RETORT ANALYSIS

10 ml Size - OFI 165-00 Series
20 ml Size - OFI 165-80 Series
50 ml Size - OFI 165-14 Series

The retort provides a means for separating and measuring the volumes of water, oil and solids contained in a sample of drilling fluid. A known volume of sample is heated to vaporize the liquid components which are then condensed and collected in a graduated cylinder. Liquid volumes are determined from reading the oil and water phases on the graduated cylinder. The total volume of solids, both suspended and dissolved, is obtained by noting the difference of the total sample volume versus the final liquid volume collected. Calculations are necessary to determine the volume of suspended solids since any dissolved solids will be retained in the retort. Relative volumes of low-gravity solids and weight materials may also be calculated.

Equipment:

Sample Cup: Either 10 ml, 20 ml or 50 ml capacity

Condenser: Sufficient mass to cool the water and oil vapors below their vaporization temperature prior to leaving the condenser chamber. Ofite 20ml and 50ml condensers are fitted with the Ultra-Torr connection to prevent stripping of the condenser threads and retard evaporation. Keep the Ultra-Torr o-ring lubricated with a small amount of grease.

Heating Element: Sufficient wattage to raise the temperature of the sample to above its vaporization point within API Specifications, without causing the solids to boil over.

Thermostat: Capable of limiting the temperature of the Retort to 930°F ± 70° F (500 ± 20°C)
OFITE retorts are calibrated to heat a sample between 930° and 1000°F per API specifications. Any manual adjustments made to the thermostat are a safety hazard and will void the factory warranty.

Liquid Receiver: Graduated cylinder or tube, transparent and inert to oil, water or salt solutions and temperatures of up to 90°F (32°C).

Fine Steel Wool: No. 000 Steel Wool. Note: Liquid Steel Wool is not recommended.

Grease: Never-Seez®. Used for a thread seal and lubricant at high temperatures.

T-handle drill: Cleaning Retort Chamber/Condenser passage.

Pipe Cleaner: Cleaning Retort Chamber/Condenser passage.

Spatula: Shaped to fit the inside dimensions of the sample cup.

The following guidelines should be followed to ensure safe operation of retorts.

1. Clean and dry the retort chamber and condenser, especially the inside of the mud sample cup, lid and the condenser passage (spout). Clean the sample cup threads with a wire brush. The spatula, corkscrew tip or a knife may be used to dislodge solids inside the sample cup. The T-handle drill and pipe cleaners should be used to scrape and drill out any residue out of the spout.

Make sure the spout and the hole in the lid of the mud sample chamber is absolutely free of obstructions.

2. The assembly should be cooled to <100°F (37.8°C) from any previous usage.

3. The threads on the retort should be visually inspected before use for any sign of damage.

4. The steel wool should be changed out after every test to prevent solids from building up.

5. Retorts used offshore should be changed out every 6 months for examination and cleaning.

Procedure:

1. Collect a representative sample of drilling fluid and pour it through a Marsh Funnel screen to remove any lost circulation material, large cuttings or debris.

2. Record the sample temperature. It should be within 10°F of the temperature at which mud density was determined.

3. If the sample contains gas or air bubbles, add 2 to 3 drops of a Defoaming Agent to about 300 mLs of mud. Stir slowly for 2 to 3 minutes to release any gasses entrained. Air or gas entrapment will result in erroneously high retort solids content due to the initial reduced liquid sample volume.

4. Pack a wad of no. 000 steel wool into the chamber to approximately 3/16 inch above the threads. As determined from experience, use only enough steel wool to prevent a boiling over of solids into the liquid receiver.

5. Using a clean syringe, fill the retort cup slowly with the non-aerated sample in order to avoid air entrapment. Lightly tap the side of the cup to expel any air and place the lid onto the cup. Rotate the lid to obtain a proper fit and be sure a small excess of fluid flows out the hole in the lid. Wipe any excess mud and clear any solids that may have accumulated in the hole in the lid.

6. Lubricate the threads on the sample cup with a light coat of Never-Seez®. This will prevent vapor loss through the threads and will also facilitate disassembly of the equipment at the end of the test.

7. Carefully hand tighten the Retort cup onto the Retort chamber and connect the assembly to the condenser. For the 20 and 50 ml retorts, carefully insert the retort chamber tube into the Ultra-Torr connection, and hand tighten. For 10 ml retorts, the chamber arm must be threaded into the condenser. Be careful not to over-tighten and strip out the threads in the condenser. Place the chamber into the heating jacket and close the insulating lid.

8. Place a clean dry liquid receiver under the condenser discharge tube. The length of this receiver may require that it be angled out from the Retort or supported off the edge of the worktable.

