

November 15, 2022

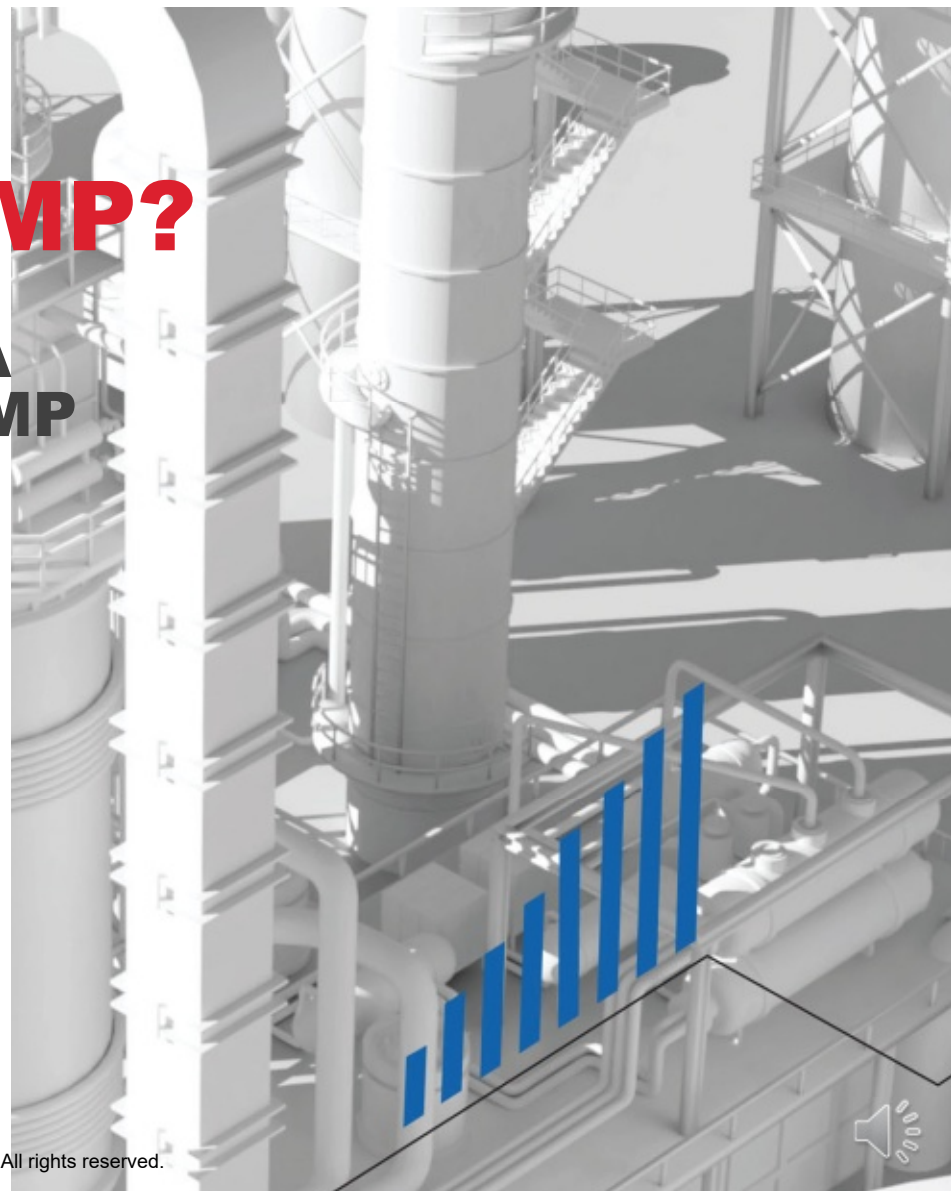
READY FOR A REVAMP?

**WE CAN GET YOU READY FOR A
PETROCHEMICAL PLANT REVAMP
OR TECHNOLOGY UPGRADE**

KEVIN RICHARDSON / SR. PRODUCT MANAGER
RAY TUCKER / PRINCIPLE ENGINEER II



© 2022 UOP LLC. A Honeywell Company All rights reserved.



