Optimizing Diaphragm Performance When Pumping Titanium Dioxide

This critical component in paint and coatings production can be challenging to handle, so the new Chem-Fuse Diaphragm from Wilden® will improve AODD pump protection

By Erik Solfelt

The paint and coatings industry is one of the world's most prominent, and titanium dioxide (TiO_2) is one of its most critical components as it provides the finished product the opacity, or hiding power, that equates to quality product. While important, TiO_2 is also very difficult for pumps to handle, which is why the new Chem-Fuse diaphragm from Wilden® can be used to optimize the performance of Pro-Flo® SHIFT AODD Pumps.

INTRODUCTION

There is scarcely a painted surface in the world – be it house, portrait or child's toy – that has not been covered by a paint containing titanium dioxide, or TiO_2, which is a fine white powder that is produced most often through the mining of the mineral ilmenite. The reason that TiO_2 is used as a white pigment in most of the world's paints and coatings is simple: it possesses the highest refractive index of any material in the world. In other words, because TiO_2 does not absorb visible light, any paint containing it has a high level of opacity, or hiding power, which is a needed characteristic for a high-performing paint or coating.

Because of its indispensability as a paint and coating component, the global TiO_2 market is a robust one, which is buoyed by the fact that it is also commonly used in the production of plastics, paper, pharmaceuticals, inks, food colorings and cosmetics, among many others.

In fact, according to market-research firm Research And Markets and its "Global Titanium Dioxide (TiO_2) Market 2019-2023" report, the TiO_2 market will experience a compound annual growth rate (CAGR) of 4% through the year 2023.

The size and importance of the global TiO_2 market make it imperative that paint and coatings manufacturers identify and deploy a pumping technology that can reliably introduce it to the production process and then transfer the finished paints and coatings in the high volumes that are required to meet the demands of strict composition characteristics and production schedules. This white paper will illustrate how positive displacement air-operated double-diaphragm (AODD) pumps have risen to the fore as a first-choice technology for TiO_2 pumping, with a new generation of diaphragm designs adding to their ability to deliver optimized TiO_2-handling performance.

THE CHALLENGE

In paint and coatings plants, TiO_2 is introduced to the production process as a high-viscosity slurry. AODD pumps have become an obvious choice for TiO_2 transfer because they can handle abrasive liquids of higher viscosities that may also contain large solid particles. Their method of operation also gives them the ability to self-prime, deadhead and run dry with low shear, which enables them to quickly reach and maintain desired flow rates throughout the entire duration of the product run while also being able to reliably handle shear-sensitive materials.

While AODD pumps can capably handle the general challenges of transferring TiO_2, there is one specific challenge that must be overcome – though TiO_2 appears to be a very fine powder, it is very abrasive in slurry form, which poses a threat to the longevity of the AODD pump's diaphragms. Specifically, the high level of abrasiveness of TiO_2 slurry exacerbates a phenomenon known as "outer piston abrasion," which is a primary failure mode for AODD pumps. Outer piston abrasion happens with all standard diaphragm designs that rely on an inner and outer piston to hold the diaphragm in place. During its operation, the diaphragm flexes around the outer piston causing normal wear of the diaphragm at the point where they touch. Add a highly abrasive slurry like TiO_2 and the touching acts like sandpaper on the diaphragm, dramatically impacting its service life.

This abrasion, if left unchecked, will cause the diaphragms to fail prematurely. The result of diaphragm failure is increased pump downtime, and higher maintenance, repair and replacement costs – and you can add cleanup costs to the equation if a product leak occurs. In these days where reliable throughput and product containment are at a premium as manufacturing facilities look to optimize their operating costs, any interruption in the production schedule, or costs associated with a product leak, can be deleterious to the manufacturer's bottom line.

THE SOLUTION

In the realm of AODD pumps, Wilden® AODD Pumps, the operating principle of which was invented by Jim Wilden 65 years ago, has long set the standard in efficient, effective and safe TiO_2 pumping. Today, Wilden offers a full range of diaphragm pumps that are ideally equipped for use in paint and coatings production. The Pro-Flo® SHIFT Series of bolted and clamped, metal and plastic pumps are outfitted with the revolutionary Pro-Flo SHIFT Air Distribution System (ADS) and operate with world-class efficiency in paint applications.

Though titanium dioxide (TiO_2) may appear to be a fine powder, in reality it is very abrasive in slurry form, which is its general state when used in paint and coatings production. Therefore, when AODD pumps are used in its transfer, the diaphragms must be able to withstand outer-piston abrasion, the chance of which the innovative integral piston design of the Wilden® Chem-Fuse Diaphragm eliminates.

Wilden® Pro-Flo® SHIFT AODD Pumps outfitted with Chem-Fuse Integral Piston Diaphragms (IPD) will optimize efficiency, service life, product containment and safety when used in the transfer of titanium dioxide (TiO_2) slurry.

While Wilden AODD Pumps have earned their stripes over the years as a go-to technology for TiO_2 pumping, it is a recent advancement in diaphragm technology that further differentiates the pumps from the competition – the Chem-Fuse Diaphragm.

The design of the Chem-Fuse diaphragm makes outer-piston abrasion irrelevant. Specifically, Chem-Fuse diaphragms feature an innovative one-piece Integral Piston Diaphragm (IPD) design that encases the outer piston within the diaphragm material itself. The elimination of the outer piston means that failure-causing abrasion can no longer occur. Moreover, it also eliminates a potential leak point around the outer piston, further improving pump reliability. The result of this is that Chem-Fuse diaphragms can deliver dramatic improvement in service life when compared to traditional diaphragms that are used in AODD pumps that handle TiO_2. The extension of service life in typical instances is usually two to three times that of old-school diaphragms, though Chem-Fuse life spans that can be up to 10 times more than normal have also been observed. Finally, the encapsulation of the outer piston in the diaphragm material allows Chem-Fuse diaphragms to handle higher inlet pressures than standard two-piece diaphragms. This performance improvement makes the Chem-Fuse diaphragm unparalleled for use in difficult applications like TiO_2 pumping.

Chem-Fuse diaphragms are constructed of Wil-Flex®, which makes them 50% less expensive than laminated models. They can also be used in all Pro-Flo and Pro-Flo SHIFT Series 1" to 3" plastic and metal pumps from Wilden, which allows them to fit into any application.

CONCLUSION

It's inherently obvious that the highest-performing paint and coatings feature titanium dioxide in their ingredient mix. It is also becoming increasingly obvious that Wilden Pro-Flo SHIFT AODD Pumps featuring Chem-Fuse IPDs are the best choice to optimize the handling and transfer of TiO_2. Because of its high abrasiveness nature, TiO_2 can put traditional two-piece diaphragms under extreme stress, leading to costly leak points, failure and downtime. Chem-Fuse diaphragms solve this conundrum through their integral-piston design, which entirely eliminates abrasion points, leading to a safer, cleaner, more reliable and more efficient pumping process. By extending diaphragm service life, Chem-Fuse allows for unprecedented optimization of TiO_2-based paint and coating production.

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