Sustained heat transfer fluid performance

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Heat Transfer Fluids by Eastman

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Why is it important?

Heat transfer fluids (HTFs) are necessary in many processes.

- Over time, fluid can deviate from optimal performance. This can lead to increases in:
  - Energy use/costs
  - Unplanned downtime/maintenance

The Eastman Therminol white paper "***Optimize Heat Transfer Fluid Performance: How to Avoid Costly Consequences***" shares more about how to establish good performance.
(See Therminol.com>Resources>System Maintenance Resources)

- Today's session can help you learn how to:
  - Sustain performance of heat transfer fluids
  - Slow the onset of deterioration effects

3 key threats to heat transfer fluid

- **Changes in fluid quality**
  - ***Composition***: Degradation outpaces fresh fluid addition benefits
  - ***Physical properties***
    - Liquid density
    - Viscosity
    - Heat capacity
    - Thermal conductivity
    - Insoluble solids content
    - Acidity
    - Fire properties
- **Changes in ability to meet process requirements**
  - Revised process conditions, new/modified circuits, or new operating units
- **Changes in heat transfer efficiency**
  - Impacts to heat transfer coefficient and system fouling potential

Understanding potential threats helps when developing a protection strategy against adverse fluid changes.

Fluid quality indicators

Composition

Can deviate by:

- **Oxidation and thermal stresses**
  - Organic acids and solids formation from fluid oxidation
  - Degradation products accumulation from thermal degradation
- **Fluid mixing, venting, replacement, and make-up fluid addition**
  - Changes from published new-fluid properties occur as a result of thermal degradation, venting capability, and fresh make-up fluid addition rates, as well as from contamination events (in-leakage, improper make-up fluid addition).

Identify and establish protection against causes of excessive oxidation and thermal stresses and maintenance impacts to the fluid.

Fluid quality indicators

Physical properties

Can deviate due to:

- **Oxidation**
  - Viscosity
  - Solids
  - Fouling
  - Corrosion
- **Thermal stresses at heat source(s)**
  - Time and temperature dependent
- **Contamination**
  - Process leaks
  - Wrong make-up fluid

Can affect:

- **Viscosities**
  - Low and high temperature
- **Liquid density**
- **Vapor pressure**
- **Boiling point**
- **Pump cavitation risk**
- **Flash point**
  - Lowest temperature at which vapors can ignite in air

Fluid quality indicators

Color

- Some fluid changes from use are apparent but have no direct impact on performance.
- Color is only an indirect indicator of fluid quality.
- Atypical color may be an indicator of:
  - Premature aging or contamination; high moisture content
  - Requires fluid analysis of key parameters to assess
- Dark fluid color can be a normal characteristic based on service conditions.

Odor

- Fluids will have typical odors based on their chemistry.
- Changes can result from stresses and contamination.
- Fluid analysis is required to properly assess fluid quality.

HTF properly matched with needs

Part 1

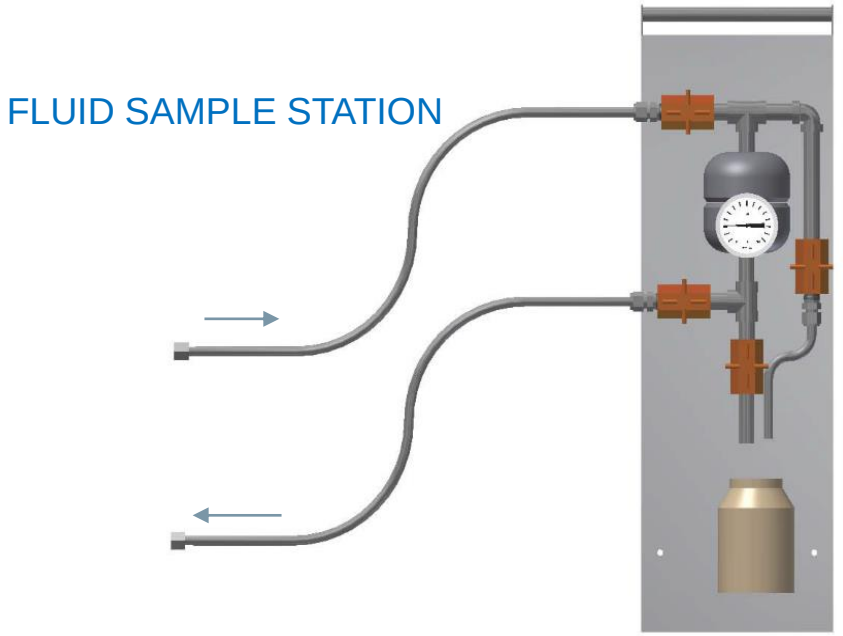
Fluid to meet process heat duty and temperatures

- Sustained performance within design constraints of the system
- Safe, ongoing compatibility
- Meets low- and high-temperature demands

