Knovel® Corrosion

Veolia uses Knovel Corrosion to pinpoint cause of valve failure

In their words

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Mel Esmacher, P.E.
Veolia Water Technologies & Solutions

Key insights

- Polyvinylidene fluoride (PVDF) should not be used with strong alkalis, fuming acids, polar solvents, amines, ketones and esters.
- A case history of stress cracking in PVDF was traced to high alkalinity and high temperature.
- A plastic compatibility guide within Knovel Corrosion confirmed variance in cracking performance depending on the manufacturer.

About Knovel Corrosion

Knovel Corrosion is a solution of smart tools, case studies and high-quality content that help engineers mitigate the impact of corrosion. Its unique coverage spans:

- Metals
- Plastics
- Coatings

Customer profile

With operations in 130 countries and over 10,000 employees worldwide, Veolia Water Technologies & Solutions leverages a comprehensive set of chemical, equipment and digital enabled services and products to solve the toughest water, wastewater and process challenges around the globe. It serves customers across all industries, including food and beverage, metals and mining, power, pharmaceutical, oil and gas, chemicals, petrochemicals, pulp and paper, and utilities.

To provide these customers with best-in-class solutions and distinguish itself from its competitors, Veolia invests significantly in its research, development and customer support capabilities. Employing over 1,000 researchers and engineers across multiple lab facilities around the globe, it is at the forefront of water and process treatment technologies.

Case study overview

Leaks were detected and brittle cracking was observed in various parts of a unique type of check valve. As part of the water treatment process, it had been exposed to a caustic chemical mixture containing 20% to 40% sodium hydroxide.

Using Knovel Corrosion, the Veolia team uncovered how much variability could be present in PVDF depending on the vendor and the process environment. They delved into the database for plastic compatibility. This revealed that it was possible, depending upon the type of PVDF used, for environmental stress cracking to develop.

Downtime at some plants can cost more than $100,000 a day. The authoritative information sources found in Knovel Corrosion enabled the Veolia engineers to provide a clear direction and advise on better material for applications.

ELSEVIER

Read the full case study on the following pages. →

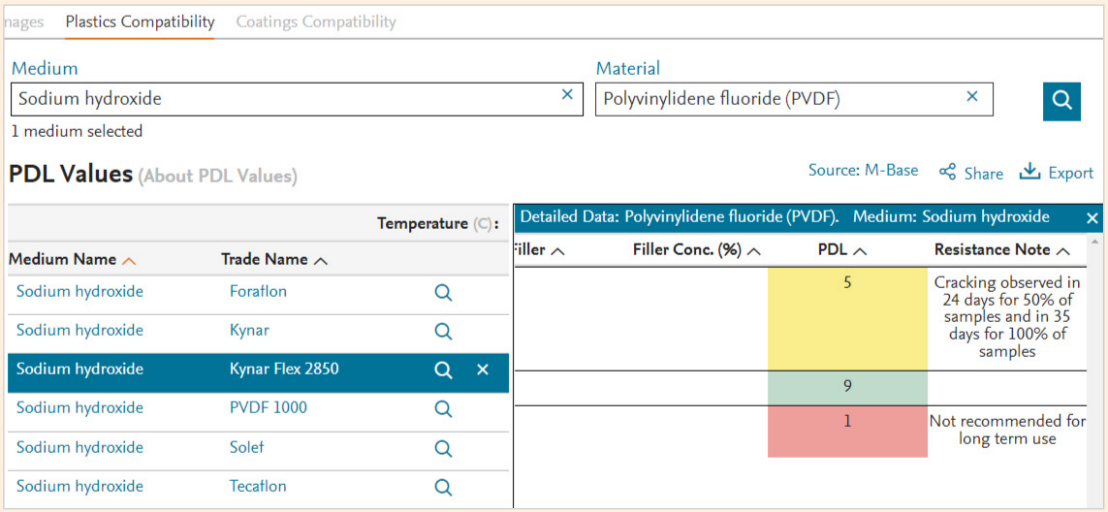

Figure 1: Knovel Corrosion provides detailed data on Plastics Design Library (PDL) values at various temperatures.

Challenge

Mel Esmacher, P.E., is a senior materials and metallurgical engineer at Veolia's R&D and Customer Analytical Services Laboratory in Tomball, Texas. A big part of the job for Esmacher and his team is helping customers solve corrosion problems. Customers send water samples and damaged components to the lab for analysis and recommendations on alternative materials or treatment programs.

"We look for strategies to mitigate corrosion," said Esmacher. "Many times, the wrong type of metal alloy, plastic or other material is being used in an application."

A recent case involved the failure of a unique type of check valve. As part of the water treatment process, it had been exposed to a caustic chemical mixture containing 20% to 40% sodium hydroxide (NaOH). Leaks were detected and brittle cracking was observed in various parts of the valve, such as the housing and diaphragm seals, although it had been in operation for only a few months.

Examination in the lab revealed that the valve used a plastic known as polyvinylidene fluoride (PVDF), which is a semi-crystalline thermoplastic fluoropolymer. PVDF is chemically resistant to most acids, bases and organic solvents. It is also resistant to wet and dry chlorine, bromine and other halogens.

"Initial testing of this type of plastic showed a good rating and performance for this water treatment product," said Esmacher, "so it should have been able to withstand these conditions."