FORWARD LOOKING STATEMENTS

This presentation contains certain statements that may be deemed “forward-looking statements” within the meaning of Section 21E of the Securities Exchange Act of 1934. All statements, other than statements of historical fact, that address activities, events or developments that we or our management intends, expects, projects, believes or anticipates will or may occur in the future are forward-looking statements. Such statements are based upon certain assumptions and assessments made by our management in light of their experience and their perception of historical trends, current economic and industry conditions, expected future developments and other factors they believe to be appropriate. The forward-looking statements included in this presentation are also subject to a number of material risks and uncertainties, including but not limited to economic, competitive, governmental, technological, and any public health factors affecting our operations, markets, products, services and prices. Such forward-looking statements are not guarantees of future performance, and actual results, and other developments, and business decisions may differ from those envisaged by such forward-looking statements. Any forward-looking plans described herein are not final and may be modified or abandoned at any time. We identify the principal risks and uncertainties that affect our performance in our Form 10-K and other filings with the Securities and Exchange Commission.



UOP HIGH PERFORMANCE EQUIPMENT

- **Maximized Production Rates**
- **Improved Product Purities**
- **Improved Produce Recoveries**
- **Minimum CAPEX**



UOP HIGH PERFORMANCE EQUIPMENT

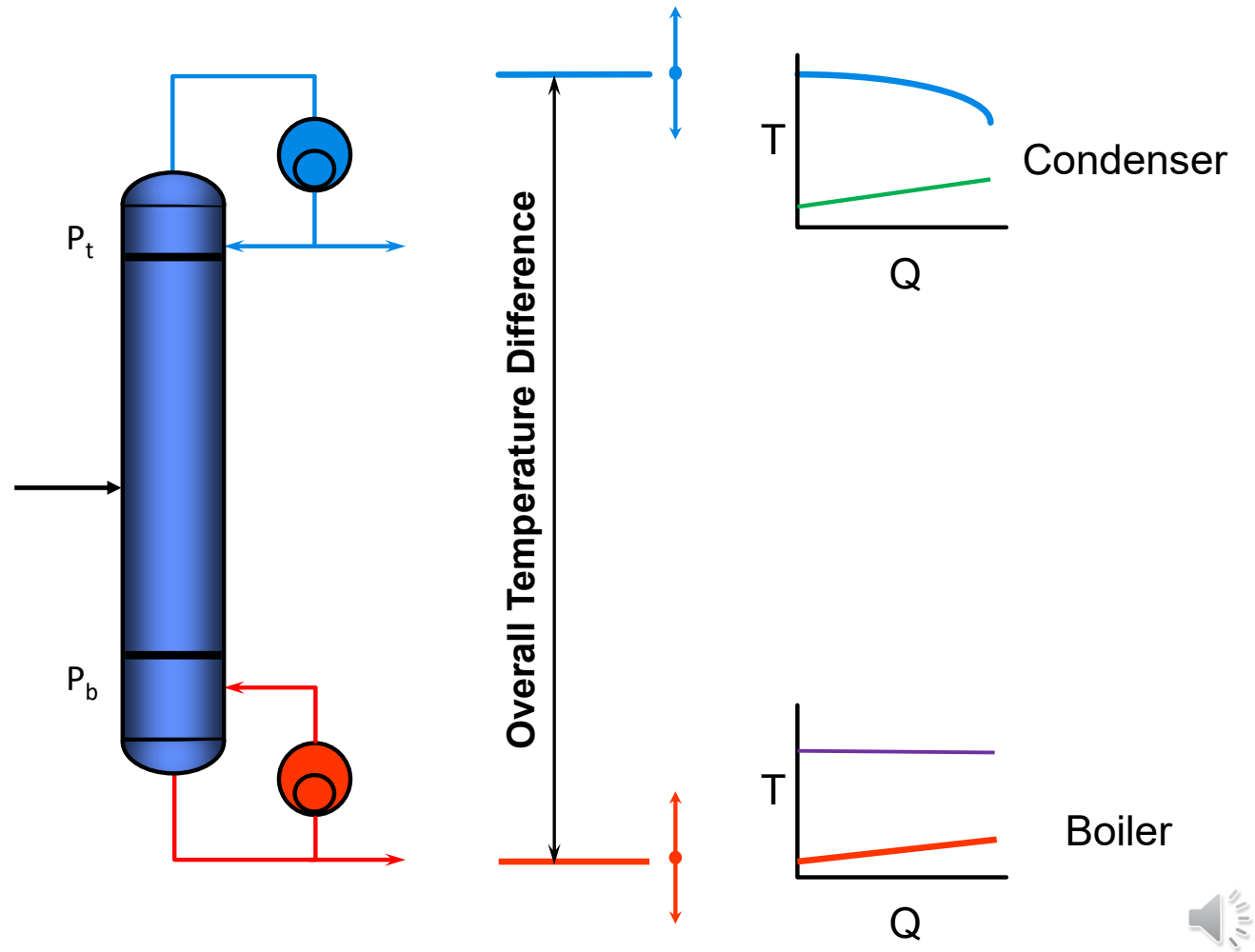
- **Maximized Production Rates** ➤ **Reduced Energy Requirement**
- **Improved Product Purities** ➤ **Maximum Use of Energy Streams**
- **Improved Produce Recoveries** ➤ **Increased Operating Flexibility**
- **Minimum CAPEX** ➤ **Increased Run Times**

