Oil Sands Discovery Centre

Fact Sheet

Alberta

SURFACE MINING: EXTRACTION

HISTORY

G.C. Hoffman of the Geological Survey of Canada first attempted the separation of bitumen from oil sand with the use of water in 1883. In 1915, Sidney Ells of the Federal Mines Branch began to study oil sands separation techniques and used the bitumen to pave 600 feet of road in Edmonton, AB that lasted for 50 years. Dr. Karl Clark of the Alberta Research Council, after extensive experimentation, was granted a patent for the hot water extraction process in 1928. The present extraction process is still very much based on the methods used decades ago.

CONDITIONING

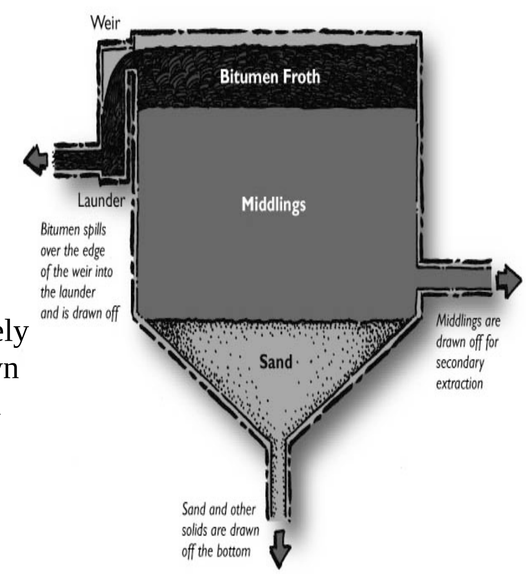
The first step in separating bitumen from sand is conditioning. In this step, any large lumps of oil sand are broken up and coarse material is removed. The oil sand is then mixed with water. One of the earlier methods to condition oil sand was to mix it with hot water in huge tumblers or conditioning drums. This mixture of water and oil sand is called a **slurry**. The tumblers introduced air into the slurry and screened it to remove coarse material. A newer approach eliminates tumblers or conditioning drums altogether. After the oil sand is crushed at the mine site, it is mixed with warm water and then moved by pipeline to the extraction plant. The piping system is called **hydrotranspor**t, this is one of the most exciting new developments in oil sands processing.

Hydrotransport is cost effective and efficient. It replaces the old conveyor system between the mine and the extraction plant. It basically combines two steps into one. It conditions the oil sand while moving it to extraction. The water used for hydrotransport is cooler than in the tumblers or conditioning drums, further reducing energy costs.

Conditioning by either method is an important step that launches complex physical and chemical changes. It starts the separation of the bitumen from the sand by breaking the bonds that hold the bitumen, water and sand together.

SEPARATION

The blended slurry is fed into **a Primary Separation Vessel** (PSV) where it is allowed to settle into three layers. Additional hot water is added as the slurry arrives which allows separation to take place rapidly. Impure bitumen froth floats on top, sand sinks to the bottom and a combination of bitumen, sand, clay and water sits in the middle (known as middlings). The settling and separation takes approximately 20 minutes. The PSV has a rake at the bottom that pulls the sand down and speeds up the separation. The sand, mixed with water, is pumped into settling basins called **tailings ponds**.



EXTRACTION, Continued:

SECONDARY SEPARATION

The **middling**s is a suspended mixture of clay, sand, water and some bitumen. The middlings go through a process called secondary separation. There are different methods, but basically it involves injecting air into the middlings in flotation tanks. This added air encourages the creation of additional bitumen froth. The intent is to recover a further 2 – 4% of bitumen. Bitumen from the secondary recovery system is recycled back to the primary system. Steam is used to heat the froth (to approximately 80°C) and remove excess air bubbles, in a vessel called a **de-aerator**. Air must be removed, to allow pumps to operate efficiently (Aerated froth causes cavitation which could destroy the pump).

FROTH TREATMENT

Bitumen froth is far from pure, it contains, on average, about 30% water and 10 % solids (mainly clays) by weight. De-aerated bitumen froth from the extraction area is now cleaned of solids and water in the froth treatment plant or **counter-current decantation vessels** (Albian Sands).

At the froth treatment plant the bitumen is diluted with naphtha, to make it flow easily and then goes through a combination of **Inclined Plate Settlers** (IPS), and **Centrifuges**. Inclined plate settlers allow for particles to settle efficiently under gravity, in a relatively small vessel by increasing settling area with inclined plates. A centrifuge uses centrifugal force to spin heavier materials outward. There are two types of centrifuge in operation in froth treatment:

- The scroll centrifuge is used to spin out coarser particles, and relies on an auger like action to convey solids out of the machine

- The disc centrifuge is used to remove the finer material, including very small water droplets. The disc centrifuge works like a spin cycle on a washing machine and spins the remaining solids and water outward. This stream is collected as tailings

Centrifuges may eventually be phased out, as IPS separation is advancing considerably.

The clean diluted bitumen product is now dry (less than 5% water) and with only small amount of solids (0.5% mineral). This completes the extraction process. This hot water extraction process recovers over 91% of the bitumen contained in the oil sand feed. The bitumen is now ready to be upgraded into synthetic crude oil.

Froth treatment tailings have trace amounts of naphtha, which is recovered in a stream-stripping column called a **NRU** (naphtha recovery unit), before the tailings are discharged to the tailings ponds.

The counter-current decantation vessels at Albian Sands mix solvent with the bitumen feed. Water, solids and some ashpaltenes (heaviest component of bitumen) are removed. The end result is a clean diluted bitumen called **Dilbit**. The Dilbit is sent down the Corridor pipeline to the Scotford Upgrader where the bitumen is processed further.