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Introduction to

hiTRAN® Thermal Systems

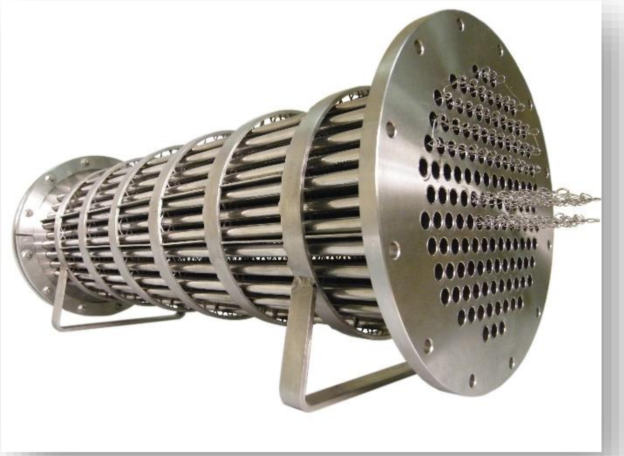
Global Consulting Engineers for Heat Transfer Solutions

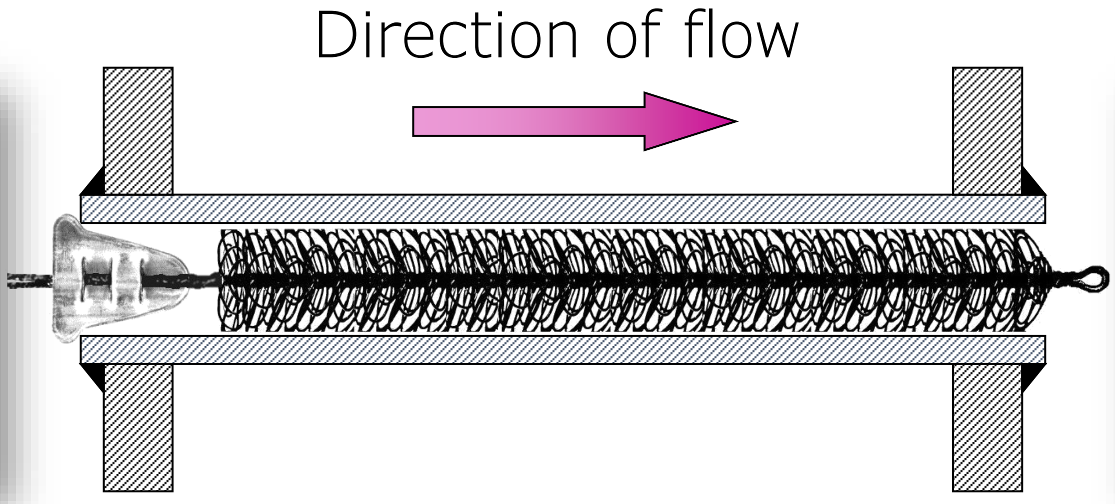
- CALGAVIN established 1980
- Head Office: Alcester, Birmingham, UK
- Manufacturing of technology carried out in UK
- 20000+ Heat exchangers enhanced globally

Extensive Research and Development in Hardware & Software

Work carried out at In-house Test Laboratory collaborating with 10+ Universities across Europe

hiTRAN
THERMAL SYSTEMS





Using hiTRAN®

Optimisation of a Typical Lube Oil Cooler

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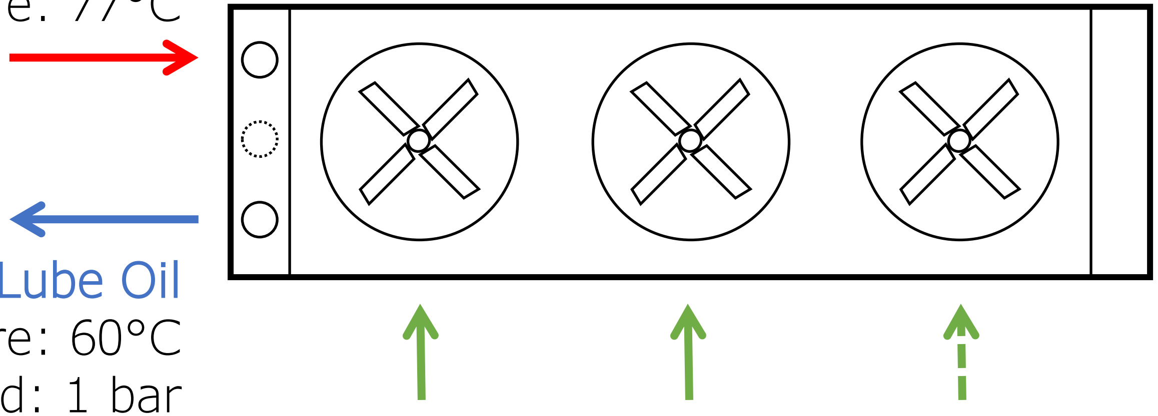
LOC for Propane Compressor Package