Benefits Maximized When Considering Entire Process Unit



SIMPLE DISTILLATION SYSTEM

- **Unit Operating Pressure**
 - Condensing Medium
 - Boiling Medium
- **Reboiler & Condenser Duties**
 - Desired Separation
 - Number of Theoretical Trays Generated



UOP DISTILLATION TRAYS

- **Low Tray Pressure Drop**
 - Maximize capacity
 - Installation at low tray spacings
- **Fully Active Area**
 - Maximize capacity
 - Less prone to fouling
 - Less prone to foams

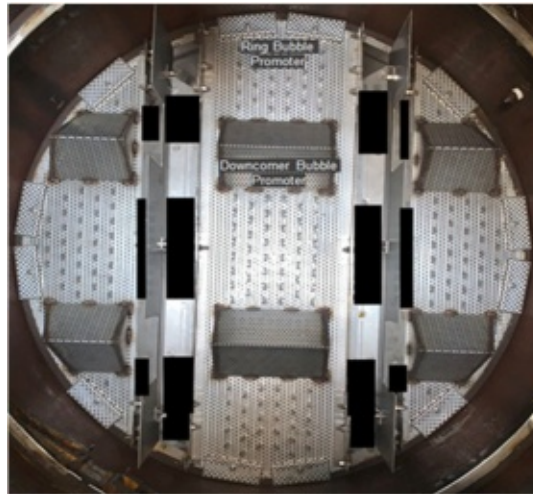
MD™ / ECMD Trays



Slotted Sieve



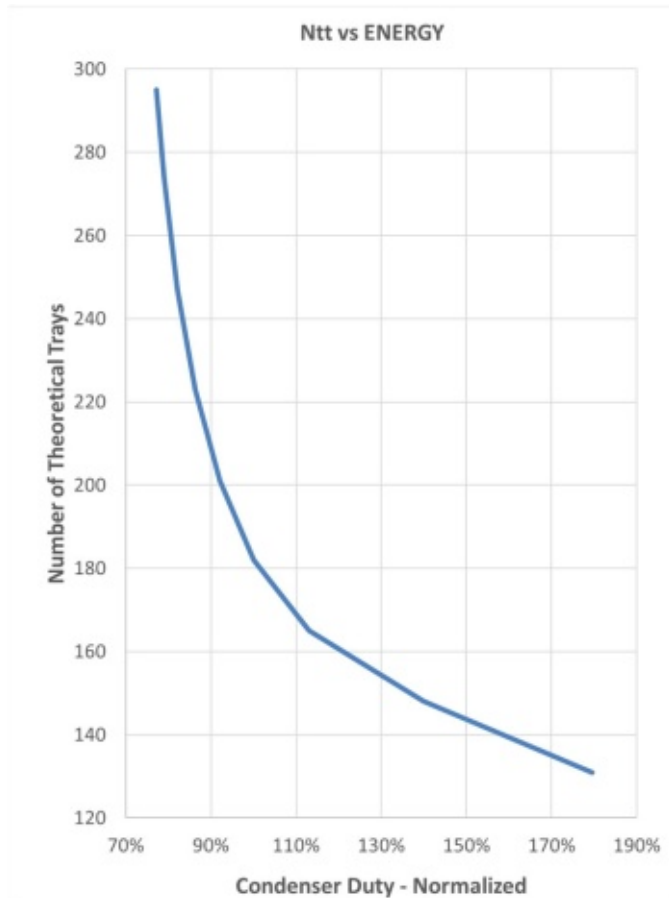
ECMD+ Trays



PFMD Trays



OPTIMIZING CAPACITY AND ENERGY



ECMD Revamp Scheme	1-for-1	5-for-4	4-for-3
Impact on Energy Requirement	100%	-14%	-16%
Number of Theoretical Trays	180	220	235
Tray spacings, mm	450	360	338

- **Curve shape dependent on desired separation**
- **Project objectives will drive best revamp option**
 - **Energy savings vs capacity**



C₂ SPLITTER TRAY REVAMP

