TDI Technology Inc.

1 May 2009

Mr. Eduardo Gonzalez
President
VARY Petrochem LLC
11103 Memphis Ave.
Brooklyn, OH
USA 44144

Re: TDI Technical Evaluation

Dear Mr. Gonzalez:

TDI is pleased to submit our technical evaluation of the piloting of VARY Petrochem's bitumen extraction process, as applied to Athabasca oil sands.

The application of high shear in the presence of VARY's proprietary "chemistry" has resulted in an outstanding pilot plant performance. TDI considers the VARY process to offer significant advantages when compared to the conventional hot water process, which is the basis of the current commercial facilities in the Athabasca region. These advantages are enhanced bitumen recovery, recovered bitumen quality adequate for direct feed to the upgrader, no froth is produced, and, therefore, no diluents are required, and the fines free middlings are suitable for immediate and continuous recycle.

The environmental qualities of the process merit special mention. Coarse and fine solids tailings are suitable for direct disposal back into the open pit mine. The small amount of liquid trapped in the solid tailings is the only liquid effluent and it is environmentally benign. As no diluents are used in the process, none are discharged into the environment.

TDI urges VARY to pursue the next stage of development as they have the potential to make a significant contribution to the oil sands industry. We are grateful for your trust and opportunity to work together.

Yours truly,

E. St. Denis

Earl St.Denis, Ph.D, P.Eng.
Vice President

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E-mail: PearseW@shaw.ca

A TECHNICAL EVALUATION

OF

VARY PETROCHEM’S

PILOT PLANT OPERATION

FOR

THE RECOVERY OF BITUMEN

FROM

ATHABASCA OIL SANDS

PREPARED FOR

VARY PETROCHEM LLC

BY

TDI TECHNOLOGY INC

EDMONTON, ALBERTA, CANADA

April 2009

SUMMARY

In the spring of 2003, Vito Altavilla and Robert Yeggy (VARY) began research into a novel process for the extraction of bitumen from the Utah oil sands, as none of the existing processes performed adequately well. About a year and a half later, they had developed CAC–24 or "chemistry," a proprietary aqueous formulation, which when mixed with oil sands in concert with high shear separates the bitumen from the solids without the formation of intractable emulsions. The process also prevents the re-association of the bitumen and solids. In bench scale trials, bitumen recovery was 99 +%. Also, the recovered bitumen contained less than 1% solids and water, while the middlings, composed of solids free chemistry, was fully recyclable. The inventors knew that they had made a significant discovery but required funding and business leadership.

Mr. Eduardo Gonzalez, President and owner of Ferragon Corporation, was approached by Altavilla and Yeggy to invest in the technology and bring his business acumen to the development program. VARY Petrochem LLC was incorporated in 2006 with Mr. Gonzalez as President.

A one ton per hour pilot plant was constructed on the Ferragon site in Cleveland, Ohio, USA. Preliminary test work, using Utah oil sands, confirmed the excellent results obtained in the bench scale trials. The properties of the solid tailings provided an added bonus when it was discovered that they were stackable when drained of chemistry, allowing immediate disposal back into the open pit mine. In addition, the EPA and two EPA approved laboratories confirmed the tailings provided no environmental threat.

In 2008, VARY switched their focus to oil sands from the Athabasca region of Alberta Canada. Preliminary bench-scale testing of the Alberta material mimicked the positive Utah results and encouraged VARY to pilot the process using the Canadian material.

TDI Technology of Edmonton, Alberta, Canada (Appendix F) was retained in late 2008 to attend the piloting trials of the Athabasca oil sands and provide VARY with a technical evaluation of their process claims, specifically:

- Bitumen recovery in excess of 99% through the entire process
- Recovered bitumen contains less than 0.25% water and less than 0.25% solids
- <u>NO</u> diluents are used anywhere in the process
- All of the middlings are continuously recyclable to the process
- The chemistry, as well as the dry stackable tailings produced by the process, are environmentally compliant with applicable Ohio (USA) EPA regulations

- Fines settle quickly and are easily captured, along with the coarse solids, forming dry stackable tailings
- Chemistry losses from the process are economically acceptable

The VARY pilot plant successfully processed 5608 # of Athabasca oil sands on February 3, 2009 and recovered 503# of high quality bitumen.

Based upon the successful pilot plant trial, TDI was able to conclude the following:

Bitumen Recovery Bitumen recovery exceeded 99 %.

Bitumen Quality The recovered bitumen contained less than 0.1% solids and water.

Middlings Quality The fines free middlings are suitable for recycle after a short settling time.

