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Article

A Cut Above

How Customizable Knife Gate Valves are Improving Oil Sands Uptime

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The world is entering an era of unconventional oil production. The Athabasca Oil Sands in Alberta, Canada, which have been mined since 1967, pose the single greatest opportunity for unconventional oil production, globally. According to a 2010 survey by the World Energy Council, Canada's oil sands reserves represent about 70 percent of the bitumen reserves in the world at about 170 billion barrels. But despite all the potential, oil sands production has complex implications.

Bitumen is more expensive to extract than traditional oil at roughly $25-$30 per barrel. With raw bitumen being as viscous as cold molasses—it has a viscosity greater than 10,000 centipoise—and as coarse as liquid sand paper, pumping it for extraction and refinement, and returning residual tailings back to earth in tailing ponds, poses a severe risk of downtime.

The Need for Resilient Valves

Although oil sands mining is not new, the processes involved in oil sands mining and transport have evolved dramatically over the last few decades. Where bitumen was once moved to the processing plants by conveyor the current primary method of moving bitumen from open pit mines to be processed is by creating a slurry with water and pumping through hydrotransport pipelines. Raw bitumen must be separated or extracted from the sand and clay mixture before being upgraded and refined.

The history of bitumen mining in Alberta is a story of steady advancement by a small number of major actors. As it stands today, the largest mining operations in the Athabasca oil sands tend to be the oldest with the most tenure in the Canadian Oil Sands. Over the last 15 years, oil prices have risen higher and production methods have improved enough to justify the extra per-barrel production costs of oil sands mining. These trends have leading mining companies who extract from the oil sands eager to find ways to increase production rates and reduce downtime.

Engineers at my company, ITT Engineered Valves, have had the pleasure of working primarily with engineers at one of the major industry players in the Canadian Oil Sands to jointly develop customized solutions to meet growing demands for more resilient valves. As production has increased

and the cost expenditure ratio continues to improve with the rising global costs of oil, more stringent specifications continue to drive innovation.

Valves involved in every stage of transport are subject to incredible wear and tear due to the nature of bitumen slurries. If there aren't fist-sized stones in the mix, there are highly abrasive sands. Slurry flow speeds have been increased to help reduce the slurry's stickiness. However, this causes high abrasion rates. In any case, bitumen transport happens under incredibly high pressures at up to 700psi or more.

All of this has combined to create a demand for knife gate valves that can withstand the extreme abrasion qualities of oil sands mixtures and the high pressures required to transport slurries long distances. Engineers are looking for more robust valves that can endure longer intervals between required maintenance.

The Fabri-Valve F133 is well suited for slurry applications.

Setting the Stage: A Major Upgrade in the Early 2000s

Between 2000 and 2005, a leading company in the Canadian Oil Sands underwent a major growth step at one particular site, adding 20 new processing units including the largest fluid coker and hydrogen plants ever built, in addition to upsizing another 20 processing units. That process involved the purchase of about 42,000 manual isolation valves and brought this leading company's daily production capacity up to 350,000 barrels per day. A variety of valves were in use including modified versions of standard knife gate valves like ITT Engineered Valve's Fabri-Valve® C67 and F133.

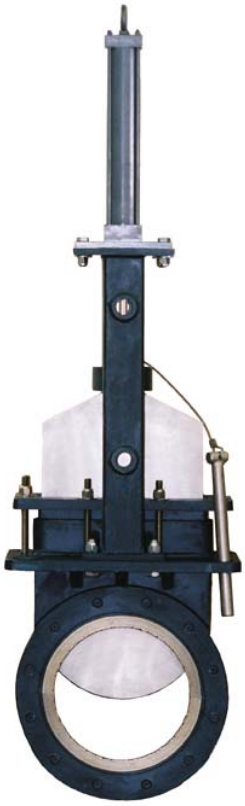
This same company utilizes over 150,000 manual isolation valves in various processes, including some 7,000 pressure safety valves, 15,000 control valves, dampers and large actuated isolation valves. Few knife gate valves are in this mix today, though those that are have been specially fabricated and deployed to meet unique needs in situations where standard valves couldn't stand up. The processes were becoming more and more rigorous and the need for a super duty valve became apparent. As time has passed, more robust valve designs were required by multiple leading Canadian Oil Sands customers. At this time, there were so many different applications for valves emerging in oil sands mining and refinement that there truly

was no such thing as a standard valve. This need spurred a drive to innovate and evolve the knife gate valves used in the oil sands reducing maintenance and meeting ever increasing specifications.

