Hydroprocessing Reactor Control – Key to Long & Optimized Runs with Advanced Temperature Measurement Systems

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Daily Thermetrics
a division of Daily Instruments Corp.

REFCOMM
GALVESTON
MAY 2-6 2016
A MORE EFFICIENT REACTION...

DECREASES COSTS
INCREASES PROFITABILITY
MAXIMIZES SAFETY

HOW CAN TEMPERATURE MEASUREMENT SYSTEMS HURT OR HELP PERFORMANCE & ROI OF HYDROPROCESSING REACTORS?
WHO IS DAILY THERMETRICS?

Specialists in Process Control Equipment for:

Hydroprocessing Fixed-Bed Reactors
Reforming (CCR, Semi-Continuous Regen, Cyclic Regen)
Hydrogen / Ammonia / Syngas Plants
Ebulating-Bed / Slurry Reactors
Heaters/Furnaces

World Headquarters, Design, Engineering & Manufacturing
Houston, Texas, USA

Established
1973
DAILY THERMERTICS
Product Offerings, Advanced Solutions

REACTOR THERMOMETRY

HEATERS & FURNACES

TUBE SKIN ENGINEERING

Field Engineering Services

Thermowells & Sensors

Vessel Skin Sensors™
GLOBAL EXPERIENCE – CatTracker®

Snapshot as of Sep 2013

Hydrotreating, 47%
Hydrocracking, 32%
Proprietary/Other, 14%
Catalytic Reforming, 6%
SynGas/Hydrogen Production, 1%

Over 700 reactors and 30,000+ sensing points
100+ Hydrocrackers, 300+ Hydrotreaters & 30 CCR/Oleflex

PATENT # US 6,550,963 & 6,599,011 / CANADA 2,449,074 / EU PATENT PENDING
Which **PROCESS LICENSORS** recognize Daily Thermetrics as specialists in reactor thermometry?
IDENTIFYING REACTOR ASSETS
Catalytic Processing Units: Key Investments

WHICH INVESTMENTS REQUIRE ADVANCED MONITORING?
(Concepts we already know.)

VESSEL /
ASSOCIATED COMPONENTS

CATALYST
IDENTIFYING REACTOR ASSETS

Catalyst Investment

CATALYST

REOCCURING INVESTMENT
Significant Consumable Investment

PRODUCTION
Reduce / Increase Production depending on Utilization and Condition
3 Critical Components for HIGH PERFORMANCE Reactors

DAILY THERMETRICS

Sensor Availability
Is there sufficient quantity of sensors to properly troubleshoot, plan, and justify future investment?

Sensor Accuracy
Does the sensor provide the highest level of confidence of the actual reaction temperature?

Sensor Reliability
Does the sensor’s life represent a maintenance cost or a long term investment?

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EVOLUTION: REACTOR THERMOMETRY

MEASUREMENT: **INLET, OUTLET, & WABT**

- Single **INLET** Temperature Measurement
- Single **OUTLET** Temperature Measurement
- **Weighted Average Bed Temperature**
EVOLUTION: REACTOR THERMOMETRY

MEASUREMENT: **INLET, OUTLET, & WABT**

**Weighted Average Bed Temperature**

WABT = **SINGLE VALUE** FOR CATALYST

**CAN NOT EFFECTIVELY DETECT:**

- PROCESS FLOW & CHANNELING ISSUES
- TEMPERATURE EXCURSIONS & HOT SPOTS
- PROCESS MAL-DISTRIBUTION
- DISTRIBUTOR / TRAY FOULING
EVOLUTION: REACTOR THERMOMETRY

MEASUREMENT: **PIPE WELL/THERMOBAR MULTI-POINT**

TEMPERATURE VISIBILITY
at Measurement Elevations
EVOLUTION: REACTOR THERMOMETRY

MEASUREMENT: **RADIAL PROFILING**

**RADIAL TEMPERATURE PROFILING**

Process Licensor Specifications for **NEW** Reactors
EVOLUTION: REACTOR THERMOMETRY

MEASUREMENT: 1st GENERATION RADIAL PROFILING

1st GENERATION FLEXIBLE SENSORS

YEAR 1987: MEETING RADIAL SPECIFICATIONS

Industrial Refinery Thermocouple

IMPROVEMENTS

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1st GENERATION RADIAL PROFILING

TECHNOLOGY LIMITATIONS: SIGNIFICANT HARDWARE

1st GENERATION FLEXIBLE SENSORS

YEAR 1987: MEETING RADIAL SPECIFICATIONS

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EVOLUTION: REACTOR THERMOMETRY
MEASUREMENT: 2nd GENERATION RADIAL PROFILING

LATEST GENERATION FLEXIBLE SENSORS
YEAR 2001: MEETING RADIAL SPECIFICATIONS

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PATENT # 6,550,963 & 6,599,011 / CANADA PATENT # 2449074 & EU PATENT PENDING
2nd GENERATION RADIAL PROFILING
CatTracker® Catalyst Tracking Solutions
Standard CatTracker® Features

1. Ultra High Accuracy™
2. Ultra High Precision™
3. Maintenance-Free, Repair-Free Technology
4. Extended Life
5. Patented, aerospace-derived technology with up to sixteen (16) measurement locations along each sheath/probe
6. Helium Leak Test
7. Certified SIL 3 Capable (Q2 2014)
WHAT IS THE CATTRACKER®?