Lube Oil (ISO VG 46)
Mass Flow: 5228 kg/hr
Inlet Temperature: 77°C



Lube Oil
Outlet Temperature: 60°C
ΔP Allowed: 1 bar

Airflow:
Ambient temperature: 54.4°C
3 x 50% fans

- ACHE Geometry:
  - 4 rows / 8 pass
  - 1″ Finned Tubes
  - 120 tubes per bundle
  - 12m tube length
- **Objective:** Reduce surface area to achieve same duty

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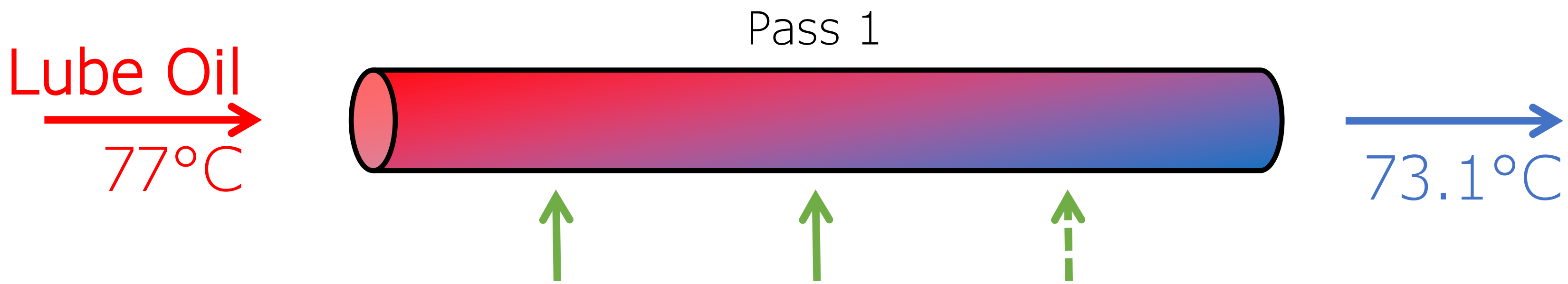
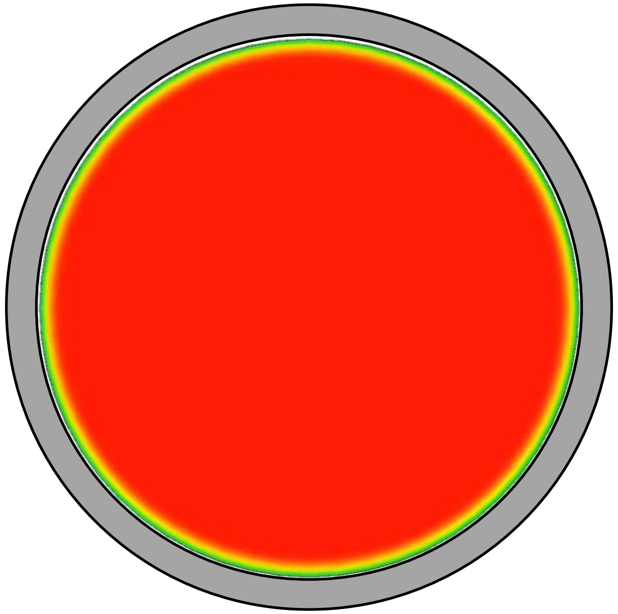
Empty Tube Heat Transfer (Laminar Flow)





