

Flexible implementation of Badger valves in a biodiesel downstream processing pilot plant

Introduction

This short article describes how the company ILS-Integrated Lab Solutions in Berlin, Germany – an independent engineering and plant construction office specializing in the design and construction of fully automated, customized reaction systems in the chemical and pharmaceutical industry - has successfully implemented Badger valves to solve a number of challenging problems in a parallel hydrotreating unit, used for oil upgrading. In particular we demonstrate how Badger valves, despite having the same fundamental design in all cases, were successfully used to tackle a wide range of different processing problems.

Pressure control

The unit in question contains two parallel fixed-bed, trickle-flow (top-down) catalyst testing reactors. Hydrotreating reactions are carried out at elevated pressures (200 bars) in a hydrogen atmosphere. Since this unit is used for process optimization, the client had a strong desire to be able to operate over as broad a flow and pressure range as possible. This is important in order to be able to screen as broad an operation-parameter space as possible to determine the optimal performance conditions.

We implemented Badger control valves operating in a feedback control loop with gold-plated Keller 4-20mA pressure sensors. The valve design allows operation over an exceptionally wide range of upstream pressures of up to 200 bars with single-step pressure regulation to atmospheric pressure on the downstream side.

High-temperature level controller

Gas/liquid separation is an integral part of any hydrotreating unit. Due to the heavy nature of the oils involved, it is required to maintain the oil at a temperature of 200°C to prevent hardening. The low-liquid flows for a pilot installation of this size (1-5g/min) and high-pressure operation (200 bars) require a high-temperature regulation valve with exceptionally low Cv-values.

We implemented high-temperature, Kalrez-sealed Badger valves operating in feedback control with Siemens Sitrans level sensors to maintain the liquid level of our gas/liquid separators at an operator-defined level.

Low-temperature cooling

A key piece of information needed by any plant operator is the mass balance. During hydrotreating, high-vapor pressure, light-end products are formed in substantial quantities. Extremely low temperatures (-70°C) are required in order to condense these products as efficiently as possible.

Temperature regulation at these low temperatures is exceptionally difficult because of ice formation and valve freezing. ILS has implemented special, low-temperature Badger valves for this. The valves regulate the flow of low-temperature silicone oil coming from a powerful, low-temperature Huber cryostat. This allows individual temperature regulation of multiple vessels using a single cryostat. This represents a significant cost savings to our client as low-temperature cryostats are particularly capital-intensive components.

Fully-automated, 2-parallel hydrotreater with distillation workup

