

Flexitallic[®]



**FLUID CATALYTIC CRACKING
AND HYDROCRACKING:
THE SEALING PERSPECTIVE**

Fluid Catalytic Cracking (FCC) & Hydrocracking The Sealing Perspective

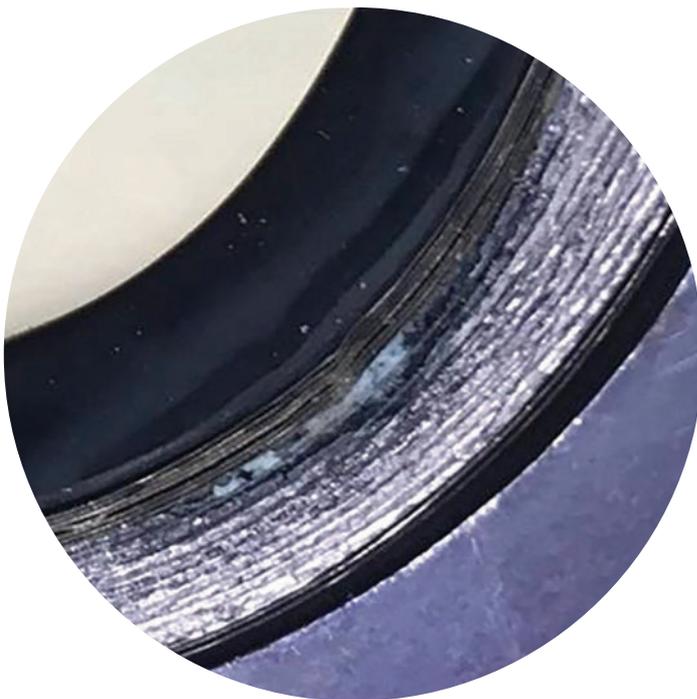
Sealing and gasket applications can sometimes be overlooked or considered at a late stage in planning for routine maintenance. However, getting this right and implementing well ahead of a shutdown can pay dividends as it has a dramatic impact to safety, reliability and asset integrity.

A refinery is a complex interconnected system of individual process units, some units stand alone but in many cases the output of one, is the feed for another so a problem in one area can potentially impact several units causing disruption and downtime with significant cost implication if these units are off line.

A process plant operates best in a steady state, shutdown and restart activities are the most challenging and pose an increased safety hazard. It is also well known that bolted flange connections, even if not disturbed after a shutdown, can experience problems when a process is restarted due to the impact of thermal cycles, causing varying expansion and contraction of the components of the bolted joint.

It is therefore preferable to minimise the frequency of planned and unplanned shutdowns. With sites looking to optimise reliability by adopting risk-based inspection and condition monitoring approaches, it is crucial to select the correct gasket technology and implement controlled installation methods combined with a bolted joint integrity programme.

It is also important to make sure the gasket technology used is appropriate for the service conditions and can cope with a process upset or unexpected shutdown. A planned shutdown provides the ideal opportunity to upgrade your sealing technology.



Example of Graphite Oxidation



Selecting the correct gasket technology

Gasket technology has developed significantly since Flexitallic invented the spiral wound gasket in 1912. Our understanding of the importance of correct gasket and material selection, assembly and installation has developed significantly over this time. Application conditions have become more challenging with temperatures and pressures increasing and operational life being extended. This ever more arduous set of conditions puts strain on the gasket and bolted joint assembly. Materials and gasket types exist now that were not available 10 or 20 years ago and offer significantly improved performance which remove the need for regular replacement of older technology.

Cracking processes within a refinery are critical to their operation and present additional challenges due to their high operating temperature. Two key technologies in use are fluid catalytic cracking (FCC) and hydrocracking. Although their process chemistry differs, they both present demands with high temperatures, gasket oxidation risk and equipment with custom flanges which require bespoke gaskets.

The FCCU unit receives its feedstock from the distillation units and cracks long chain heavy molecules into shorter more valuable products, it is a complex continuous process that requires correct gasket selection. The main characteristics of an FCCU are its wide range of different pieces of equipment including shell and tube heat exchangers, large diameter pipework and high temperature systems. Particular areas that can be problematic include the flue gas lines from the regenerator often characterised by large diameter, lightweight flanges which present sealing issues due to the thermal gradients and the narrow access between flanges. Pipe work between the reactor and fractionator can often be challenging to seal, due to the high temperatures and their large diameter.

