HEAVY OIL SCIENCE CENTRE

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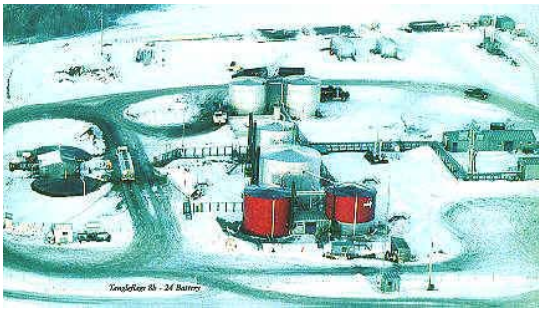
Introduction:

Heavy crude when first produced can have high levels of impurities such as 5+% sand and 30+% water. Before it can go into a pipeline, the total of these two must be reduced below 0.5%. As well, the viscosity must often be decreased so it will flow. The Battery is where the cleaning and "treating" of heavy oil occurs.

Time, heat, and chemical manipulation are the three main factors in the upgrading of heavy crude. Field storage tanks and slop tanks at the battery can provide time for the solids such as sand and clay, and the salt water, to settle out below the oil. To speed and enhance the cleaning, heat is applied and, in some batteries, chemical treatments are applied to break apart the oil and water emulsion. This emulsion is often "tight" especially if the crude has been produced by enhanced recovery techniques such as steam injection or firefloods.



Overview of a Battery

Run you cursor over the illustration and click the various hotspots to link to a description of each part.

While most batteries contain the components described, the layout will vary from battery to battery.

Pressure, too, is used in some batteries; called "pressure treaters", where the oil is subject to about 2.5 times atmospheric pressure. Other batteries do not add pressure and are referred to as "atmospheric treating".

While heating and cleaning can improve viscosity, for heavy oil, condensate may be added to dilute the crude and allow it to flow more readily, and enhance the treating process. Some batteries add the condensate before the "treaters" while many add it at the pumping station where the oil from the sales tanks is injected into a pipeline.

There are a variety of designs and techniques at batteries. It is one of the most active areas of innovation and experimentation in the ongoing challenge to bring heavy oil to market.

The battery is now a fairly common sight in the Lloydminster region and is an important aspect of heavy oil production. Heavy oil at the wellhead is laden with saltwater and solids (including sand), and these must be removed before the oil can be refined. Battery facilities remove these impurities from heavy oil. Since batteries are usually tied into a pipeline gathering system, they have access to a condensate supply. The addition of condensate to raw heavy crude renders it much more treatable and reduces its viscosity so it can be more easily pipelined to market.

Oil is either flowlined or trucked into the battery. Since trucked oil has already spent some time in the wellsite tank, much of the saltwater and solids have settled out. Crude that is flowlined from the well is often more than 50% saltwater.

Components:

Truck Pit

Trucks hauling oil to the battery dump their load into 300+m^3 tanks, called dump tanks, usually buried in-ground. Some dump tanks have a siphon line at the bottom to remove accumulations of saltwater. However, all tanks must be cleaned periodically to remove the solids that have settled out from the raw crude oil.

Truck Pit Transfer Pump

This pump transfers the raw crude oil from the dump tank(s) into the first of two charge tanks located above ground. These tanks are both heated with standard fire tubes so once again some salt water and entrained solids will settle out here. One of the two tanks may be designated a "slop tank" to handle not only raw crude but also "recycled" crude which may have to be run through the system a second time in order to be cleaned sufficiently.

Slop Tank

The slop tank is the primary tank in the charge system of the battery. It receives oil from the truck pit transfer pump and acts as a sediment bowl where more solids are allowed to settle. Saltwater is also siphoned off at the bottom of the tank. Pressure created by the pit pump forces the oil out of the slop tank and into the charge tank. Residual solids from the treaters can be reintroduced here for further treatment, but more often this slop, along with slop that is produced in other areas of the battery, is trucked to a more specialized cleaning facility before it is pumped back into the earth.

Charge Tank

This is the second tank in the battery's charge system and is another step in the progression to clean oil. It provides an additional opportunity for water and solids to separate, and it has a siphon line for water. Pressure supplied by the pit pump provides a head of pressure in the charge tank as well. This is similar to the pressure tank used in a domestic water well system. Both the slop and the charge tanks have level controls and a portion of the tank always contains air. When oil is pumped into the tank the trapped air is compressed providing a relatively constant head of pressure.

Feed / Blend System

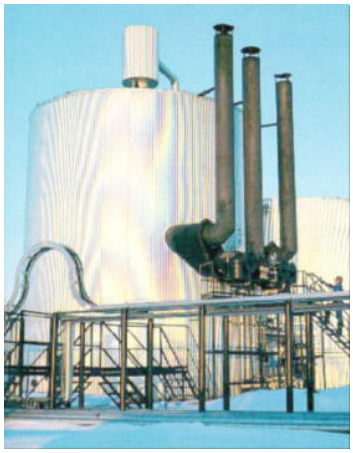
This system contains the pump(s) that charge the treater(s) with raw crude. At this point, additional treating chemicals may be added to the stream, and, if condensate is being injected to enhance treating, it will be added at this point.

Water Pump

Moves water from the truck tank and the tanks in the charge system into the battery water tank. This waste water is commonly injected into a salt water disposal well by an injection pump.

Heat Exchanger(s)

The raw crude being transferred from the charge tanks by the treater charge pump may be routed through a series of heat exchangers which transfer heat from the clean crude oil on its way to the treater. This is an energy conservation measure which reduces the amount of heat that the treater must apply to the raw crude that it is processing.



Header Assembly

The header assembly is a bank of valves which controls the flow of oil from satellite wells (if any), and through the charge system. Product coming in from the wells is often 50+% saltwater.

Treaters

Batteries may employ either "atmospheric treating" (i.e operating at normal atmospheric pressure) or "pressure treating" systems (operating at about 2.5 times atmospheric pressure). Newer batteries are essentially a combination of both systems. The internals of pressure treaters in use today are a far cry from the original treaters developed to clean light gravity crude.

Twin Horizontal Treaters at the Marshall Battery near Lloydminster

Horizontal treaters in our batteries today are often massive vessels with large fire tubes in both ends. Oil from the charge pump is routed the length of the treater through a series of screens and baffles while high temperatures (93°C) are developed by the natural gas fired fire tubes. Gas is vented off the top of the treater by a control system. Clean oil is drawn off at mid-levels and the sand and water are removed from the bottom of the treater. Water is drawn off easily but sand must be removed through a desanding process which is carried out a couple of times a day. The salt water is transferred to the water tank. The hot, clean crude oil proceeds through the heat exchanger and then on to the sales tanks.

Water Tank

A battery can produce high volumes of saltwater a day. Saltwater is removed at all stages of the process and must be stored before it is injected into a salt water disposal well. The water tank also has a skimmer to remove any residual oil that floats to the top.

Sales Tanks

These are tanks where the treated oil is stored, ready to move on to the refinery or upgrader. Usually, it is pumped into a pipeline at this point but it can also be trucked. The term "sales tank" derives from the fact that it is often at this point that crude oil is sold by the producer to the refiner or other agent.

Natural Gas System


Clean oil sales tanks at Tanglefl ags 88-24 battery

Natural gas is brought in to fire the treaters. Gas pressure is controlled by a series of pressure control valves. The system is also designed to remove the gas that is separated out of the oil. A vent system removes escaping gas from the treater and also handles any gas that is vented from the fuel system's pressure control valves.