Clearly, a deeper investigation was required.

Solution

Esmacher and his team turned to Elsevier's Knovel Corrosion solution to investigate the issue. Research using the database provided several insights. One reference that turned up in the search indicated that PVDF should not be used with strong alkalis, fuming acids, polar solvents, amines, ketones and esters. The document added that when used with strong alkalis, PVDF can suffer from brittle Environmental Stress Cracking (ESC).

"Knovel Corrosion helped us to discover that the cracking resistance of PVDF in caustic solutions varies markedly depending upon the testing protocols used by the manufacturer and the method used to manufacture the material," said Esmacher. "We also discovered that certain manufacturers noted the appearance of cracking damage when NaOH was present in the water." (Figure 1)

Once he understood how much variability could be present in PVDF depending on the vendor as well as the process environment, Esmacher delved into the Knovel Corrosion database for plastic compatibility. This revealed that it was possible, depending upon the type of PVDF used, for environmental stress cracking to develop, as test samples showed cracking within 35 days in 100% of samples when exposed to a 10% NaOH solution. Another document that came up using a search within Knovel was a case history of stress cracking in PVDF (Figure 2). It highlighted embrittlement in a PVDF pipe section after one month in a 20-30% NaOH concentration at 80°C. Cracking was traced to high alkalinity and high temperature. The remedy in that case was to reduce the temperature and alkalinity by improved process control.

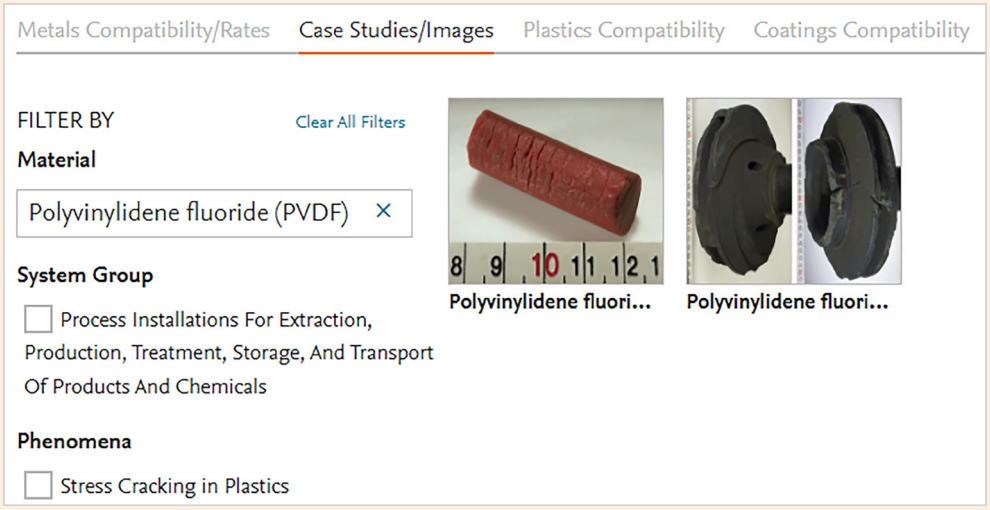

Figure 2: Knovel Corrosion case study showing a history of stress cracking in PVDF.

Solution, continued

Additional work in the Veolia lab confirmed that the type of PVDF used in the valve was reinforced with fiberglass. This increased cracking susceptibility by altering the material's chemical resistance.

"The plastic compatibility guide within Knovel Corrosion confirmed variance in cracking performance depending on the PVDF manufacturer. It also identified specific data confirming cracking problems in caustic test solutions," said Esmacher. "Several different sources within Knovel Corrosion made it clear that the PVDF used in the valve housing was not crack-resistant to the chemical properties of the fluid it contacted."

As several experts within Veolia had access to Knovel Corrosion, Esmacher could share findings with his collaborators, answer questions and agree on the best course of action.

Impact

At Veolia, about 50% of the lab work is routine, such as typical water analysis test grids and corrosion monitoring. But in the other 50% of cases, challenges appear that call for in-depth study of the manufacturing variance and potential failings of materials in certain environments or processes. This PVDF case fell into the latter group.

Esmacher explained that without the authoritative information sources found in Knovel Corrosion, he would have had to rely on internet searches. As well as generating too many hits — many from questionable sources — internet searches inevitably end up on manufacturers' websites which can be ambiguous, added Esmacher.

"Use of the internet typically offers fewer specifics for the client. This means we would not be able to provide a clear-cut direction," he said. "Knovel Corrosion, on the other hand, gives targeted literature references to support a probable cause of failure, which sets the stage for engineers to make correct decisions and advise the client on better material for applications."

As Veolia has been involved in this challenging field for decades, its engineers possess reference books and handbooks that help them understand many of the problems their clients face. In some cases, it is a race against time to solve a pressing problem. Downtime at some plants can cost more than $100,000 a day. That's another reason why Esmacher appreciates the digitization of the search process within Knovel and the speed at which his team can cross reference various sources.

"Knovel Corrosion quickly gave us rankings for plastics in many different environments, as material compatibility is not always a simple yes/no answer. It also provided supporting case studies to help explain our conclusions. I had never seen all this within a single reference source before," he said.

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