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LIFE SCIENCE CASE STUDY

SUPERCRITICAL FLUID CHROMATOGRAPHY (SFC) WITH CO_2 MEDIUM

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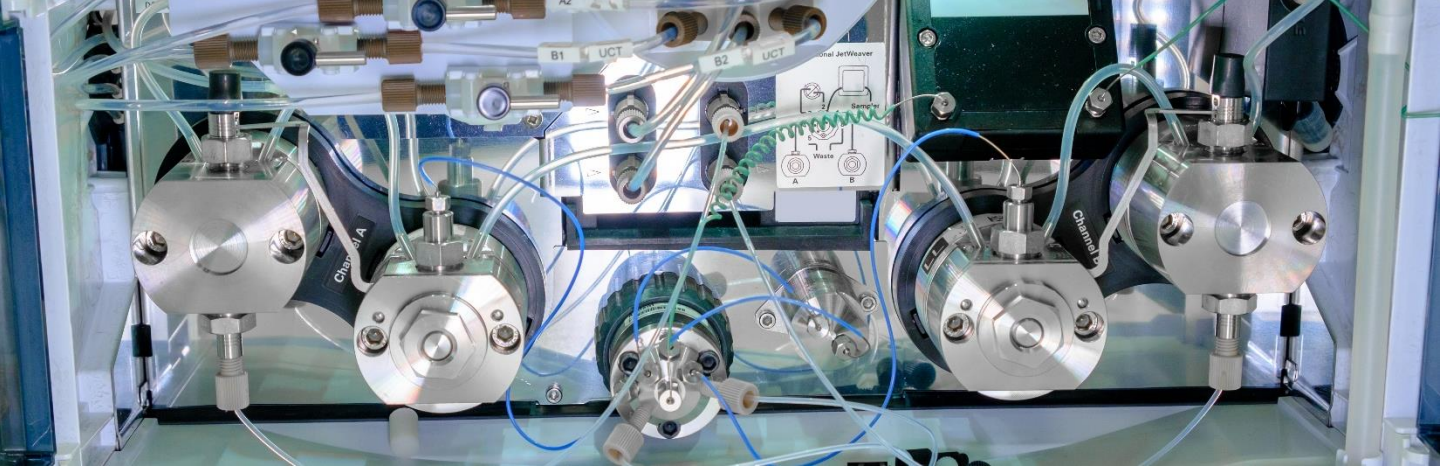

OMNISEAL® SPRING-ENERGIZED SEALS

Supercritical Fluid Chromatography With CO_2 Medium

Jeff Ribley & Joan Maldonado January 2025

LIFE SCIENCE PURITY TESTING LOW FRICTION & WEAR ACCURACY

Environment

A growing global market trend is the increase in pharmaceutical manufacturing and supercritical fluid chromatography (SFC) for purity testing. Many chemicals used in medicinal pharmaceuticals occur in extremely low concentrations and can be difficult to detect with accuracy. Analyses of these compounds are typically performed using gas chromatography (GC) or liquid chromatography (LC).

More testing labs, however, are turning to supercritical fluid chromatography because it provides higher analytical resolution and faster throughput compared to LC or GC. The most popular SFC medium is CO_2, which is non-toxic and can be easily recycled. CO_2 is also safer to use versus volatile and flammable hydrocarbons used in GC or LC. One major drawback to SFC though is that over time, CO_2 can degrade pump seals, creating variances in measurements and shortening the life span of the equipment. Due to this wear, labs are reluctant to use SFC despite its analytical advantages.

Challenge

SFC may be more widely used for medical purity testing if a seal existed that did not degrade in the presence of CO_2. The seal material must be dense enough to resist penetration of CO_2 through the seal. Seals for SFC are typically made from polytetrafluoroethylene (PTFE) or ultra-high molecular weight polyethylene (UHMWPE). Some PTFE-based materials can also swell in the presence of CO_2, which accelerates seal degradation. UHMWPE materials fail to offer the same low friction and torque advantages.

Solution

The best seal material for SFC has low friction and wear, withstands high pressures, and does not degrade in the presence of CO_2. To determine the most effective material for seals in SFC/CO_2 systems, Omniseal Solutions' team modified several proprietary polymer materials with different fillers and tested them using market pumps from major pump manufacturers.

Using our test rig in Kontich, Belgium, to represent the SFC/CO_2 environment, materials were analyzed under real-life conditions, i.e., continuous cycles were run under market conditions, pressures and reagents were evaluated, and a number of consecutive cycles were recorded and observed without leakage or degradation. Testing showed that our modified PTFE materials provided lower friction with less association issues, such as torque and break away, with outstanding CO_2 resistance in comparison to standard PTFE or UHMWPE seals. Our modified PTFE seals also showed no signs of leakage after 1,000 hours of testing. The weights of the seals before and after testing showed very slight differences, which were not significant enough to affect the wear pattern. These 1000-hour test results confirmed that our custom-engineered seals meet the rigorous conditions of SFC/CO_2 testing.

Supercritical benefits: speed, accuracy & cost savings

Benefits

- Proprietary seal materials, specifically engineered to resist degradation:
    1. Dense and strong enough to repel permeation by CO_2
    2. Tested for more than 1,000 hours of operation with little physical or chemical deterioration
- SFC testing firms are assured of speed, accuracy, and cost advantages of their systems, without the drawbacks of degradation, leakage, shorter life span, and the higher costs that typically result when using CO_2 systems

Omniseal Solutions
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Design Expertise & Tailor-made Solutions for Your Critical Applications

Omniseal Solutions is a global **engineering leader with over 65 years of historical legacy, relentlessly dedicated to the design and manufacture of precision** sealing and wear and friction control solutions that protect critical applications in the most demanding environments and passionately driven to push "**Beyond the Boundaries of Possible**."

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Let's go BEYOND the boundaries of possible

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