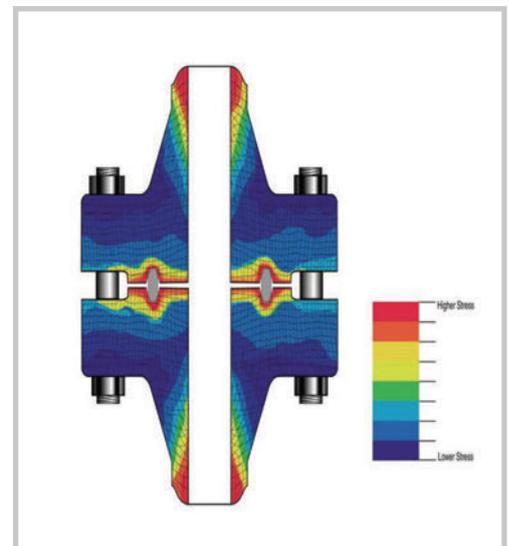
Selecting the correct gasket technology

Hydrocracking, in contrast to FCC, is a two-stage process involving hydrogenation of the hydrocarbons and catalytic cracking into small chain molecules. Hydrocracking process also removes the presence of impurities, making it ideal for low sulphur requirements. Hydrogen at high pressures and elevated temperature results in media being difficult to seal. Specific issues include solid metal ring type joint (RTJ) gaskets and flange grooves that are prone to stress corrosion cracking. Flanges on high pressure systems, reactor effluent circuits, fin-fan air coolers and shell and tube heat exchangers all present challenges. In addition, effluent air coolers and associated piping flanges and gaskets can be exposed to ammonium bisulfide corrosion.

With refineries looking to the future and considering transition from a focus on transport fuels to broadening output to include petrochemical feedstocks for ethylene and propylene production, so-called "Crude-to-chemicals" sites with FCC and hydrocracking capability are ideally placed to take advantage of this transition. With refinery output temporarily reduced, now is an ideal time to review and upgrade your sealing technology and assess your installation and joint integrity procedures.

Flexitallic can support you with both gasket and materials technology as well as support your wider joint integrity approach with training and specification advice through our Academy of Joint Integrity and Applications Engineering Teams.

AN EXAMPLE OF CRACKED RTJ



High stress concentrations in the grooves can result in cracks forming.



Thermiculite®

Thermiculite® has a proven track record in FCC and Hydrocracking units globally. Manufactured from chemically and thermally exfoliated vermiculite, with a similar structure to exfoliated graphite, Thermiculite® offers one critical advantage – it can endure a wide range of temperatures without compromising integrity as it is intrinsically resistant to oxidation.

Thermiculite® products are developed for use in high temperature processes in services up to 1000°C (1832°F) working in highly oxidising environments.

KEY FEATURES:

- Total freedom from oxidation
- Wide chemical compatibility
- Can be used in temperatures up to 1000°C (1832°F)
- TA Luft compliant
- Fire safe to API 6FB
- Proven track record in refining including FCC and hydrocracking
- Wide range of formats to suit all applications

Case Study

SUCCESSFUL APPLICATION: OIL REFINERY, TEXAS, USA

An oil refinery in Texas, USA upgraded their process resulting in increased cat cracker temperatures to 649°C (1200°F).

Replacing graphite spiral wound gaskets and CNAF sheet gaskets with Thermiculite®. Thermiculite® handled the increased temperature and with its proven track record provided confidence in reducing the risk of failures. Due to this change the plant was able to run 4-5-year turnarounds.

Flexitallic solutions:

Thermiculite® TH845 Flexpro® Kammprofile for the piping on the heater and furnaces up to 649°C (1200°F).

Thermiculite® TH835 Spiral Wound Gaskets for the 1" (25mm) inlet pipe into the expander with temperatures up to 649°C (1200°F).

Thermiculite® TH815 Gaskets for the exhaust side temperatures at 315°C (600°F - 800°F).

Change™ Gasket

Designed with a unique wire profile and manufactured with a laser welding process, Change™ is able to perform longer than any other gasket with a dynamic seal used within critical equipment.

