Six steps for choosing the right gasket material for continuous digesters in pulp and paper plants

Ensuring a reliable seal in continuous digesters is critical for pulp and paper plant uptime. This article explores why restructured PTFE (rPTFE) gaskets outperform traditional options under extreme conditions, offering superior sealability, torque retention, and long-term durability.

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Continuous digesters are vital for maintaining high productivity in pulp and paper plants. As any disruption can result in significant operational losses, it is critical to ensure these systems are sealed effectively. The extreme conditions, abrasive and chemically aggressive fluids, high temperatures, high pressures, thermal cycling and vibration, present unique challenges for gasket selection. Understanding which options to consider when selecting a sealing solution for pulp and paper digesters is essential for ensuring optimal gasket performance.

Step 1: Understand the sealing challenges

Digesters operate under extreme conditions, making the selection of suitable gasket material crucial. Metal gaskets are often impractical due to insufficient available bolt loads. Flexible graphite gaskets, which are frequently suggested by designers, are also not viable alternatives as graphite is an extremely fragile material, which makes handling large gaskets difficult.

Step 2: Evaluate material options

Gaskets can be manufactured from various materials, such as metals, composites and polymers, which must be carefully selected to meet the application's requirements. Non-metallic gaskets are often considered a more feasible choice for industrial sealing applications due to their greater chemical resistance, higher sealability and advantage over flexible graphite in handling. Among these options, polytetrafluoroethylene (PTFE) has emerged as a versatile solution, especially in processes involving aggressive media. PTFE is widely used in industrial sealing due to its exceptional physical properties:

- Excellent chemical resistance
- Non-stick characteristics
- High load capability
- Low stress to seal requirements

Since it is a flexible polymer, PTFE can easily be fabricated into long lasting gaskets that pose no risks during installation.

It is important to note that there are different types of PTFE available on the market. The use of resins of different qualities and distinct production processes generates a wide variety of PTFE gasket types with specific mechanical characteristics. Among these, compressibility and creep at elevated temperatures or during thermal cycling stand out.

Therefore, attention must be paid to the mechanical properties of PTFE gaskets.

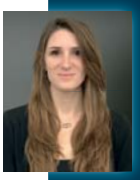
Step 3: Review PTFE manufacturing methods

Specific processes demand different types of PTFE resin, and the choice depends on the properties of these resins, such as molecular weight, average particle size and fibrillation. The type of resin and the method used to manufacture the sheets can impact the minimum and maximum allowable gasket stresses and significantly contributes to the creep performance of the product by as much as 70%, as shown by Werner et al.[2]

The manufacturing process, therefore, significantly impacts the properties of PTFE gaskets. The primary methods include:

- **Molded PTFE**
  - Process: Manufactured from virgin or reprocessed resins. The resin is compressed under high pressure and temperature, resulting in a solid sheet with uniform thickness and density.
  - Pros: Easy to manufacture a consistently flat sheet.
  - Limitations: High creep under compression and poor load retention increases the risk of leakage.

About the author



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- **Skived PTFE**
  - Process: Manufactured from virgin or reprocessed resins. The material is compacted and sintered into a cylinder. Then a thin layer is sliced, or skived, off the cylindrical billet to form a sheet.
  - Pros: Very cost effective. Can be manufactured with glass filler.
  - Limitations: Prone to high creep, especially at elevated temperatures or during thermal cycles. Potential limitations in tensile strength.

- **Expanded PTFE (ePTFE)**
  - Process: PTFE resin is extruded, forming a fibrillated structure. This material can then be expanded in one direction (monoaxial tapes) or multiple directions (multidirectional sheets), depending on the desired properties. The stretching process results in an incredibly lightweight, yet strong material.
  - Pros: High compressibility and excellent creep resistance.
  - Ideal for: Fragile flanges and applications with surface irregularities, as it conforms to surface imperfections.

- **Restructured PTFE (rPTFE)**
  - Process: Calendered and sintered to create a highly fibrillated structure. Fillers are added directly to the microstructure to improve the mechanical properties of the material. Pigment is added to easily identify the various filler/PTFE combinations.
  - Pros: Superior creep resistance, when compared with moulded and skived PTFE, high torque retention, enhanced mechanical properties, and it can be produced in one piece for any dimension.
  - Ideal for: Severe operating conditions, including strong acids and caustics.

Step 4: Prioritise mechanical properties for effective sealing

To ensure effective sealing in continuous digesters, it is important to select materials with the following mechanical properties:

- **High torque retention:** Maintains bolt load for consistent sealing.
- **Resistance to thermal cycles:** Adapts to temperature fluctuations without degrading.
- **Low creep:** Prevents bolt load loss over time.
- **Good sealability:** Maintains and effective seal under various pressures and temperatures.

Step 5: Choose rPTFE for high-performance applications

Results from several performance tests indicate that the best gaskets to be used in continuous digesters are restructured PTFE (rPTFE).[3] For example, rPTFE gaskets such as TEADIT®'s Tealon TF1570 are particularly suitable for applications in digesters because they offer the following advantages:

- **High stability at elevated temperatures:** Maintains mechanical integrity under extreme conditions.
- **High torque retention:** The fibrillated structure of rPTFE provides excellent torque retention, crucial for maintaining sealing under extreme operating conditions.
- **Ease of handling:** Flexible and resilient for large-dimension installations without material fracture.

Moreover, rPTFE allows for the thermal fusion of multiple gasket segments, allowing large gaskets to be manufactured, even if they exceed the size of the sheet the gasket is cut from.

Step 6: Optimise gasket selection based on your process needs

To ensure reliable sealing performance and extend the operational life of your digesters, consider your specific process requirements, including fluid aggressiveness, operating temperatures and pressures and flange surface conditions. By aligning these factors with the properties of rPTFE gaskets, operators can optimise the performance and durability of a pulp and paper digester.

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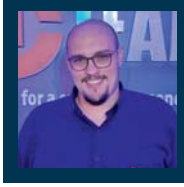
About the experts

Roberto Araujo graduated as a Mechanical engineer in 1993. He has worked at Teadit since 1988, first in the research and development of new products, such as PTFE filaments for braided packings, and then in the export department. Since 2005, he has been working as an Application Engineer Manager, giving technical support in sealing products to final customers in Brazil and Latin America. He participated in the ASME PVP conference in Seattle in 2010 and Vancouver in 2016 as the author of the following papers: Evaluation of Pipe Flange Gaskets Relaxation (2010) and Development of Gaskets and its Accessories for Electrical Insulation of Pipelines (2016).



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