifically of its zirconium solution:

- The full body material is solid machined zirconium, eliminating the need for welding dissimilar materials like the tantalum sleeve to the flange body.
- There is no involvement of a sleeve, eliminating the risk of damage during installation, often associated with tantalum sleeves.
- Zirconium diaphragms can be manufactured with a thickness of 125 microns, ensuring durability and accuracy.
- Unlike tantalum diaphragms, zirconium diaphragms do not experience memory loss, maintaining their flexibility and accuracy performance over time.
- The zirconium full body material allows for excellent refurbishment possibilities, enabling cost-effective maintenance.

Conclusion

In light of the risks and limitations associated with tantalum diaphragm seals, it is crucial for UREA operators to prioritize safety and consider alternative solutions. By transitioning to full body zirconium diaphragm seals, a significant step can be taken towards further securing production output, enhancing safety and minimizing risks in UREA applications.

If you have further questions or would like to learn more about the advantages of zirconium diaphragm seals and their implementation, we encourage you to reach out. Our team of experts is committed to providing comprehensive support and assisting you in making well-informed decisions that prioritize safety, reliability, and the successful integration of zirconium diaphragm seals into your UREA operations.