Mass Transfer: UOP ECMD™ Trays Designed for an Additional 15% Future Expansion

Customer Needs

- Increase ethylene production >20% above nameplate
- Improve ethylene product purity
- Reduce energy consumption per ton ethylene produced

UOP ECMD™ Tray revamp resulted in:

- 23% ethylene production increase
 - Ethylene product now meets pipeline specification
- Transportation savings
- Ethylene losses through bottoms product reduced
 - Energy requirements for separation minimized

	Before Revamp	After Revamp	Change
Number of Trays	131	157	+20%
Tray Type	2-pass valve	ECMD™	
Tray Spacing, mm**	500/450/400	500/338/267	
Feed Rate*	100	121.4	+21%
Ethylene Product Rate*	86.9	106.8	+23%
Ethane in Ethylene	600 ppm	460 ppm	-23%
Ethylene in Ethane, vol%	3.9	0.57	-85%
Reflux/Ethylene Ratio	4.0	4.0	
Pressure Drop, bar	0.81	0.56	-31%

*Rates are based on normalized feed rate of 100%

**No welding was performed to tower shell

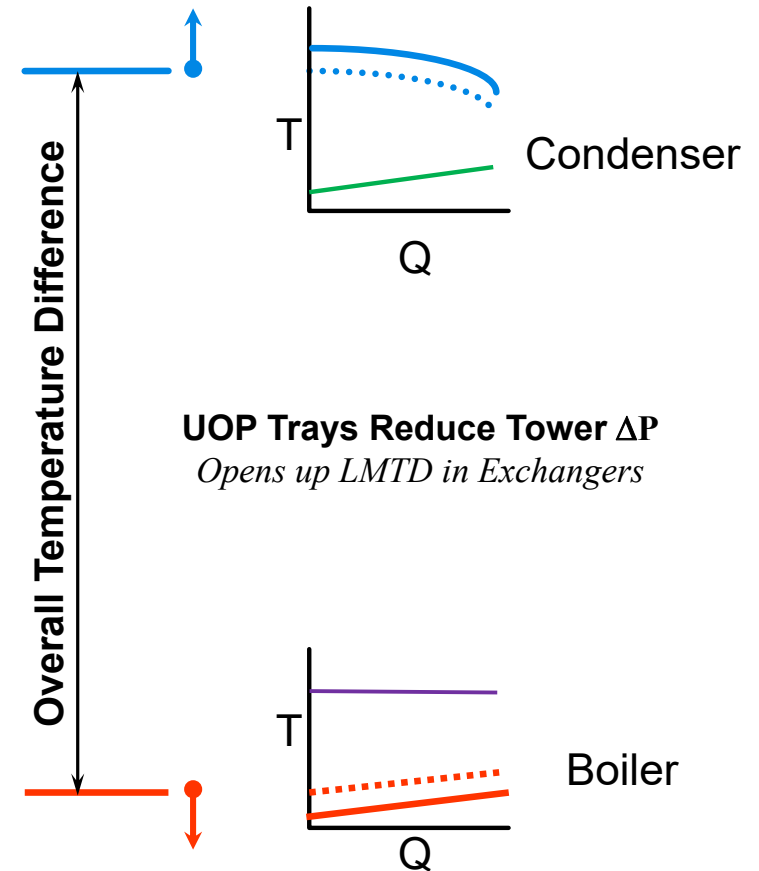
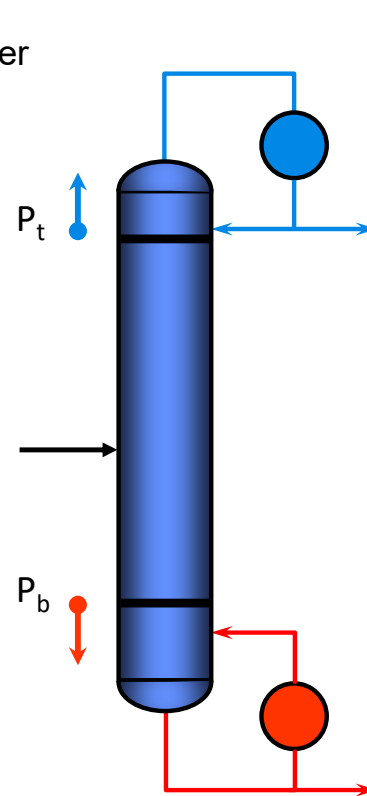
Column Revamped in Only 15 Days



