Knovel®

Case Study: Finding the right material for a highly corrosive manufacturing process

Knovel helps a zirconium manufacturer quickly identify the metal best suited to prevent a corrosion issue in a pollution control system's pipes, thereby avoiding potential HSE issues.

Summary

To avoid the risks of a health, safety and/or environmental incident, a nuclear power company must resolve a corrosion issue in a pollution control system at its zirconium manufacturing plant. A company chemical engineer uses information in Knovel to identify pipe metals that can withstand highly corrosion compounds, enabling him to design, build, and install new corrosion-resistant piping without delay.

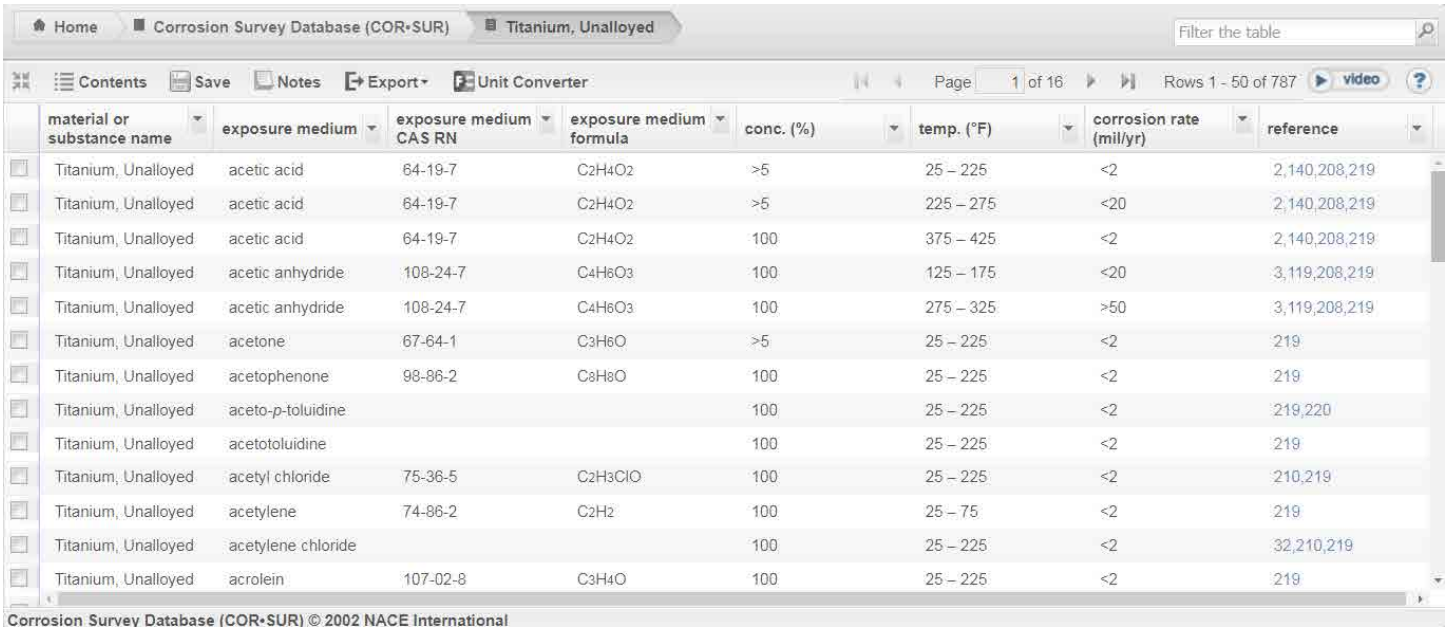
Zirconium is the optimal metal for cladding nuclear fuel rods because it absorbs relatively few of the neutrons produced in a fission reaction.

Challenge

A U.S.-based nuclear power company offers a wide range of products and services—including nuclear fuel, service and maintenance, instrumentation and control, and plant design—to utilities worldwide. It owns and operates a manufacturing plant that produces zirconium containers to hold nuclear fuel for use in nuclear power plants. Zirconium is the optimal metal for cladding nuclear fuel rods because it absorbs relatively few of the neutrons produced in a fission reaction and it's highly resistant to both heat and chemical corrosion.