For high temperature applications and those prone to thermal cycling, Change™ with Thermiculite® offers an ideal solution.

KEY FEATURES:

- Construction is more robust than a spiral and kammprofile
- Compression is more consistent than a spiral and kammprofile
- Low creep and high recovery result in very stable in operation
- Seals extremely well, especially in thermal cycle conditions
- Crush resistant
- Fits wide range flange arrangements
- Fire safe to API 6FB
- TA LUFT approved (in accordance with VDI Guideline 2440)

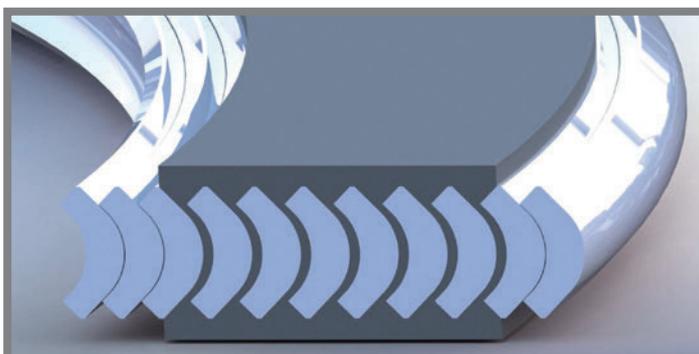
Case Study

SUCCESSFUL APPLICATION: OIL REFINERY, GREECE

An oil refinery in Greece, had problematic connections on a shell and tube heat exchanger. Replacing gaskets several times but still not solving the leaks. The original gasket selection was metal jacketed gaskets and spiral wound gaskets.

Flexitallic solutions:

The problem was solved, and leakage stopped, saving unexpected incidents, and saving time and money for the refinery. This was achieved by installation of CHANGE™ gaskets in the shell, and channel to tube sheet positions, to avoid leaks in both connections.



Change™ Gasket cross section cutaway.



Joint Integrity Training

The Academy was formed to provide the process industry with access to the best training and engineering services available to ensure the efficient operation of plants and equipment. A comprehensive range of accredited training courses are aligned to *Industry Best Practice* and provide a blend of sealing technology and practical elements associated with flange assembly.

All training can be offered across our network of locations utilising specialist mobile training rigs (FADU). Free site Integrity surveys are available providing cost effective proposals for Integrity Management solutions, with a focus on safety and compliance directives.



Engineering Support

Flexitallic's Application Engineering Teams offer a range of engineering services that are designed to complement and enhance Flexitallic's product offering. Allowing customers to operate their plants, complete projects and start-up from turnarounds safely and efficiently. Our goal is to help customers achieve leak free start-up and operation within the scheduled maintenance cycle.

These services include:

- Engineering Drawings
- Bolt Torque and Load Calculations
- Joint Integrity Calculations BS EN 1591
- End User Support for Problematic Sealing Applications
- Design reviews for Bespoke Connections and Critical Equipment
- Piping and Gasket Specifications
- Gasket Selection and Installation
- Pressure Vessel Design Review (Flange)
- Technical Consultation
- Joint Integrity Management Software (JIMS)
- Joint Integrity and Flange Integrity Training
- Gasket Installation Supervision

Turnaround services

Time is the most valuable commodity during shutdowns and turnarounds. With assistance from our Shutdown and Turnaround Support Service we aim to make the process as quick and easy as possible for you and your team. With hands-on site support from our experienced engineering team, we'll make sure the supply of gaskets and seals during your turnaround is trouble free.

We have a fleet of blast rated mobile service units which can be positioned on-site to give you additional support for all gasket-related issues during a turnaround. We'll be there to manufacture and refurbish gaskets as required and provide you with information and an immediate point of contact for any gasket-related problems.

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About The Flexitallic Group

The Flexitallic Group is a global leader in specialised sealing solutions and products serving the oil and gas, power generation, chemical and petrochemical industries in emerging and developed markets. Focused on the upstream, downstream and power generation sectors, it has operations in France, the United States, Canada, Mexico, the United Kingdom, Germany, Italy, Belgium, the United Arab Emirates, Thailand and China plus a network of worldwide licensing partners and distributors.

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