System design to support fluid quality maintenance

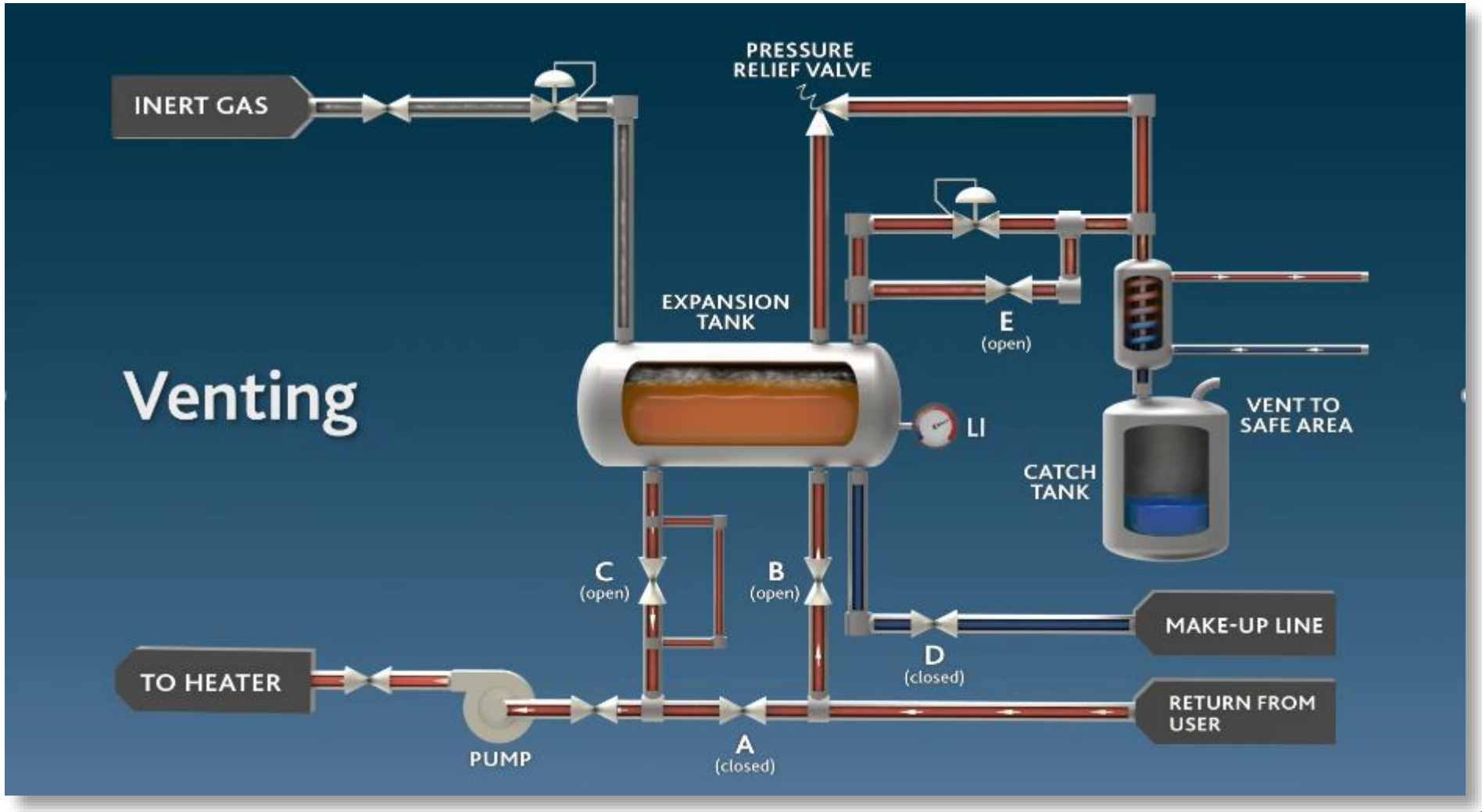
Ability to:

- Remove excess moisture
- Remove low-boiling degradation products
- Add make-up fluid
- Provide for insoluble solids removal
- Protect the fluid from detrimental oxidation



B.O.S.S 1000 Fluid Sampling Station is a trademark of Heat Exchange & Transfer, Inc.

Expansion tank design for fluid management



HTF properly matched with needs

Part 2

- **Proper HTF storage**
  - Bulk—storage vessels protected from oxidation and moisture condensation
  - Drums—store indoors on sides in drum racks, or use drum covers
- **Proper reuse, removal, and disposal**
  - Safely protect fluid handling during system downtimes (e.g., turnarounds).
  - Ability to properly remove and add fluid; complete removal with minimal ‘heel’
  - Comply with jurisdictional requirements for used fluid disposal management.

TYPICAL FLUID DRUMS

BULK STORAGE TANKS

Key threats to HTF performance

Oxidation

- Increases viscosity and acidity
- Use static pad of inert gas for protection.

Thermal stress/degradation

- Time and temperature dependent
- Avoid high-temperature excursions.
- Refer to NFPA 87 Standard for fluid heaters.

