

KAM Controls

Karl Fischer for Crude Oil Custody Transfer



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World Oil Economics Quiz

- World's Daily Oil Consumption
 - 75 M bbls
- US Daily Oil Consumption
 - 18 M bbls
- Top Oil Producer in the World (top 3)
 - US (8.2 M), Saudi (7.9), Former USSR (7.7)
- US Daily Oil Imports
 - DUH !!! 10 M
- Average Water Content of Each Oil Transaction
 - Depends on which device used for analysis!!

Karl Fischer

for Crude Oil Custody Transfer

Unique Application Challenges

- **Simplicity** - because measurement technicians wear many hats; device must be easy to use
- **Accuracy** - because \$ are involved with each analysis, accuracy is critical
- **Repeatability** - to satisfy buyer & seller all results must be repeatable

Unique Application Challenges

- Crude Oil - crude's complex chemistry presents a challenge for traditional Karl Fischer moisture analysis
- Non Laboratory Environment - water content determination has traditionally been a non-laboratory procedure
- Buyers & Sellers - Test Results determine Large \$ Transactions, both parties must accept data with minimal challenges!

Karl Fischer

SIMPLICITY

- Crude Oil analysis is typically performed in a non-laboratory environment
- Crude oil techs are typically not “white-coat” chemists (unaccustomed to lab procedure)
- Employee cross training requires Karl Fischer to be easy to operate & easy to understand

Karl Fischer - ACCURACY

- US crude market is \$540 M per day
- World crude market is \$ 2.2 B per day
- \$\$\$ Every crude oil water analysis determines a monetary transaction \$\$\$
- Because money is involved, Karl Fischer for crude oil must be extremely accurate!!!

Karl Fischer

REPEATABILITY

- Every KF transaction involves a buyer & seller
- Each analysis result must repeat to avoid conflict
- To keep both parties happy Crude Oil Karl Fischer analysis must be repeatable.

Reagent

Requirements for Crude Custody Transfer

- Standard KF Reagent
 - Pre-bottled or by recipe
 - **Methanol**: solvent for petrochemical & hydrocarbons
 - **Pyridine**: PH optimizer, reagent stabilizer, prolongs reagent degradation
 - **SO₂**: accepts free O molecules generated in KF reaction
 - **Iodine**: bonds with free H₂ ions from KF reaction
- Crude Reagent
 - **Xylene**: specifically attacks oil-asphalt-water bond in crude,
 - **Methanol**:
 - **Chloroform**: PH optimizer, catalyst for KF reaction
 - **Imidizol**: enhanced PH optimizer & reagent stabilizer
 - **SO₂**:
 - **Iodine**:

Crude Oil Moisture Determination

Traditional Methods Analysis

REPRODUCIBILITY OF ASTM & API STANDARD TEST METHODS FOR WATER DETERMINATION IN CRUDE OIL

<u>TEST METHOD</u>	<u>TEST TIME (minutes)</u>	<u>WATER VOL %</u>	
		<u>0.1%</u>	<u>0.5%</u>
Centrifuge (D-4007)	20	0.20	0.28
Water by Distillation (D-4006)	120	0.11	0.11
Karl Fischer Titration Weight Injection (D-4928)	5	0.02	0.06
Karl Fischer Titration Volume Injection (D-4928)	5	0.02	0.07

Crude Oil Moisture Determination Traditional Methods Analysis

Economic Comparison on 1 M bbl transaction
at \$30 per bbl

<u>Device</u>	<u>Accuracy</u>	<u>Result</u>
Centrifuge	0.20%	+/- \$ 60K
Distillation	0.11%	+/- \$ 30K
Karl Fischer	0.02%	+/- \$ 6K

Karl Fischer for Crude Oil RECAP

- **Simplicity** for ease of use
- **Accuracy** Best Solution for Monetary settlements
- **Repeatability** eliminate conflict for Buyers & Sellers