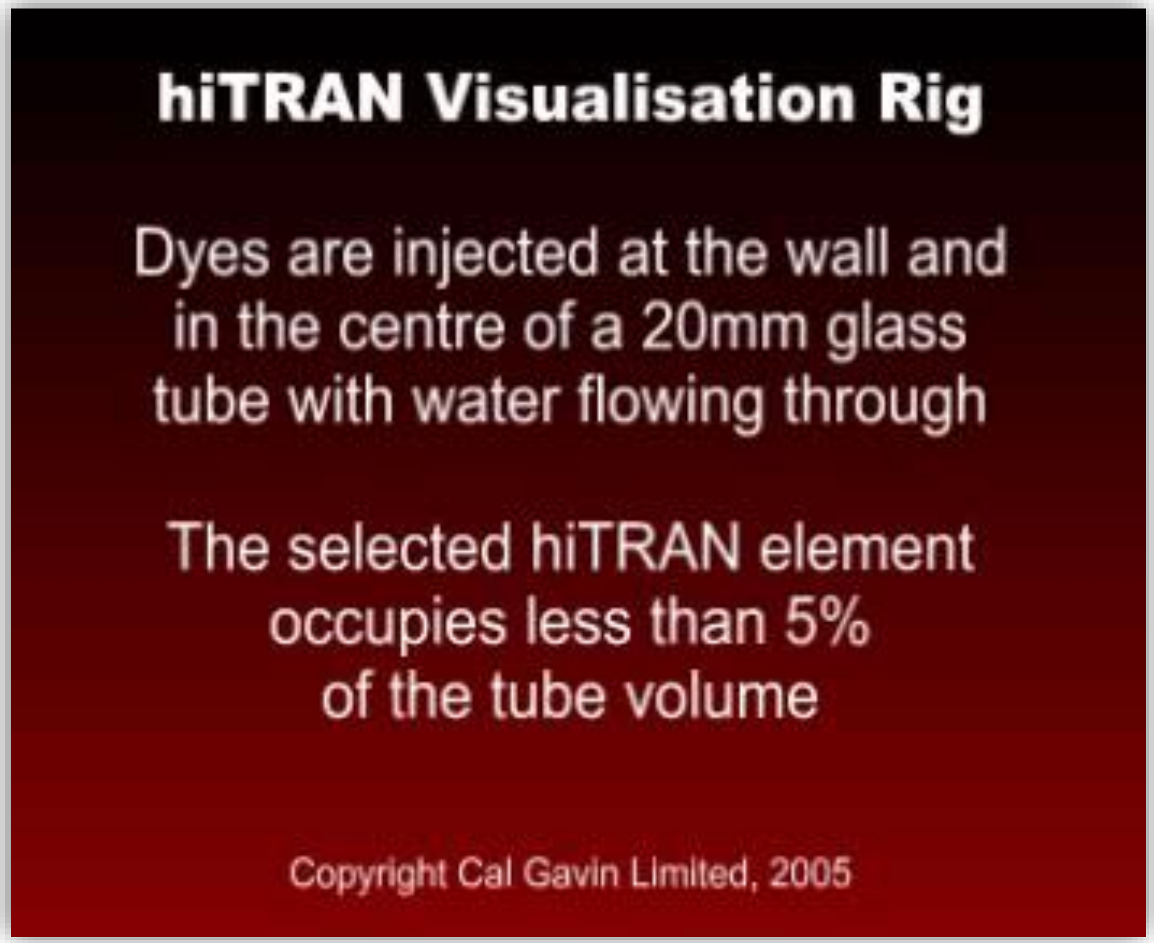
- Low heat transfer coefficient (71 W/m²K)
- Temperature after 1st pass only 73.1°C
  - Need multi-pass, long tube length
- Uneven temperature profile
  - Cold fluid sinks to bottom of tube
  - Central fluid still hot

