Revamping Valves, Adding FIELDVUE® Instruments Saves a Refinery and its PSA Unit $2M Per Year

RESULTS

- Fisher® valves provide tight shutoff, high-cycle stroking, and diagnostic capabilities.
- PSA unit increases its hydrogen recovery rate by ~20%.

APPLICATION

Pressure Swing Adsorption (PSA) skid for hydrogen purification

CUSTOMER

Refinery in Texas

CHALLENGE

Many industrial processes require high-quality hydrogen as a feed stock. Plants can either produce their own H2, using steam-reforming or methanol-cracking processes, or they can recover hydrogen from "waste" process streams. This refinery chose the recovery method and uses a Pressure Swing Adsorption (PSA) skid for hydrogen purification. The unit provides uninterrupted vapor processing and purified hydrogen as a fuel for other parts of the refinery.

The PSA process involves the adsorption of impurities from a hydrogen-rich gas onto a fixed bed of adsorbents at high pressure. Switching valves are manipulated in a predetermined sequence, and the plant must be continually tuned to account for changes in feed flow and composition. Impurities are subsequently desorbed at low pressure into an off-gas stream, thereby producing extremely-pure hydrogen at levels up to 99.9% recovery.

The PSA unit is a very abusive process for control valves. The damaging effect in the PSA skid is not the process but rather the high cycling action required for the constant production of vapor. Valves and actuators are expected to stroke up to once every three minutes. Depending on the type and size of PSA skid, the number and type of

"Improving valve performance and diagnostics on a PSA skid enabled us to improve hydrogen recovery by ~20%. The few days we did process high feed rates, the H2 production was close to 28 MMSCFD versus the 20 MMSCFD seen earlier in the year (2006)."

Operations Support Engineer
Hydroprocessing

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EMERSON™ Process Management

control valves will vary. In any case, the valve and actuator selected must provide tight shutoff and high-cycle stroking ability.

Due in part to poor valve performance, the PSA skid was recovering only about 65 to 70% hydrogen. Plant maintenance personnel worked with Asset Managers from Puffer-Sweiven (Emerson's LBP) to identify the unique application requirements for their PSA skid. They used off-line diagnostics to analyze the performance of the PSA skid's valves and thereby justified the unit's revamp.

SOLUTION

More than two dozen PSA valves, such as those with coupling wear issues, were repaired. About three-dozen others were replaced with new Fisher® high-cycle, rotary valves (A41s and ETs), some with special constructions: Chromium carbide-coated shafts, PEEK bearings, or UHMWPE seals. The assemblies included Field Q actuators and FIELDVUE® DVC6000 AD-tier digital valve controllers. FIELDVUE DVC6000 Series instruments with Advanced Diagnostic (AD-tier) capabilities, in conjunction with ValveLink® Solo software, improve valve monitoring, reduce operating costs, and enable predictive maintenance.

In September 2006, Emerson Process Management installed 40 new Fisher valves in the PSA skid. After the revamp, the PSA unit was recovering H2 at a rate of 80 to 84%. In addition, the tail gas compressor was operating with 26% hydrogen compared to the 45 or 50% it required before the valve revamp. (Increased density of the process flow has improved the compressor's performance.)

On average, there is typically 25 MMSCFD of H2 in the feed to the PSA. The ~20% improvement in H2 recovery equates to an additional 3.75 MMSCFD. Figuring $1500/MMSCFD, this valve project saved about $5600 USD per day or $2 Million per year.

Emerson Process Management has a PSA testing facility in Marshalltown, Iowa, that simulates real-world operating conditions. In this facility, Fisher® control valves with FIELDVUE® instruments are subjected to full bi-directional pressure swings, plus cycle counts that exceed one million. (Each side of the valve plug is alternately pressurized to 500 psig and then vented.) Actuator stroke time is controlled so that the 0-100% and 100-0% strokes occur in less than two seconds. Performance data (friction, spring rate, bench set, etc.), stroking time, and seat-leak tests are monitored and recorded to meet stringent life-cycle and quality standards.

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