The manufacturing process for the zirconium containers uses a highly acidic solution, thus requiring a powerful pollution control system that scrubs chlorine. The company discovers that a section of piping in the pollution control system is corroding rapidly and must be replaced quickly because a ruptured pipe would create health, safety and/or environmental concerns.

A company chemical engineer is tasked with finding a piping material that will be substantially more resistant to corrosion. The new material must withstand the corrosive properties of sodium hypochlorite, sodium hydroxide, and chlorine gas—the substances that interact with the inner surfaces of the pollution control system pipes. Speed is critical because the company will suspend plant operations if the corroding pipes begin to pose a leakage risk.



material or substance name	exposure medium	exposure medium CAS RN	exposure medium formula	conc. (%)	temp. (°F)	corrosion rate (mil/yr)	reference
Titanium, Unalloyed	acetic acid	64-19-7	$C_2H_4O_2$	>5	25 – 225	<2	2,140,208,219
Titanium, Unalloyed	acetic acid	64-19-7	$C_2H_4O_2$	>5	225 – 275	<20	2,140,208,219
Titanium, Unalloyed	acetic acid	64-19-7	$C_2H_4O_2$	100	375 – 425	<2	2,140,208,219
Titanium, Unalloyed	acetic anhydride	108-24-7	$C_4H_6O_3$	100	125 – 175	<20	3,119,208,219
Titanium, Unalloyed	acetic anhydride	108-24-7	$C_4H_6O_3$	100	275 – 325	>50	3,119,208,219
Titanium, Unalloyed	acetone	67-64-1	C_3H_6O	>5	25 – 225	<2	219
Titanium, Unalloyed	acetophenone	98-86-2	C_8H_8O	100	25 – 225	<2	219
Titanium, Unalloyed	aceto-*p*-toluidine			100	25 – 225	<2	219,220
Titanium, Unalloyed	acetotoluidine			100	25 – 225	<2	219
Titanium, Unalloyed	acetyl chloride	75-36-5	C_2H_3ClO	100	25 – 225	<2	210,219
Titanium, Unalloyed	acetylene	74-86-2	C_2H_2	100	25 – 75	<2	219
Titanium, Unalloyed	acetylene chloride			100	25 – 225	<2	32,210,219
Titanium, Unalloyed	acrolein	107-02-8	C_3H_4O	100	25 – 225	<2	219

Figure 1: Knovel makes finding specific data points in large engineering databases, such as NACE's Corrosion Survey Database, simpler and easier with advanced search and filtration options tailored for engineers.

Knovel offered him foundational knowledge, including highly relevant information on pollution control systems, as well as insights into best practices.

Solution

To determine the optimal alloy for the pollution control system's pipes, the engineer turned to Knovel. Its data-rich features enabled him to find and compare the compatibilities of various metals with sodium hypochlorite, sodium hydroxide and chlorine gas. He used Knovel to access the Corrosion Survey (CorSur), an essential NACE corrosion database that provides information on the performance of metal materials in more than 1,500 different chemical environments under various exposure conditions.

Knovel's searchable tables and charts made it easy for the engineer to extract the performance data he needed from trusted sources, enabling him to assess the viability of various piping metals quickly. By helping him narrow down the candidates and refine his searches when looking for specific information in research papers, Knovel minimized the engineer's research time.