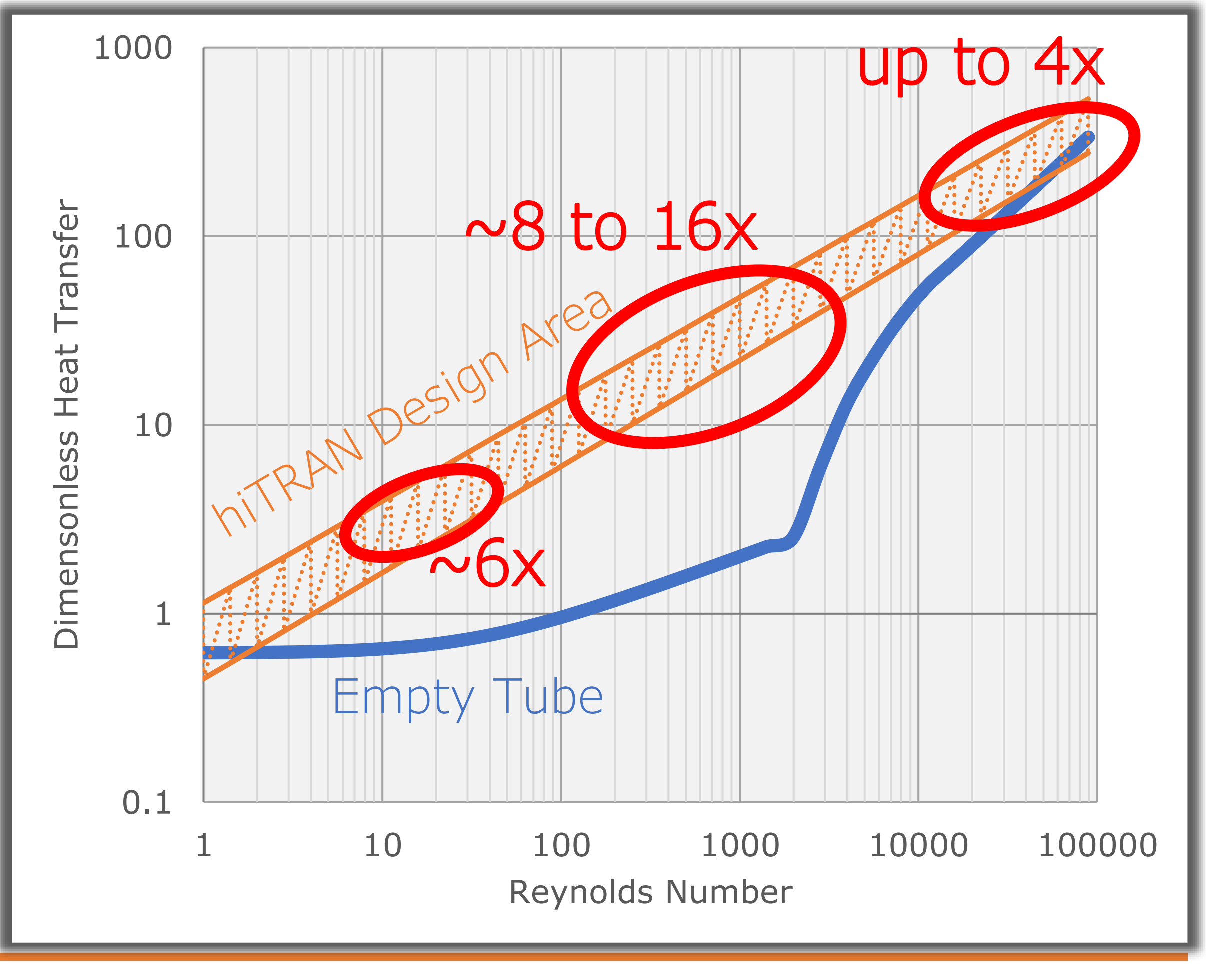
Options to Improve Performance

- More passes / higher velocity
- More surface area
- Higher air flow
- Use tube-side enhancement…

- Exceeds allowable pressure drop
- Insufficient plot space
- Higher CAPEX
- Tube-side is heat transfer controlling
- Noise limits & energy use (OPEX)