UOP DISTILLATION TRAYS

- **Low Column Pressure Drop**

- Get the most out of energy streams
- Open LMTD for reboilers and/or condenser



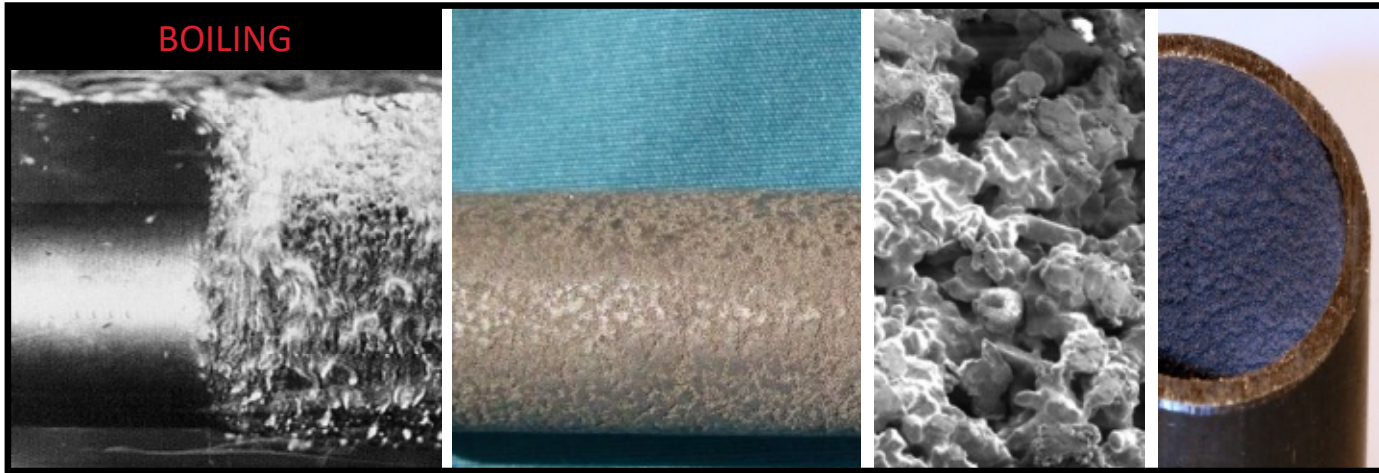
UOP HIGH FLUX AND HIGH COND TUBING



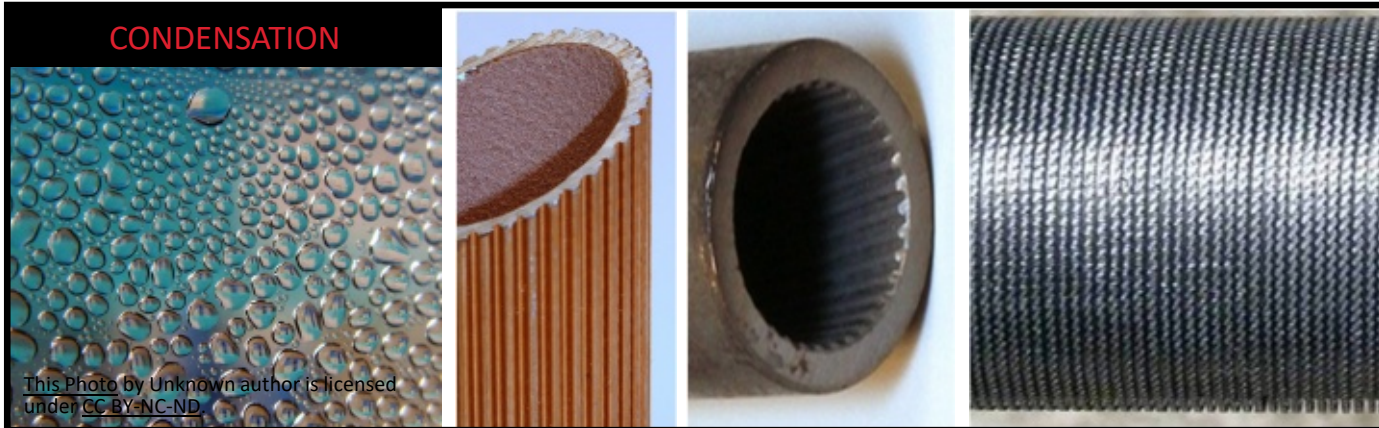
- **Engineered Surfaces**
- **Enhancing Performance**
