FUNDAMENTALS OF NATURAL GAS MEASUREMENT

Course Curriculum

1. **Units of Measure**

   Common units of measurement in hydrocarbon fluid quantification

   a. Pressure
   b. Temperature
   c. Volume
   d. Mass
   e. Density
   f. Viscosity
   g. Heating Value

2. **Standard Conditions**

   Common standard conditions of measurement in hydrocarbon fluid quantity and quality determination

   a. Pressure Base (Volumetric)
   b. Pressure Base (Energy)
   c. Temperature Base

3. **Fundamental Gas Laws**

   Fundamental physical laws that define the behavior of gases

   a. Boyle's Law
   b. Charles' Law
   c. Gay-Lussac's Law
   d. Ideal Gas Law
   e. Real Gas Law
   f. Dalton's Law of Partial Pressure
   g. Avogadro's Law

4. **Natural Gas Chemistry and Physical Properties**

   Primary components, properties and quality determination of natural gas compounds

   a. Component of Natural Gas
      i. Hydrocarbons
         1. Methane
         2. Ethane
         3. Propane
         4. Iso Butane
         5. Normal Butane
         6. Iso Pentane
         7. Normal Pentane
         8. Normal Hexane

9. Normal Heptane
10. Normal Octane
11. Normal Nonane
12. Normal Decane

ii. Non Hydrocarbons
1. Nitrogen
2. Carbon Dioxide
3. Oxygen
4. Hydrogen Sulfide
5. Water

b. Quality Determinations from Composition
i. Compositional Determination
1. Chromatography
ii. Quality Determination from Composition
1. Compressibility
2. Heating Value
a. Gross Heating Value
i. Ideal
ii. Real
b. Heating Value Conditions
3. Relative Density
a. Ideal
b. Real
4. Theoretical Liquid Hydrocarbon Content
a. Ideal
b. Real

5. Measurement Elements and Fluid Flow Calculations

Common flow measurement elements and related flow calculations used in natural gas measurement

a. Primary Elements
i. Orifice Meter
ii. Turbine Meter
iii. Ultrasonic Meter
iv. Positive Displacement Meter
v. Coriolis Meter
vi. Other Meter Types
b. Secondary and Tertiary Elements
c. Fluid Flow Calculations

i. Orifice Meter Flow Calculations
ii. Linear Meter Flow Calculations
iii. Volumetric Quantities per Flow Rate Determination

d. Elemental Variance, Error Calculations and Variable Averaging
    i. Elemental Variance Determination
        1. Pressure
            a. Static
            b. Differential
        2. Temperature
        3. Other
    ii. Square Root Error
    iii. Averaging Methods
        1. Root Mean Squared
        2. Flow Weighted
        3. Time Weighted

6. Total Energy Determination

Combining volumetric quantities with physical properties and fluid quality

7. Measurement Ethics

A discussion of critical thinking and practices related to hydrocarbon measurement policies, procedures and circumstantial decision making