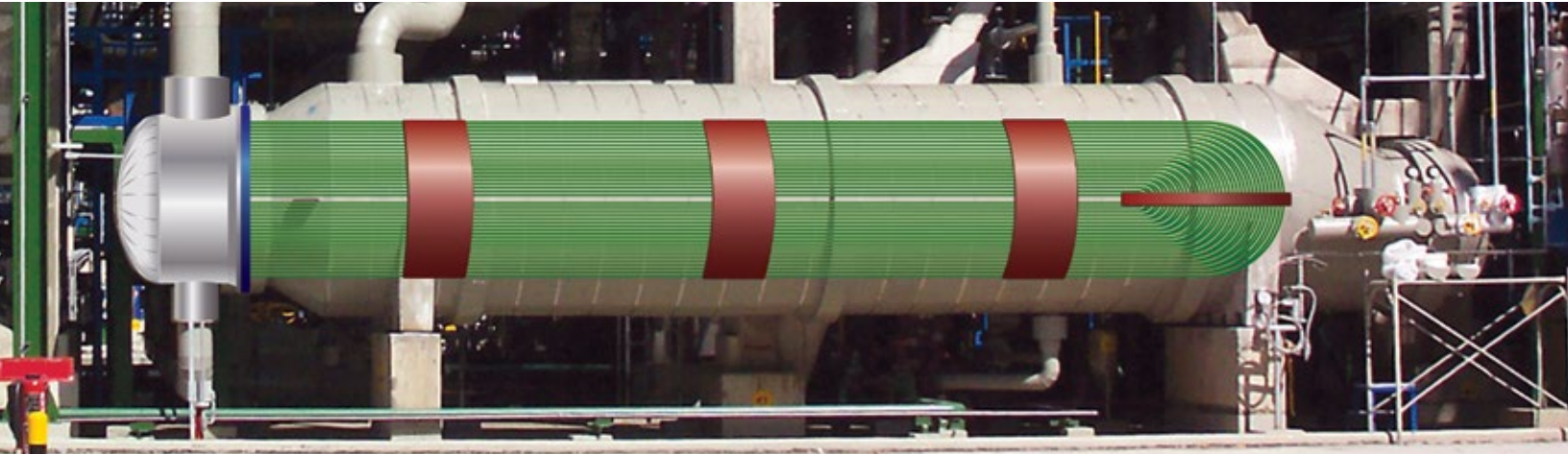


TUBE BUNDLE AND TUBE INSERTS FOR THE STRATCO® CONTACTOR™ REACTOR



OPTIMIZE HEAT TRANSFER DISTRIBUTION AND INCREASE HEAT TRANSFER FOR IMPROVED PERFORMANCE

3/4" TUBE BUNDLE The 3/4" tube bundle was developed in response to a desire to increase Contactor™ capacity by increasing the amount of heat transfer surface area available for a given Contactor™ reactor volume. With up to 40% more surface area, the 3/4" tube bundle design allows the Contactor™ to process as much as 12% more olefin feed at a fixed Contactor™ temperature. No additional olefin feed? Installing a 3/4" tube bundle can also provide benefits such as reduced acid consumption and increased octane while reducing Contactor™ temperature up to 6° F (~3° C) at a fixed olefin feed rate.

TUBE INSERTS When two phase effluent enters the Contactor™ tube bundle channel head, the vapor separates and rises causing the upper tubes to operate hotter due to higher vapor content. The result is reduced heat transfer and higher corrosion rates in those tubes. Tube Insert technology eliminates vapor separation



in the channel head by maintaining back pressure on the effluent, keeping it liquid until it flashes inside the Tube Inserts. With Tube Inserts all of the tubes see the same vapor/liquid mixture resulting in efficient heat transfer and more even corrosion rates across all of the tubes. Tube Inserts can reduce Contactor™ temperatures by 4° F (~2° C) at a fixed olefin feed rate. If additional olefin feed is available, the improved heat transfer will allow up to 7% additional olefin feed to be processed at a given Contactor™ temperature. DuPont has designed the Tube Inserts to provide optimized flow distribution and the resulting benefits in both 1" and 3/4" tube bundles.



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TUBE BUNDLE AND TUBE INSERTS FOR THE STRATCO® CONTACTOR™ REACTOR

TUBE INSERTS BENEFITS

- Reduced tube corrosion since all tubes experience equal flashing and operate at the same temperature
- Increased heat transfer due to even flashing occurring in all tubes, a 15 to 20% U-value increase
- 2 ways to realize heat transfer benefits
 - ▶ Reduce reaction temperature at constant feed
 - (-) 2 to 4° F (~1 to 2° C) decreased reactor temp.
 - Decreased acid consumption
 - Improved alkylate quality
 - Reduced corrosion
 - OR
 - ▶ Increased feed at constant temperature
 - (+) 5 to 7% increase in olefin feed rate

3/4" TUBE BUNDLE BENEFITS

- (+) 35 to 40% surface area vs. 1" bundles
- (+) 5% U-value increase due to increase tube side velocity
- 2 ways to realize heat transfer benefits
 - ▶ Operate with constant feed and reduce reaction temp.
 - (-) 4 to 6° F (~2 to 3° C) decreased reactor temp.
 - Decreased acid consumption
 - Improved alkylate quality
 - Reduced corrosion
 - OR
 - ▶ Increase feed and operate at constant temperature
 - (+) 10 to 12% increase in olefin feed

3/4" TUBE BUNDLE AND TUBE INSERTS BENEFITS

- 35 to 40% U-value tube bundle area increase
- 20%+ heat transfer coefficient increase
- 8 to 12° F (~5 to 7° C) reaction temperature drop at constant olefin rate
- 12 to 15% olefin rate increase at constant reaction temperature
- Reduced corrosion

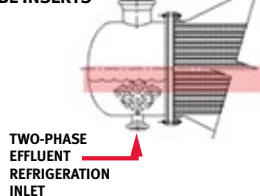
ECONOMIC EVALUATION (3/4" TUBE BUNDLE AND INSERTS)

	Constant Olefin Feed	Increased Olefin Feed
No. of STRATCO® Contactor™ Reactors	6	6
Whole Alkylate, bpsd	19,500	22,300
Delta Reactor Temp, F (C)	-6.5 (-3.6)	0 (0.0)
Octane Improvement, Δ(R+M)/2	+0.3	-0.4
Delta Acid Usage, short ton/day	-28	+34
Total Benefit, US\$/Year	\$2,200,000	\$30,200,000
US\$/Reactor/Year	\$330,000	\$5,000,000

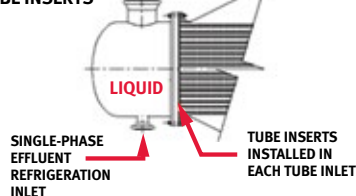
ECONOMIC ASSUMPTIONS

Alkylate Value:	\$1.80 US\$/octane-barrel	(\$ 0.40 in 2012)
Alkylate Margin:	\$80.00 US\$/bbl	(\$15.00 in 2012)
Acid Regeneration Costs:		\$150/short ton (varies)

OPERATION WITHOUT TUBE INSERTS



OPERATION WITH TUBE INSERTS



WORLDWIDE SALES AND SUPPORT

For more information, please contact the following DuPont representative:

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DuPont Sustainable Solutions CLEAN TECHNOLOGIES

STRATCO ALKYLATION TECHNOLOGY

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