Tailings Quality The dry stackable solid tailings, including fines, are virtually free of bitumen and suitable for direct disposal back in the open pit mine. There is little or no liquid tailings as the middlings are free of solids and are continuously recycled directly back into the process.

Evaporative Losses About 291 USG of water was evaporated during the collection of 503 # of bitumen. Evaporative water loss will be dramatically reduced in a commercial plant through conventional engineering practice

Recovery of Chemistry It is believed that CAC–24 losses can be reduced to the equivalent of 0.02 USG of chemistry per USG of recovered bitumen if the solid tailings are filtered and washed.

Environmental Impact The solid tailings are free of bitumen and suitable for direct disposal back into the open pit mine. A small amount of chemistry is retained in the solids tailings. The EPA and two independent EPA approved laboratories have, however, determined that the tailings are benign and offer no environmental threat. In addition, since no diluents are used anywhere in the process, they will not appear in the liquid or solid effluent.

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1. INTRODUCTION

1.1. Development of the VARY Chemistry

In the spring of 2003, Vito Altavilla and Robert Yeggy (VARY) became interested in the recovery of bitumen from the Utah oil sands deposits. They were aware of the failure of the conventional Clark hot water process and other technologies to provide satisfactory results in Utah. During their early test work, they concluded that substantially more shear was required to provide acceptable recovery of bitumen using the hot water process. They also recognized that high shear leads to intractable oil and water emulsions as well as excessive entrainment of solids and water in the product bitumen. Both inventors wished to avoid the use of diluents, as practiced in the current hot water process, to treat the froth in order to clean up the bitumen. At this early point in their work, they abandoned the conventional hot water approach and switched their focus to the prevention of emulsion formation and solids entrainment in the product bitumen following a high shear separation process.

Altavilla and Yeggy drew upon their diverse chemistry backgrounds in formulating a number of chemical mixtures to prevent the reassociation of the bitumen, solids, and water after separation in a high shear field. Bench scale testing of Utah oil sands, using a high speed disperser, began in earnest in the fall of 2003. By the fall of 2004, Altavilla and Yeggy had developed a proprietary aqueous chemical formulation, CAC-24 (carbonaceous agglomeration chemistry) or “chemistry,” which permits the oil sand slurry to be subjected to high shear prior to the separation of bitumen without the formation of intractable emulsions or reassociation of the bitumen, solids, and water. Further, the chemistry promotes the rapid settling of the fines out of the middlings layer, which presents the current operators of the hot water process a major disposal problem in their tailings ponds. No froth is produced in the process, which eliminates the need for diluents. The chemistry is not a solvent or surface active agent, is non reactive, non-toxic, and contains no VOC’s. The chemistry has a specific gravity of 1.01 to 1.04 allowing the separated bitumen to float on the surface. Since some chemistry exits the process with the solid tailings, it is paramount to ensure that it is environmentally benign. Independent laboratories (see Appendices B, D, &E) have confirmed that the chemistry is benign and safe to dispose of into the city sewage system or residential landfill, critical to an environmentally acceptable process. Furthermore, bitumen recovery of 99.75% was realized through to the end of the process. The middlings were clear after 20 minutes of settling, thereby permitting immediate recycle of the aqueous chemistry. A larger scale test was conducted in a 55 USG drum and yielded similar results.

1.2. VARY Petrochem LLC

Mr. Eduardo Gonzalez, President and owner of Ferragon Corporation, was approached by Altavilla and Yeggy to invest in the technology and bring his business acumen to the development program. On November 8, 2006, VARY Petrochem LLC was incorporated with Mr. Gonzalez as President. Operations were moved from Cincinnati to Ferragon's facilities in Cleveland, where ample space, skilled personnel, and infrastructure are available for construction and operation of a pilot facility.

1.3. Pilot Plant

On 13 June 2007, a one ton per hour (oil sand feed basis) pilot facility was commissioned and began testing with Utah oil sands. A full description of the pilot facility follows in the "Process Description." A number of equipment modifications were made to enhance the operation. About 20 runs were made with typical results achieving a bitumen recovery of 99.75%. The recovered bitumen contained less than 0.5% solids and less than 0.5 % water. The recirculated middlings or chemistry was largely free of fines and the drained tailings, containing coarse and fine solids, were adequately dry and stackable.

1.4. Athabasca Oil Sands

In October 2008, VARY took a strategic change of direction and shifted their interests to the Canadian oil sands from the Athabasca region of Alberta. To this end, two truckloads of oil sand were received at VARY's Cleveland pilot plant. Preliminary bench scale tests were successful with typical results achieving a bitumen recovery of 99.75% and the recovered bitumen containing less than 0.25% solids and less than 0.25% water. The Canadian oil sands contained a higher percentage of bitumen and were easier to process than those from Utah.