MEASUREMENT: 2nd GENERATION RADIAL PROFILING

Aerospace Technology

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Number of Tubes Required: 45 Sensing Points

Out -Dated Technology

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1st GENERATION THERMOCOUPLES
LIMITATIONS OF CONVENTIONAL SENSORS

- Short Term Drift
- Knocked Out of Calibration During Manufacturing
- Shortened Life
- Lost Points
- Long Term Drift
- Instability

Temperature °F

Time (Years)
ADVANCED: Thermocouple Moisture

Understanding Thermocouple Performance

Moisture in contact with thermocouple wires and insulation cause:

WIRE CORROSION
Changes in composition of wire metallurgy also changes known voltage

Corroded Type K, E, and J wires do not carry the same temperature gradient/voltage at a given temperature as non-corroded clean thermocouple wire

GHOST JUNCTIONS & SHORTS
Moisture creates resistance drops and if localized, will short out a thermocouple or create multiple low output junctions

Resistance drops, especially between thermocouple wires between designated hot and cold junctions create unintended junctions that disrupt the EMF and output voltage resulting in poor measurement
Introduced in 2012
Ralexian™ Transition Design

• Developed and offered exclusively by Daily Thermetrics
• Moisture-tight Seal
• Multiple Epoxies with different curing temperatures used
• Function tested multiple times to ensure moisture resistance
• Water Submersion Test

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ADVANCED: Thermocouple Moisture

CatTracker® Sets a NEW World Standard

Measuring Moisture in Thermocouples: Insulation Resistance (IR) Test

This test is performed by testing the resistance between any single ungrounded thermocouple wire and the external thermocouple sheath.

- **Industry Standard**: 1 GΩ at 500V at ambient temperature
- **Daily Thermetrics**: 10 GΩ at 500V at ambient temperature

After a water submersion period of 10 minutes is performed:

- Gigaohms at 500V at ambient temperature

**IMPROVEMENTS**

- **AVAILABILITY**: MAXIMIZED
- **ACCURACY**: IMPROVED
- **RELIABILITY**: IMPROVED
CatTracker® = Highest Stability and Extended Sensor Life

CatTracker®

Conventional Thermocouples

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REACTOR THERMOCOUPLES

What’s the importance?

Accurate Measurement allows for Accurate Inlet Temperature Control Decisions

Too Hot
- Coking
- Overproduction of Lights
- Reduced Yield Value
- Exotherms
- Upset Propensity

Optimum Temperature

Too Cold
- Below Optimum Conversion
ULTRA HIGH ACCURACY™
Daily Thermetrics Corporation (EXCLUSIVE OFFERING)

Standard Accuracy
+/- 3.2 °C at 427°C

Special Limits
+/- 1.6°C at 427°C

Daily Thermetrics Accuracy
+/- .80°C at 427°C

Up to 4X MORE ACCURATE than previous generation sensors
ULTRA HIGH PRECISION™

Daily Thermetrics Corporation (EXCLUSIVE OFFERING)

Guarantee: Every sensor in the entire reactor is designed and manufactured to achieve a 1°C maximum delta-T at 427°C

At 427°C:

CatTracker®
SPECIAL LIMITS

+3/4% TOLERANCE

+3/8% TOLERANCE

STANDARD LIMITS

MAX

1°C MAX

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THERMOMETRY

3 Critical Criteria for REACTOR THERMOMETRY

SENSOR AVAILABILITY
Is there sufficient quantity of sensors to properly troubleshoot, plan, and justify future investment?

SENSOR ACCURACY
Does the sensor provide the highest level of confidence of the actual reaction temperature?

SENSOR RELIABILITY
Does the sensor’s life represent a maintenance cost or a long term investment?

2ND GEN. CatTracker® OFFERS:
As many as SIXTEEN TIMES (16X) A More efficient quantity of sensors using the same quantity of equipment as 1ST GENERATION systems.

Up to FOUR TIMES (4X) MORE accurate than standard 1ST GENERATION systems.

REPAIR-FREE, maintenance-free operation backed by an industry-leading warranty (up to 10 years) plus SIL3 Certification in Q2 2014.
Conclusion: Precise Temperature Management

Reactor Thermometry

CatTracker® Offers Process Managers Maximum:

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Which results in:

**INCREASED ROI**

when compared to process units monitored by older systems.