hiTRAN® Performance vs. Empty Tubes





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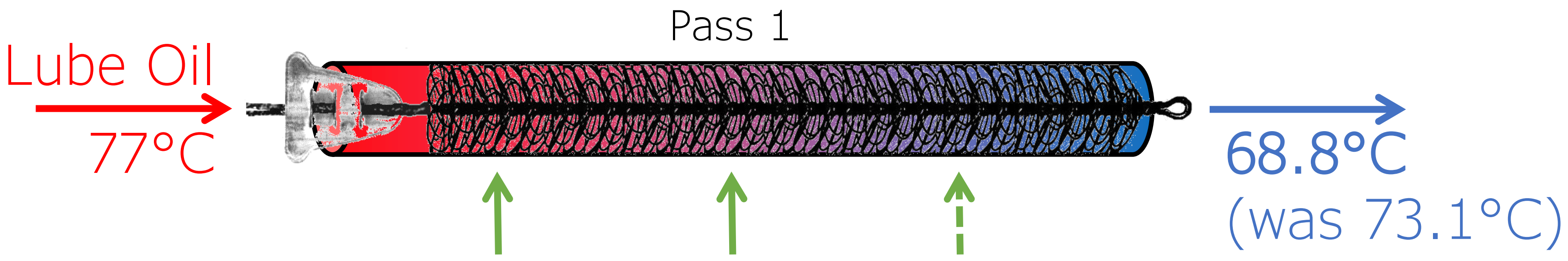
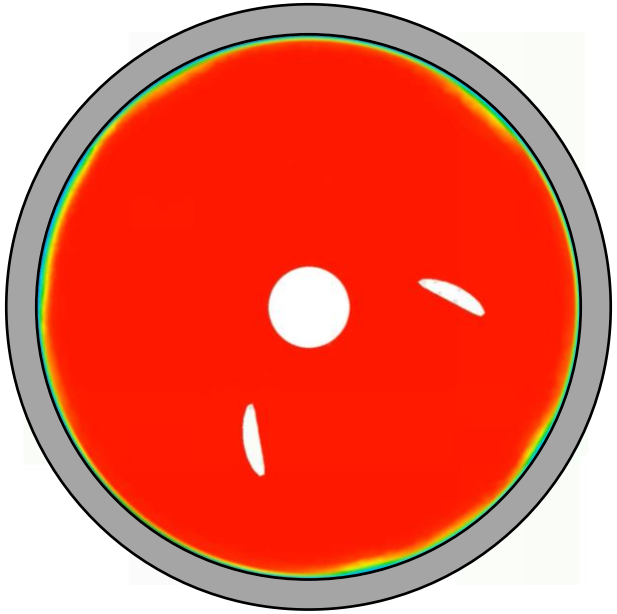
hiTRAN® Tube Heat Transfer





- 11x Improved heat transfer coefficient
- Lower outlet temperature after 1st pass
  - Fewer passes / shorter length needed to reach same final temperature
- More uniform temperature profile

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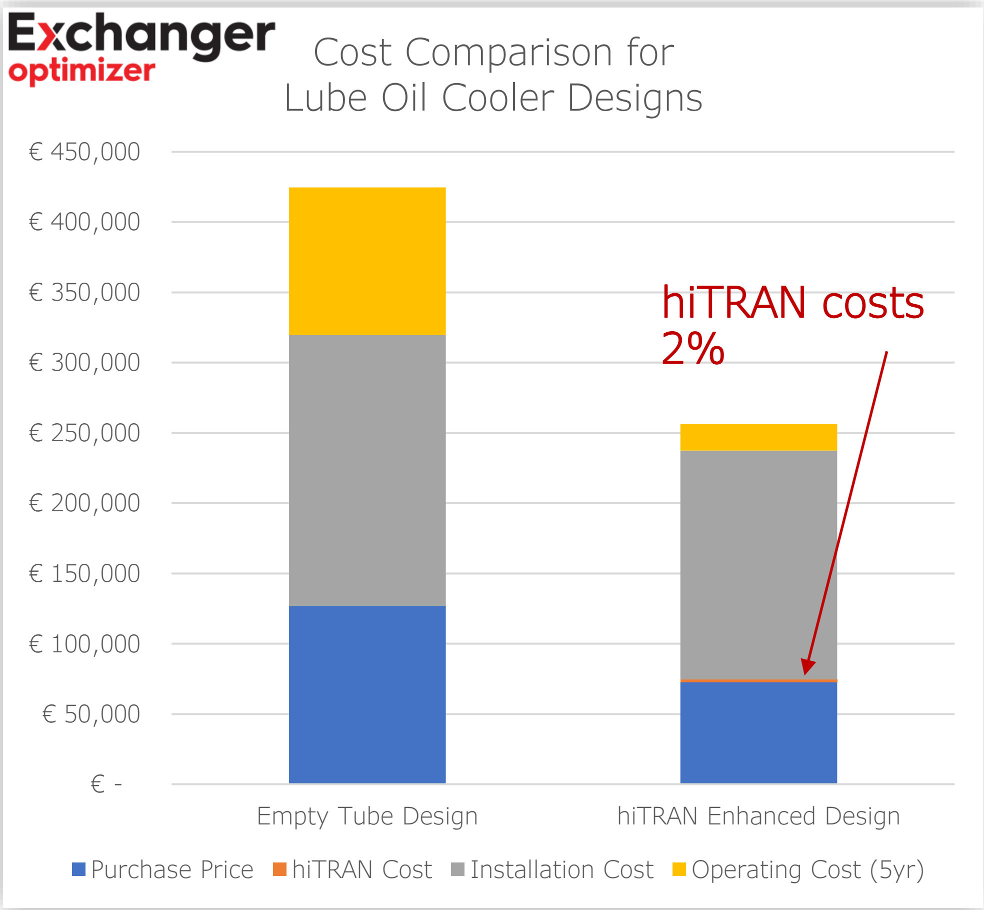
Results after Size Reduction

