

### Procedure to determine the amount of Recover required

1. Determine the height (thickness) of the solids at the bottom of the tank (the bottom sludge). You can measure in either feet or meters, using one of the three methods below (a, b, or c):

- (a) **TH (Total Height of the tank) MINUS the MH (Measured Height from the top of the tank with a plumb bob) = height of the bottom sludge.**

Measurements should be taken at various positions around the bottom of the tank, as *solids do not build in a uniform thickness across the bottom of the tank*. An average of all measurements should be used to determine the average height (thickness) of the bottom sludge.

- (b) As an alternative to a plumb bob, an infrared camera may be used to measure the height of the bottom sludge, marking every 4 feet (1.2 meters) around the circumference of the tank. Take the average height of all measurements to determine the average height of the bottom sludge.
- (c) As another alternative, measure the total volume of crude oil in the tank (BBLs) and subtract the amount that must be added to fill the tank to its full capacity. This difference is the volume of the bottom sludge, in BBLs.

2. Calculate the volume of the bottom sludge in the tank using the **Recover – Product Calculator** (you can download this excel workbook template from [ECI's website](#)). This workbook has separate calculations for vertical cylindrical tanks, horizontal cylindrical tanks, and box (square or rectangular) tanks.

- (a) For **vertical** cylindrical type tanks, use the **Cylindrical – Vertical** tab in the Product Calculator. You will need the radius of the tank (1/2 the diameter) and the average height of the bottom sludge (in feet or meters). After selecting the measurement units used, input your measurements in the appropriate fields highlighted in yellow in the workbook. Using this data, the Product Calculator will compute the volume of bottom sludge in the tank (in BBLs).
- (b) For **horizontal** cylindrical type tanks, use the **Cylindrical – Horizontal** tab in the Product Calculator. You will need the radius of the tank (1/2 the diameter), the length of the tank, and the average depth of the bottom sludge (in feet or meters). After selecting the measurement units used, input your measurements in the appropriate fields highlighted in yellow in the workbook. Using this data, the Product Calculator will compute the volume of bottom sludge in the tank (in BBLs).
- (c) For **box (square or rectangular)** tanks, use the **Box** tab in the Product Calculator. You will need the length and width of the tank, and the average height of the bottom sludge (in

feet or meters). After selecting the measurement units used, input your measurements in the appropriate fields highlighted in yellow in the workbook. Using this data, the Product Calculator will compute the volume of bottom sludge in the tank (in BBLs).

3. Determine the density of the bottom sludge using a collected sample, or via a rod insertion test, using the industry standard rating: Hard (hardpan), Firm (milkshake), or Soft (soupy).
4. Select the density of the bottom sludge from the drop-down list in the Product Calculator. Based on the volume (in BBLs) and density of the bottom sludge, the Product Calculator will compute the amount of Recover required to clean your tank.

#### Procedure to recover product from the tank's bottom sludge

1. To facilitate effective mixing of **Recover** with the bottom sludge in the tank, there must be sufficient crude oil in the tank **prior** to the addition of **Recover** (the **Mixing Crude Volume**).

This volume is equal to the **greater of**: (A) two times the height of the bottom sludge in the tank; or (B) the minimum amount of crude oil necessary to cover the tank mixer's impeller. Ideally, the crude oil should be of the same type that was stored in the tank.

- (a) The tank must be drained of all crude oil until only the Mixing Crude Volume remains.
  - (b) Or, if all crude oil has already been removed from the tank, then an amount of crude oil equal to the Mixing Crude Volume must be added **back into the tank** for **Recover** to mix properly with the bottom sludge.
2. Add the amount of required **Recover** into the tank, using the volume calculated by the Product Calculator above.
3. Engage the mixer(s), or the determined mixing apparatus, in the tank and mix the liquid crude oil and Recover three times daily for at least 60 minutes (first, middle, and end of shift). This process should continue for at least two weeks to ensure the bottom sludge dissolves properly.

**NOTE:** The method of mixing and the type of solids to be dissolved will dictate the time and amount of mixing required on a tank-by-tank basis.

4. Test with a sample that the bottom sludge has been completely dissolved. If not, continue the mixing procedure for one more week.

Once the bottom sludge has been completely dissolved, the recovered product may be removed from the tank, or additional product may be added to refill the tank to capacity. Recover is refinable, does not affect the chemistry of the recovered product, and does not need to be separated from the recovered product before refining.

**Note on the amount of Recover necessary for a specific tank**

Four variables determine the length of time and amount of mixing necessary to completely dissolve the bottom sludge in a tank:

1. Amount of (concentration of) **Recover** added into tank;
2. Amount of bottom sludge (based on average height from bottom);
3. Density of bottom sludge (from soupy to hardpan); and
4. Mixing time and frequency (more frequent mixing speeds solubilization).

The more **Recover** used, the faster the bottom sludge will be dissolved. However, this also increases the cost of petroleum recovery. ECI can provide technical advice as necessary to determine the optimal amount of **Recover** to use, and the amount and type of mixing in a specific application. Please contact us if you have any special requirements or questions.