- **Boiling & Condensation**
- **Reduce CAPEX & OPEX**
- **50+ Years Experience**
- **1870+ Installed Worldwide**
- **440+ Revamp Projects**



BOILING



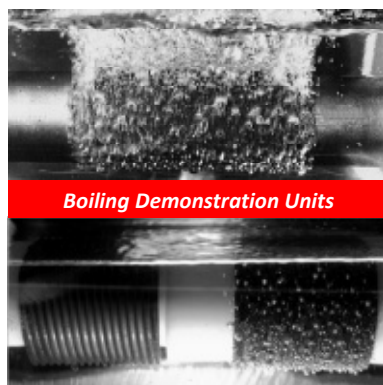
CONDENSATION



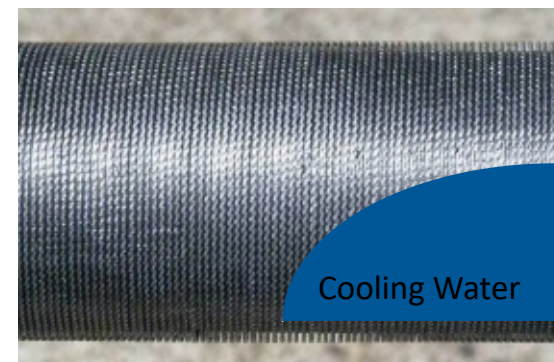
Engineered Surfaces for Boiling and Condensing