9. Turn on the Retort and observe the liquid exiting the Condenser. Continue heating for ten minutes beyond the time that no more condensate is being collected. If whole mud boils over into the receiver tube, the test must be rerun. Pack the Retort body with a larger amount of steel wool and rerun the test. Allow it to run a minimum of 45 minutes.

10. Remove the liquid receiver and allow it to cool. Read and record the volumes (or volume percentage) of 1. total liquid volume; 2. oil volume; and 3. water volume, after it has cooled to ambient temperature. If an emulsion interface is present between the oil and water phases, heating the interface may break the emulsion. One way to do this is to remove the retort assembly from the heating jacket by grasping the condenser. Carefully heat the receiver along the emulsion band by gently touching the receiver for short intervals with the hot Retort Chamber. Avoid boiling the liquid. After the emulsion interface is broken, allow the receiver to cool, and read the water volume at the lowest point of the meniscus.

11. Turn off the Retort and allow it to cool prior to cleaning. Do not use cold water to try to rapidly cool down the chamber.

Temperature Controller Instructions - OFI 20 and 50 ml Retorts:

20 ml Retort:
To set the temperature on the OFI 20 ml retort with the electronic temperature controller, press and hold down the "set" button while pressing the up "∧" button or down "∨" button and set to the desired temperature. The temperature range is between 32°F (0°C) and 950°F (509°C) unless otherwise requested at the time of purchase.

50 ml Retort:
To set the temperature on the OFI 50 ml retort with the electronic temperature controller, press the up "∧" button or the down "∨" button. Lubricate the threads on the sample cup with a light coat of Never-Seez®. This will prevent vapor loss through the threads and will also facilitate disassembly of the equipment at the end of the test.

Additional information about the temperature controller is included in the operators manual sent with the retort or may be requested by contacting OFITE's technical division.

Calculations:

The measured volumes (mLs) of oil and water are converted into volume percents based on the volume of whole mud in the retort cup.

$$\textit{Volume Percent (\%) Oil} = V_o = \frac{\textit{100 (Oil volume collected, mLs)}}{\textit{Sample volume, mLs}}$$

$$\textit{Volume Percent (\%) Water} = V_w = \frac{\textit{100 (Water volume collected, mLs)}}{\textit{Sample volume, mLs}}$$

$$\textit{Volume Percent (\%) Solids} = V_s = 100 - (V_o + V_w)$$

Note: The volume percent solids include both suspended solids (weight material, etc.) and dissolved materials (for example salts). This volume percent will represent total suspended solids only if the mud is an untreated, freshwater mud.

To find the volume percent (%) of suspended solids and relate them to the relative volumes of low-gravity solids and weighting materials. In order to make these calculations, an accurate mud weight and Chloride concentration must be known.

$$V_{ss} = V_s - V_w \frac{\text{Chloride Concentration, mg/L}}{1{,}680{,}000 - 1.21\,(C_s)}$$

Where:

V_{ss} = *Volume Percent (%) Suspended Solids*
C_s = *Chloride Concentration, mg/L*

Volume percent (%) Low-Gravity solids, V_{1g}, are calculated as follows:

$$V_{1g} = \frac{1}{P_b - P1_g} [100\,P_f + (P_b - P_f)V_{ss} - 12\,W_m - (P_f - P_o)\,V_o]$$

Where:

V_{1g} = *Volume percent (%) low-gravity solids.*
W_m = *Mud Weight, pounds per gallon*
P_f = *Density of filtrate, grams per cubic meter*
P_b = *Density of weighting material, grams per cubic meter*
P_{1g} = *Density of low gravity solids, grams per cubic meter (use 2.6 if unknown)*
P_o = *Density of oil, grams per cubic meter (use 0.84 if unknown)*

Volume percent (%) weighting material (V_b) is calculated as follows:

$$V_b = V_{ss} - V_{1g}$$

Concentrations of low gravity solids, weighting material and suspended solids may be calculated as:

$$C1_g = 3.49\,(P_{1g}) \times (V_{1g})$$
$$C_b = 3.49\,(P_b) \times (V_g)$$
$$C_{ss} = C_{1g} + C_b$$

Where:

C_{1g} = *Low gravity concentration, pounds per barrel*
C_b = *Weighting material concentration, pounds per barrel*
C_{ss} = *Suspended solids concentration, pounds per barrel*

For more information, please contact us:

ExpotechUSA
10700 Rockley Road
Houston, Texas 77099
USA

281-496-0900 [voice]

281-496-0400 [fax]

E-mail: sales@expotechusa.com

Website: www.ExpotechUSA.com