Determining Water Content of Crude Oils

How its done, what can go wrong.
Introduction

- Overview of the tests methods used for water determination in and factors affecting their precision and accuracy
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Topics of Discussion

- Why is water important:
  1. Money – Water displaces crude which costs money
  2. Processability – Water content can cause difficulties in refining and transportation; corrosion
  3. Environmental – Water must be treated before it can be disposed of
Test Methods for Determining Water

- D 96 - Water and Sediment in Crude Oil by Centrifuge Method (Field Procedure)
- D 4006 - Water in Crude Oil by Distillation
- D 4377 - Water in Crude Oils by Potentiometric Karl Fischer Titration
D96 – Centrifuge Method

- Heated Crude is mixed with solvent (generally water saturated toluene)
- De-emulsifier added if needed
- Crude is centrifuged at 500X gravity
- Amount of sediment and water read at bottom of tube
D 96 – Factors Effecting Precision and Accuracy

- Incomplete Centrifugation
- Improper reading of Results
- Formation of an emulsion (rag) layer
D 4006 – Water by Distillation

- Crude is mixed with water immiscible solvent (xylene)
- The mixture is boiled (refluxed) forcing water and solvent overhead
- Condenser condenses solvent and water into trap
- Trap returns solvent to crude while retaining water
D 4006 Factor which affect precision and accuracy

- Water can adhere to glassware if it’s not cleaned properly
- Incomplete refluxing of crude
- Improper reading of trap
D 4377 – Water by Karl Fischer

- Titration cell solvent is titrated (zeroed) with Karl Fischer (KF) solution
- Sample is injected into cell
- Water in sample reacts with Iodine from KF solution raising cell resistance
- Fresh KF solution is added until original resistance restored
- Amount of KF solution added is directly proportional to water in sample
D 4377 Water by Karl Fischer Apparatus
D 4377 – Factor affecting Karl Fischer Precision and Accuracy

- Strength of KF titrant
- Accuracy of sample weight introduced
- Interferences in crude such as sulfur compounds, metals, and others
- Improper determination of cell equilibrium (Zero)
The Big Problem!!

- Sampling, Sampling, and Sampling
- Water settles out making it hard to obtain samples which are truly representative of the bulk crude
- Water will settle in samples over a very short time making it necessary to homogenize some samples
- Water will form emulsions with crude oil which are very hard to break and can go undetected
Questions?

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