UOP HEAT TRANSFER EQUIPMENT OVERVIEW



UOP High Flux Tubes / *Enhanced Boiling*

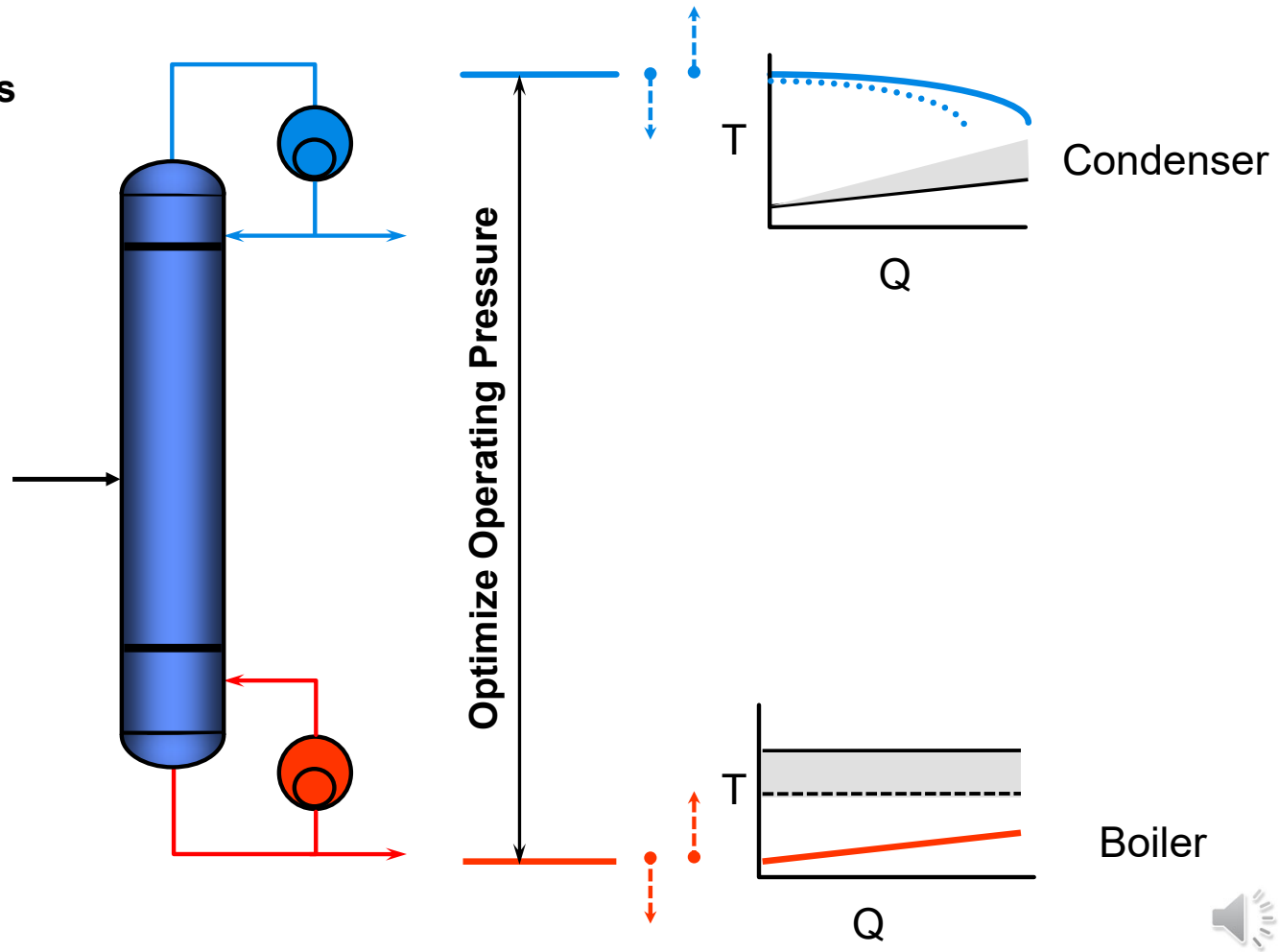
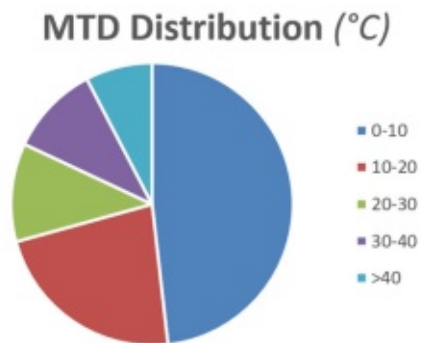


UOP High Cond Tubes / *Cooling Water Condensers*

Common Features	UOP High Flux and High Cond Tubes Provide
Thermal Performance:	2X to 5X Higher Coefficients
Enables Smaller Temperature Approach:	Nucleate Boiling at 1°C / Condensation at 5°C
Benefits:	• Capacity Expansion / Process Improvements • Eliminate Operational Constraints • Simple Bundle Replacement / Short Turn Around • Reuse / Retain Existing Assets • Energy and OPEX Savings • Sustainable Solution / GHG Reduction • Greater Operating Flexibility

UOP ENHANCED TUBES

- Increase Capacity
- Eliminate Temperature Pinches
- Reduce OPEX / Save Energy
- Debottleneck Compressor



CASE 1: HF ALKYLATION DEPROPANIZER REVAMP

Heat Transfer: UOP High Flux Tubes Enabled Use of Cheaper, Lower Pressure Steam

Customer Needs:

