Multiple Applications of CFD in the Flow Control Industry

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Introduction to Control Valves

- Control valves control the flow
- They are the anti-pumps
- Reduce the energy
Introduction to Control Valves

- Typical problems where CFD can be a vital contributor to the solution
  - Cavitation

\[ P_1 \quad P_{V} \quad P_2 \]
Introduction to Control Valves

- Typical problems where CFD can be a vital contributor to the solution
  - Vaporization/Flashign

\[ P_1 \rightarrow P_V \rightarrow P_{VC} \rightarrow P_2 \]
Introduction to Control Valves

- Typical problems where CFD can be a vital contributor to the solution
  - 2-phase sizing
Introduction to Control Valves

• Typical problems where CFD can be a vital contributor to the solution
  • Design Iteration
Introduction to Control Valves

- Typical problems where CFD can be a vital contributor to the solution
  - Thermal Analysis

280 MW Solana CSP Plant in Gila Bend Arizona
Introduction to Control Valves

- Typical problems where CFD can be a vital contributor to the solution
  - Vibration

![Sine Wave Graph]
Introduction to Control Valves

- Typical problems where CFD can be a vital contributor to the solution
  - Large Valve Flow Testing
Introduction to Control Valves

- Typical problems where CFD can be a vital contributor to the solution
  - Full Flow Curve Generation
Cavitation

- Decoking valve bypass analysis
- Cavitation analysis matched observed cavitation damage

Cavitation damage observed in plates section
Vaporization/Flashling

One of a kind proprietary flashing model:

- Mining flash let down
- High energy flashing applications
2-Phase Sizing

- Example water treatment valve with water and N₂ gas
  - Water was 31.7% by volume
  - Nitrogen gas was 68.3% by volume
- The result was accurate valve sizing that the customer was very pleased with
Design Iteration

- CFD played key role in the development of the newly released anti-cavitation trim DiamondBack US Pat # 8,881,768 B2
Design Iteration

- CFD predictions match test data very closely
Design Iteration

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Thermal Analysis

- Thermal analysis for NASA rocket test stand valves
  - Liquid Oxygen in valve at -320° F
  - Checking to make sure packing stayed above certain temperature so no leaks occur
Thermal Analysis

- Ambient outside temperature natural convection and conduction.
Vibration

- Vibrating plug problem able to make modifications and eliminate the vibration
Large Valve Cv

- 20” Y-body valve too large to test in house.
- Dynamics issue 3.02
Large Valve Cv

- Analyzed and optimized using CFD
- Tested at large flow facility at Utah State University, test and prediction were within 2%.
Full Flow Curve Generation

- Following ISA standard ANSI/ISA 75.02
- Extruder puts 2 diameters upstream and 6 down
Full Flow Curve Generation

- STAR-WORKS makes the interface between the CAD and CFD seamless
Optimate introduces the possibility of quick and efficient flow curve generation.
Introduction

Design Exploration

Automation
- Define Parameter Space
- Process Capture

Exploration
- Parameter Sweeps
- Direct Optimization
- Design of Experiments (DoE)
- Robustness Analysis
- Reliability Analysis
Technical Capabilities

- **STAR-WORKS**
  - Leverage CAD already defined in SOLIDWORKS

- **Template Sim File**
  - Leverage previous simulation setup.

- **Optimate**
  - Leverage easy process automation
Full Flow Curve Generation

FLOWSERVE

STAR-Works

STAR-CCM+®

Experience In Motion
Questions?

Valtek Survivor Control Valve