ITT Engineered Valves has become one of the leading manufacturers in the development of custom valves for a myriad of applications. In particular, ITT Engineered Valve's Fabri-Valve HD series of knife gate valves were developed for the oil sands and are meeting the need for a more robust valve. The HD series of fabricated valves are custom engineered to operate in higher pressures and be robust enough to extend maintenance schedules. What follows is the story of the HD knife gate valve's evolution in oil sands mining.

Case Study: The Knife Gate Valve, Evolved

The HD 150 knife gate valve was the result of numerous design improvements requested by large oil producers in the Athabasca Oil Sands and traces its roots back to the late 1940s with the Fabri-Valve C37. This valve was used in the shipping industry and the Fabri-Valve business in Portland, Oregon was owned by Grinnell Corporation. Over the next two decades the knife gate valve continued to evolve and was improved for primary use in the paper and pulp industries. In 1969 ITT Corporation purchased Grinnell and has continually made improvements to their fabricated valves to meet a variety of unique needs across several industries. The HD knife gate valve used in the Oil Sands of Alberta today is the latest in this long lineage.



The Fabri-Valve HD150 knife gate valve designed for the oilsands.

When the Fabri-Valve HD valve line was introduced to the Oil Sands it was an entirely new platform of valves that was specifically designed for the abrasive processes in extracting the oil. It all started in July of 2002 when an ITT Engineered Valves development team traveled to Alberta to consult with industry leaders in the Oil Sands and obtain feedback on its knife gate valves designed for the Oil Sands. Many of these knife gate valves were fabricated, not cast, and featured replaceable carbide overlaid wear rings and seats, and utilized other hardened materials to withstand varying degrees of abrasion present in the then evolving oil sands processes. Engineers had to overcome major hurdles related to extreme abrasion resistance, design pressures in excess of 500 psi, and the sticky nature of the bitumen and how it adheres to the gate of the valves. The leading mining companies provided feedback and challenged ITT Engineered Valves project engineers to make further improvements. This process

resulted in multiple design improvements made to wear rings and seats, hardening of gates, gate scrapers, and a HNBR resilient seal. The valve at the time was called the SuperDuty and the name was changed to the HD150 knife gate valve. This new standard for knife gate valves was launched in late 2004.

The HD valve design has exceeded industry standards from the initial design at the beginning of the century. Over the next seven years, the first iteration of the HD150 went through rigorous testing with industry leaders in hydrotransport, tailings and extraction processes. Beginning in 2005, ITT Engineered Valves spent two years developing a high-pressure version of the HD150, called the HD300. The same design improvements that were inherent to the HD 150 design were included in the HD300 valve for use in applications where pressures exceeded 700 psi. In 2008, the demands for newer more efficient technologies led to more customer requests. ITT Engineered Valves assigned a project engineer specifically to the Oil Sands region in Alberta with the goal of redesigning the existing HD valves.

Pump isolation valve on floation line.

In just under a year, ITT Engineered Valves re-launched the HD300 with notable improvements mostly driven by customer's demands for ease of maintenance and more durability. The HD300 boasted a redesigned yoke, stem clamp and structural enhancements made to the body. These improvements were also added the HD150. The results were significant. Customers no longer had to throw away the body of the valve. The Fabri-Valve HD valve line now has non-pressurized wear rings that can be rotated and replaced, resulting in less maintenance, less downtime and reduced costs.

Over time, the Fabri-Valve® HD valve line has been certified by ANSI for pressure, wall thickness and sturdiness of flanges. They meet full MSS-SP135 face-to-face guidelines, and are also fully rated and recognized by CRN. Not once has the ITT Engineered Valves team had to go back to the drawing board to build a better knife gate valve. As the demands of an ever more aggressive production environment have evolved, so has the Fabri-Valve® HD valve line.

Energy Demands Drive Future Innovation

With increasing demands surely on the horizon for valves in the Athabasca Oil Sands of Alberta, sturdier system components will need to evolve and improve for the foreseeable future. These demands will result in increased unconventional oil mining, production processes and advanced challenges. Heightened complexity will be unavoidable and demand for more customized and durable components will follow suit. The endless global demand for energy should drive the growth of new processes such as in-situ. One primary area for growth is deep extraction in the oil sands using in-situ methods.

Certain methods using in-situ such as steam and water treatment, require valves likes the F133, requiring high alloy steels to be compatible with the aggressive temperatures and chemical characteristics in the process. Heavy scaling will continue to be a growing challenge and new product evolutions with improved designs will be better equipped to tackle heavy scaling. The future will demand engineers to build longevity into their products and continually push to improve engineering technologies with interchangeable internal parts, more robust materials and improve coatings to reduce wear. The oil sands of Alberta will continue to drive innovation and progress with its endless energy opportunities.

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