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IMPROVING COLUMN FLEXIBILITY IN INCREASINGLY COMPETITIVE MARKETS

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Introduction

What does column flexibility mean?

Tray towers vs. packed towers

Improved tray designs for more efficient turndown

Improved tray designs for efficient flexibility

Conclusions

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AGENDA

INTRODUCTION

Challenges to petrochemicals in Asia:

- The global oversupply of petrochemicals reached 218m tonnes last year
- High oil and gas price
- Decreased demand in China
- Low margins in Asia
- Reduced operating rates

Decarbonization

- >90 percent of top 25 chemical companies have carbon-neutral or net-zero targets
- Distillation consumes ~40% of the energy used in the global chemical process industry
- Maximum energy efficiency is essential







FLEXIBILITY - DEFINITIONS

Maximum = 120% of Design Minimum = 30% of Design

25% Turndown from Maximum

4:1 Turndown Ratio







TRAY TOWERS COMPARED TO PACKED TOWERS



Liquid Flexibility limited by the Liquid Distribution Device

Limited Vapor Flexibility







DISTILLATION / ABSORPTION / STRIPPING

VALVE TRAY FLEXIBILITY / TURNDOWN



FLEXITRAY[®] valve tray



MODIFYING TRAYS FOR IMPROVED TURNDOWN



EXAMPLE — NAPHTHA CRACKER C2 SPLITTER



Base Design:

85 x 4-pass Valve Trays @ 90% Efficiency
Ethylene Product Rate = 262,500 kg/h
Reboiler duty = 75 MW = 285W/tonne
Turndown Design:
85 x 4-pass Valve Trays @ 70% Efficiency

Ethylene Product Rate = 43,750 kg/h

Reboiler duty = 15 MW = 340 W/tonne

+20% higher energy cost per kg of Ethylene

BLANKING TRAYS FOR IMPROVED TURNDOWN



WE NEED A HIGHER FLEXIBILITY VALVE TRAY





FLEXIPRO[®] VALVE TRAY -FEATURES

Valve is wider than deck opening Coined edge of cap above deck opening

Upwards deck orifice extrusion



Tabs to prevent the valve cap contacting the deck extrusion opening

Upsteam valve leg is wider than downstream leg

FLEXIPRO[®] VALVE TRAY - ADVANTAGES



contacting even at minimum rates



FLEXIPRO[®] VALVE TRAY - BENEFITS

Increased capacity Up to 30% over Conventional Valves

Increased tray efficiency

Very wide efficient operating range

Maintains good tray efficiency even at minimum rates

With value in "fully closed" position, there is a tortuous path for vapor to pass through value

Improved efficiency at turndown Enhanced fouling resistance

Increased capacity Enhanced fouling resistance

Reduced damage and wear



FLEXIPRO[®] VALVE TRAY INDEPENDENT PILOT TEST

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System = iC4/nC4 at 11.4bar [165psia]
Column diameter = 1219mm [4'-0"]
Number of trays = 7
Tray spacing = 457mm [18"]
Relative volatility, \alpha = 1.23
Vapor density = 29 \text{ kg/m}^3 [ 1.8 \text{ lb/ft}^3 ]
Liquid density = 485 \text{ kg/m}^3 [ 30 \text{ lb/ft}^3 ]
Liquid viscosity = 0.09 \text{ cP}
Surface tension = 5 \text{ dyne/cm}
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FLEXIPRO[®] valve tray Operating at Extreme Turndown

105% TRAY EFFICIENCY

KOCH-GLITSCH HYDROCARBONS PILOT COLUMN



1.68m [5.5ft] diameter hydrocarbons distillation tower



HYDROCARBON PILOT PLANT PERFORMANCE AT LOW TRAY SPACING





Tray Capacity

CONCLUSIONS:

- The FLEXIPRO[®] value tray has been proven in independent testing and large-scale hydrocarbon pilot tests and in 100's of commercial installations.
- The FLEXIPRO[®] value tray offers:
 - Excellent efficiency
 - Excellent capacity up to 30% greater than traditonal valve trays
 - Excellent turndown ratio with similar pressure drop to comparable valve trays.
- The Floating FLEXIPRO[®] value tray offers benefits for revamps and new towers
 - Higher capacity and/or better separations from existing towers
 - Smaller footprint / reduced investments cost for new towers

THANK YOU!

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