	Empty Tube Design	hiTRAN Design	Comparison
Process			
Tube side heat transfer [W/m2K]	71	786	+11x
Tube side pressure drop / Allowable [bar]	0.36 / 1	0.92 / 1	+2.55x
Geometry			
No of rows / passes	4 / 8	3 / 3	
Total No of tubes	120	51	-57%
Tube length [m]	12	5.25	-56%
Plot area [m2]	27.2	6.7	**-75%**
Fan Power	31.7	5.6	**-82%**



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Case Study 2

Optimisation of a Heavy Cycle Gas Oil Cooler

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Shell & Tube HCGO Cooler Comparison

Performance Details	Empty Tube	hiTRAN® Design
Shell diameter (mm)	1524	689
Number of tubes	1828	371
Number of tube passes	8	1
Tube length (m)	6.1	6.1
Effective surface area (m^2)	889	180
Estimated Purchase/Installation Cost	$1,072,000	$552,000 (incl. hiTRAN®)

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Case Study 3

Optimisation of an Export Oil Trim Cooler

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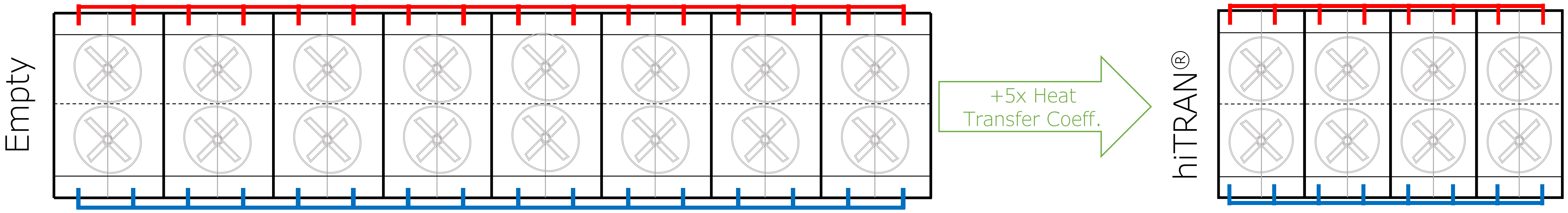
Export Oil Trim Cooler Comparison



Geometry	Empty Tube Design	hiTRAN® Design
Bays in parallel	8	4
Tubes per row / tube rows / No of passes	50 / 12 / 8	43 / 11 / 2
Tube per bundle / Total	600 / 9600	473 / 3784
Plot area (m^2)	712.3	309.7
Fan Power (kW)	271	107
Cost after 10yrs	$3,100,000	$1,200,000 (incl. hiTRAN®)

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Heat Transfer Benefits - New Equipment

Reduced surface area for the same duty

Reduced space requirement

Less weight

Lower energy demand

Lower installation & maintenance costs

Heat Transfer Benefits - Existing Equipment

Overall improvement of existing equipment

Increase in production & reduction in energy use

Maintained performance through mitigation of fouling

Reduction in Operational cost

Low capital cost compared to new equipment

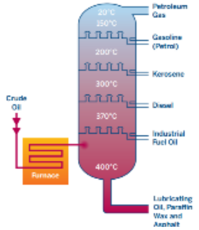
Target Applications for hiTRAN® Technology