- Increase duty by 17%
- Optimize steam economy
 - Bare tube exchanger using MP steam
 - Low pressure steam readily available

UOP High Flux revamp results:

- Achieving duty requirements
- Use less expensive LP steam
- Reuse of existing exchanger shell, heads and piping
 - Minimal capital costs to implement

	Bare Tube	UOP High Flux Tubes	Change
	MP Steam	LP Steam	
Duty (MW)	20.5	24.0	+17%
MTD (°C)	60.6	15.7	-74%
Area (m ²)	484	749	+55%
U-value (W/m ² -°C)	600	1,753	+192%
Steam Flow, Ton/hr	36.6	40.3	+10%

\$850K/Year OPEX Savings (59% Reduction); <6 Month Payback

CASE 2: NGL PLANT REBOILER REVAMP

Heat Transfer: UOP High Cond Tubes Enabled Column Pressure PLUS Energy Savings

Customer Needs:

Maintenance Revamp

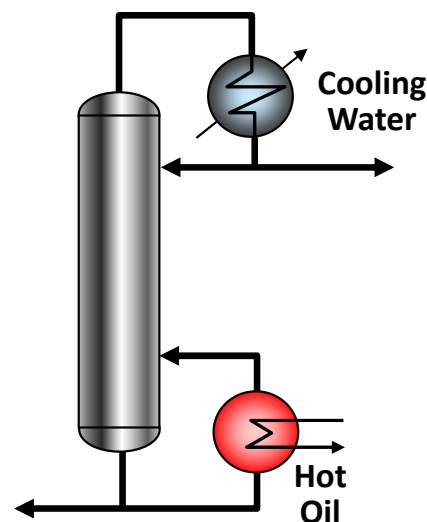
- Existing exchanger at end of life
- Investment Upgrade
- Summertime Water Temp Limit

UOP High Cond revamp results:

- **Maintained Existing Footprint**
- **Lower energy consumption**
 - Overhead Pressure Reduced 1.4 Bar(g)
 - Reduced Cooling Water Usage
 - 4.5% reduction in reboiler duty
- **Stable operation year round**

Depropanizer Condenser Operating Pressure Reduction

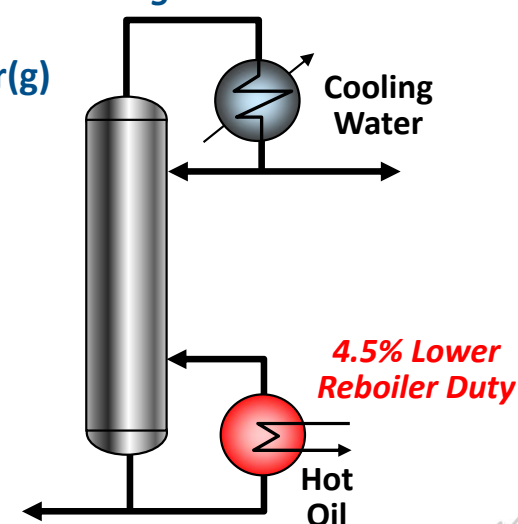
Bare Tube Condensers



15.2 Bar(g)

13.8 Bar(g)

High Cond Condensers



\$5MM Savings Over Unit Lifetime; < 2 Year Payback

CONCLUSION

- **UOP can identify benefits for entire distillation system (columns/HX)**
- **Upgrades can provide targeted solutions for energy reduction**
 - Think beyond in-kind replacement for end-of-life equipment
 - Equipment currently demonstrating seasonal limitations
- **Contact UOP for study requests**
 - TonEng1@Honeywell.com
 - Bob.Miller@Honeywell.com
 - Kevin.Richardson@Honeywell.com
 - Raymond.Tucker@Honeywell.com

Benefits Maximized When Considering Entire Process Unit



**THANK YOU
FOR YOUR
PARTICIPATION**

Q&A



FOLLOW US

<https://www.uop.com/>

Honeywell
Uop

<https://twitter.com/HoneywellUOP>



<https://www.youtube.com/user/Honeywell>



<https://www.linkedin.com/company/uop>



<https://www.accessuop.com/>