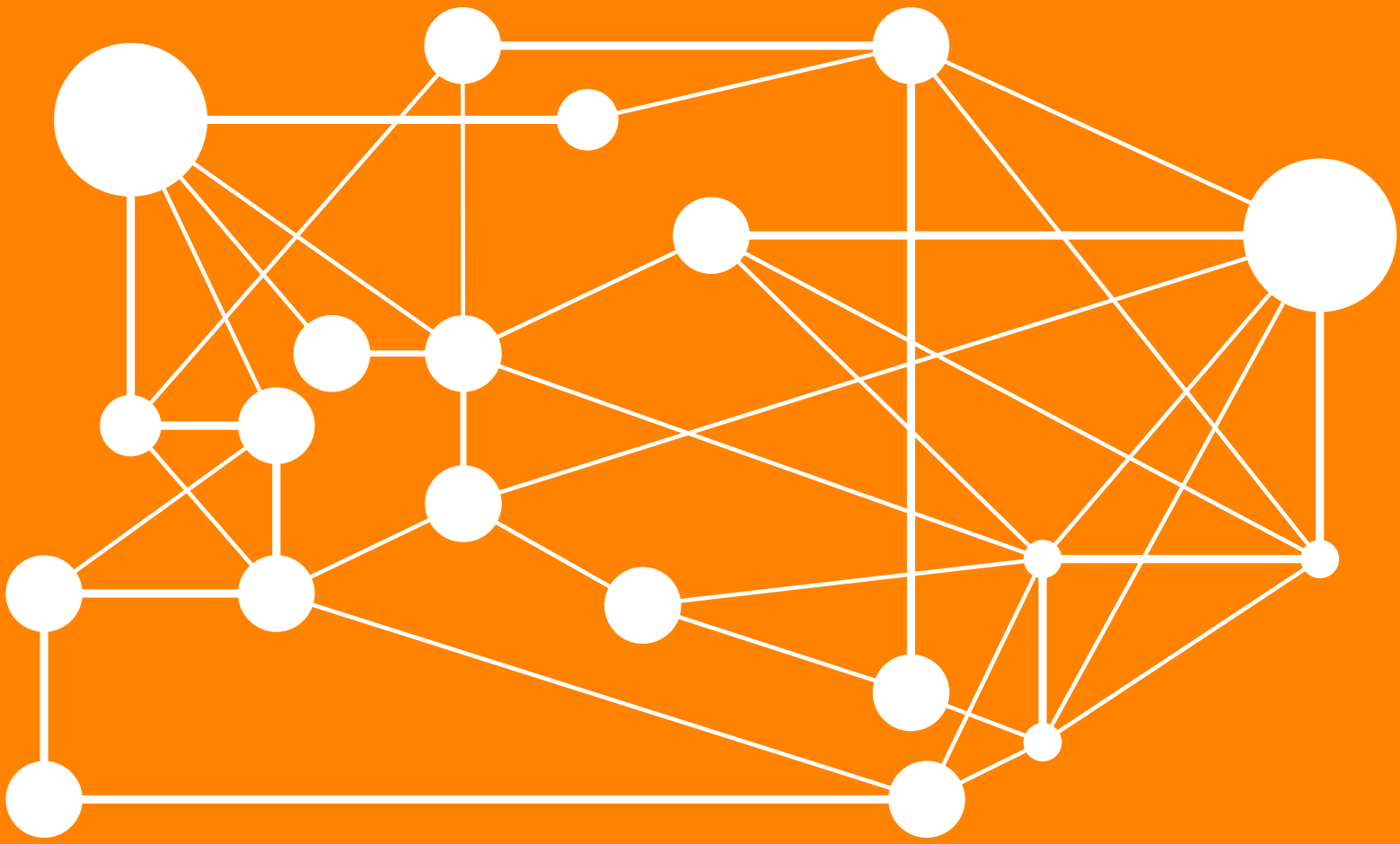
In additional to providing access to the data to solve the engineer's corrosion problem, Knovel offered him foundational knowledge, including highly relevant information on pollution control systems, as well as insights into best practices. He used Knovel to take an in-depth look at different types of bleach-making processes and equipment, because this long-established process uses substances similar to those found in the zirconium plant's pollution control systems.

The information and insights from Knovel guided the engineer to a well-informed business decision about the type of pipes that should be installed in his plant's pollution control system to replace the corroding pipes.

Business Impact

After identifying the optimal material for the new piping, the engineer was able to design, manufacture and replace the pipes in the pollution control system. He installed the new pipes within a short time frame and with minimal production downtime—and before corrosion caused a costly suspension of operations. The new piping required a capital expenditure of $1 million, but the new materials enabled the engineer to design it to last for up to 20 years.

Knovel's interactive tools, including searchable charts and tables, were essential to speeding up the chemical engineer's research project identifying metal candidates that could withstand the extremely corrosive environment in the pollution control system. The company achieved operational excellence while lowering the risk of a potential health, safety, and/or environmental incident due to a pipe leak.



Knovel®

Knovel is an engineering decision-support solution enabling engineers to solve problems faster. With powerful search and interactive analytical tools, engineers can confidently find answers to technical questions through best practice insights, validated equations and materials and substances data from more than 120 providers. For more than 15 years, Knovel has helped thousands of engineers and researchers from leading companies and institutions around the world enhance research and productivity, achieve operational excellence, reduce costs and time to market and build expertise.

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