Offshore

Wet/Dry Crude Exchangers

Glycol Gas Dehydration

LNG/LPG Vaporisers



Oil Refining

Feed/Effluent Exchangers

Lube Oil Coolers

CDU/VDU Bottoms Coolers

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Target Applications for hiTRAN® Technology

Chemicals

&

Petrochemicals

Reactor Coolers

Condensers

Evaporators

Resin/Polymer Coolers

MDI/TDI

Amide Coolers & Ammonia Vaporisers

SELECTION OF CALGAVIN'S REFERENCES

	O.NO.	ITEM TYPE	APPLICATION DESC.	CUSTOMER BENEFIT	END USER	INSTALL COUNTRY	TUBESIDE FLUID
	5494	Air Cooler	Oil cooler	Reduced Size	SAUDI ARAMCO	Saudi Arabia	Oil
	5495	Air Cooler	Oil cooler	Reduced Size	SAUDI ARAMCO	Saudi Arabia	Oil
	5496	Air Cooler	Oil cooler	Reduced Size	SAUDI ARAMCO	Saudi Arabia	Oil
	5497	Air Cooler	Oil cooler	Reduced Size	SAUDI ARAMCO	Saudi Arabia	Oil
	5498	Air Cooler	Oil cooler	Reduced Size	SAUDI ARAMCO	Saudi Arabia	Oil
	5499	Air Cooler	Oil cooler	Reduced Size	SAUDI ARAMCO	Saudi Arabia	Oil
	5500	Air Cooler	Oil cooler	Reduced Size	SAUDI ARAMCO	Saudi Arabia	Oil
	5501	Air Cooler	Oil cooler	Reduced Size	SAUDI ARAMCO	Saudi Arabia	Oil
	5502	Air Cooler	Oil cooler	Reduced Size	SAUDI ARAMCO	Saudi Arabia	Oil
	5503	Air Cooler	Oil cooler	Reduced Size	SAUDI ARAMCO	Saudi Arabia	Oil
	5504	Air Cooler	Oil cooler	Reduced Size	SAUDI ARAMCO	Saudi Arabia	Oil
	5662	Air Cooler	Lube oil coolers	Reduced Size	KTS	Saudi Arabia	ISO VG46
	5663	Air Cooler	Lube oil coolers	Reduced Size	KTS	Saudi Arabia	ISO VG46
	7851	Air Cooler	Oil cooling	Reduced Size	Baric Systems / Saudi Aramco	Saudi Arabia	ISO VG46
	8179	Air Cooler	Oil cooling	Reduced Size	Baric Systems / Saudi Aramco	Saudi Arabia	ISO VG46
	8571	Shell and Tube	Propylene Vapouriser	Improved Duty	TASNEE	Saudi Arabia	
	8801	Shell and Tube	Propylene Vapouriser	Improved Duty	TASNEE	Saudi Arabia	
	9423	Air Cooler	Lube oil cooler	Reduced Size	SAUDI ARAMCO	Saudi Arabia	ISO VG 46
	9424	Air Cooler	Lube oil cooler	Reduced Size	SAUDI ARAMCO	Saudi Arabia	ISO VG 46
	9482	Air Cooler	Lube oil cooler	Reduced Size	SAUDI ARAMCO	Saudi Arabia	OIL ISO VG 32
	9897	Air Cooler	Oil cooler			Saudi Arabia	Lube oil
	11771	Air Cooler	Lube oil coolers	Reduced Size	Saudi Aramco Oil Company	Saudi Arabia	Lube oil
	11772	Air Cooler	Lube oil coolers	Reduced Size	Saudi Aramco Oil Company	Saudi Arabia	Lube oil
	11773	Air Cooler	Lube oil coolers	Reduced Size	Saudi Aramco Oil Company	Saudi Arabia	Lube oil
	10812	Air Cooler	Lube oil air cooler	Improved Duty	SAUDI ARAMCO	Saudi Arabia	ISO VG 46

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Any questions?

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