Contaminants

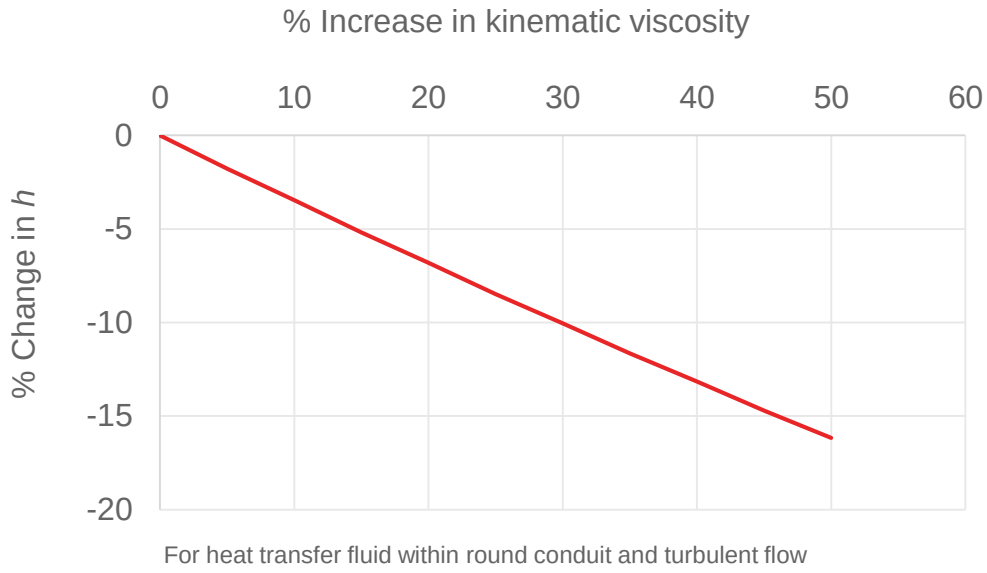
- HTX design (strength-welded tube connections)
- Avoid mixing fluids.
- Do not reuse vent condensate.
- Use correct make-up fluids.

Lack of fluid monitoring

Basic stewardship of HTF includes:

- No/low-cost sample analysis
- Trending of quality parameters
- Establish relationship with the HTF manufacturer's rep and use their expertise.

Change in fluid-side heat transfer coefficient, *h* with viscosity



For heat transfer fluid within round conduit and turbulent flow

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Monitoring of performance

Fluid

- Stable temperatures over time
  - Heater outlet, process users
- Energy efficiency
  - Heater and process users
  - Pressure drop
- Key HTF quality parameters

  Monitor the following with help from fluid manufacturer:
  - Viscosity
  - Acid number
  - Moisture
  - Solids
  - Degradation products
  - Flash point

Process

- Key process indicators
  - Batch times
  - Heat-up times
  - Low-temperature start-up
  - Pressure drops
  - Temperatures at heat exchangers
- Operation symptoms
  - Cavitation
  - Excessive venting
  - Gurgling sounds
- Equipment
  - Corrosion
  - Fluid leakage
  - Pump seal failures
  - Instrument tubing plugging
  - Difficulty starting pumps in low temperatures

Monitoring heat transfer fluid

Sample HTF the first month and annually thereafter.

Monitor key indicators:

- Viscosity
- Acid number
- Moisture
- Solids
- Degradation products

Compare analysis results to normal/expected results.

- On track? Problems?
- Utilize expertise available from the fluid manufacturer

Consider causes of trends and take actions to correct.

- Example #1—A case of no action taken
- Example #2—Proactive response extends fluid life

Monitoring system features*

Examples

Heat sources—heater, WHRU, and electric heater

Monitoring to include:

- % excess air
- Soot/ash
- Pressure drop
- Coil skin temperature
- Burner vibration
- Stack gas temperature
- Flame appearance
- Flow rate each pass
- Coil temperature profile
- Damper positions
- Fire box temperature
- Temperature rise
- Heater skin temperature
- Fuel usage
- MFR** PM*** checks

Inert gas supply—typically nitrogen

Monitoring to include:

- Gas purity
- Valve alignment
- Spare cylinders
- Supply pressure OK
- No constant purge
- Check valve in service
- Regulated pressure OK
- Back-pressure regulator working

Pumps—commonly centrifugal, but can vary

Monitoring to include:

- Vibration
- Shaft alignment
- MFR PM checks
- Seal leakage
- Cavitation
- Spare pump readiness
- Barrier seal pot level/pressure
- Lubrication
- Flow rate stability

* This is not a comprehensive list.
** MFR: manufacturer
*** PM: preventive maintenance

Action plan

- Establish site goal.
  - Implement a plan to expand on the information provided.
  - Make it site specific with exact make/model equipment used.
- Train essential personnel to assume ownership of the monitoring plan.
- Take initial baseline readings.
- Refine plan as needed.
- Encourage action when deviations are observed.
- Report observations, actions taken, and results obtained.

Enjoy the benefits of implementing this routine!

For more information, visit Therminol.com.

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