1.5. Summary of VARY's Preliminary Results

Results to date from the bench scale and pilot testing of Utah oil sands and bench scale work with Athabasca oil sands leads VARY to make the following claims:

- Bitumen recovery through the entire process is in excess of 99%
- Recovered bitumen from the Athabasca oil sands contains less than 0.25% water and less than 0.25% solids, with comparable figures from the Utah material to be 0.5% and 0.5% respectively
- Fines settle quickly and are captured in the coarse solid tailings
- The chemistry can be immediately and continuously recycled
- Solid tailings are suitable for dry stacking
- Contaminated tailings, as produced in the Clark hot water process, have been eliminated

- All solid and liquid tailings discharges from the process have been certified to be environmentally compliant with applicable Ohio EPA regulations (Appendices B, D, & E).
- No froth, in the conventional understanding, is produced and no diluents are required anywhere in the process

VARY has applied for a number of patents to protect their intellectual property. The patents cover the formulation of the chemistry, process configuration, and specialized equipment.

1.6. Objectives

The objective of the this work is to demonstrate the efficacy of the process in the pilot plant using Athabasca oil sands operated for sufficient time to achieve steady state.

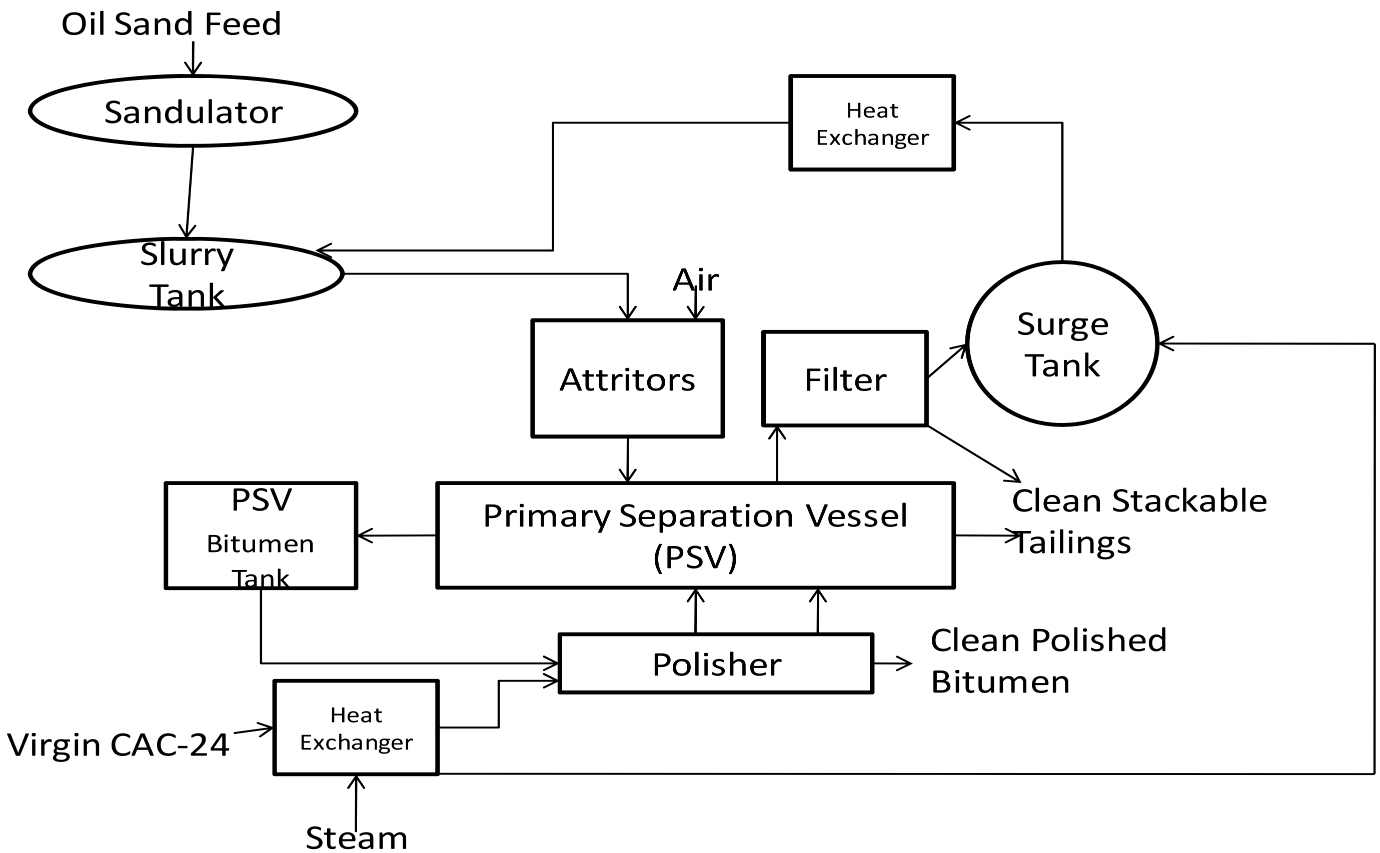
2. PROCESS DESCRIPTION

2.1. Overview

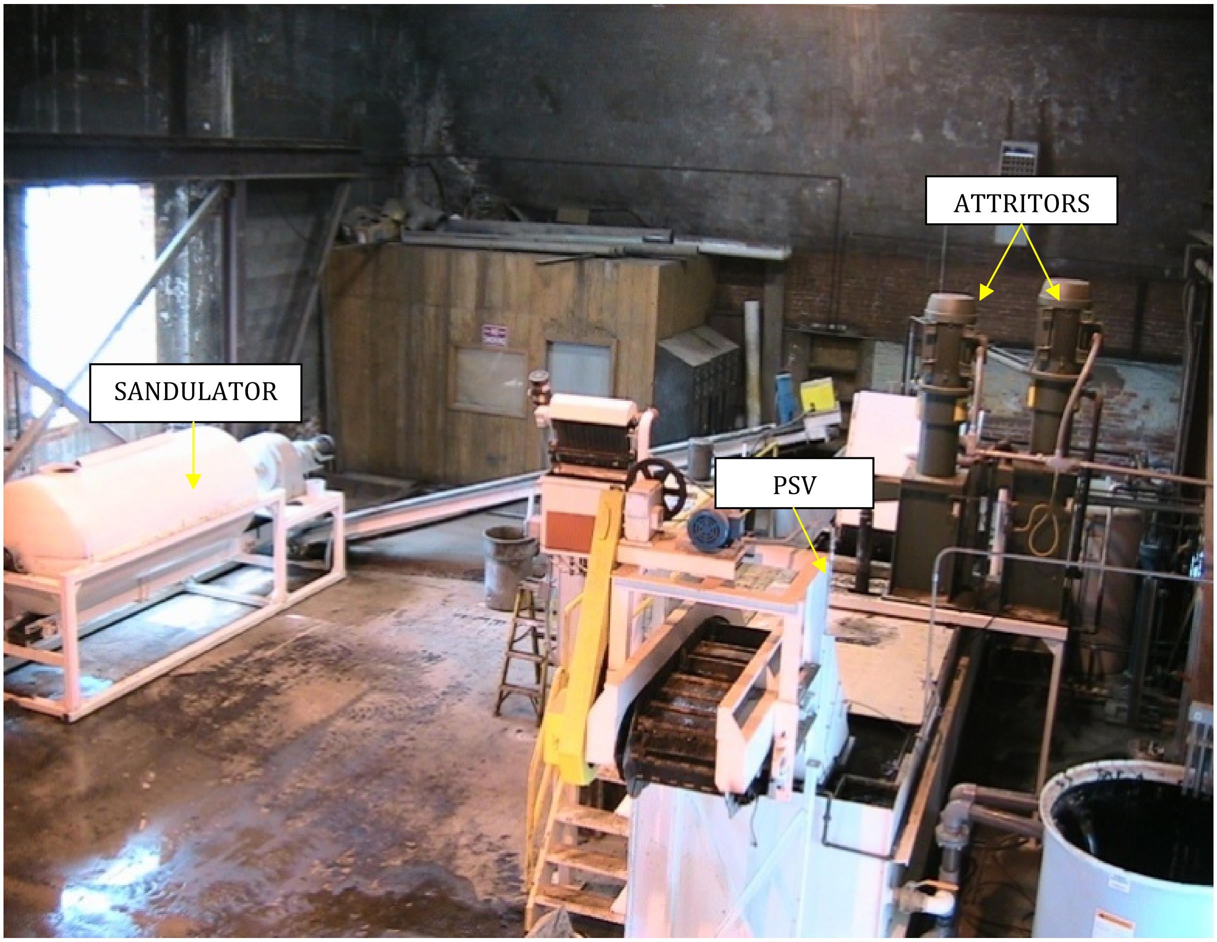
At the heart of the novel VARY process technology is the chemistry, CAC-24, which permits unprecedented recovery of high quality bitumen and elimination of fines from the middlings following exposure of the oil sands slurry to a high shear field. A pilot plant was constructed at VARY's Cleveland site to demonstrate the process on a continuous basis. The process flow diagram, shown on the following page, depicts the configuration of the process and material flows.

Oil sands are fed to the slurry tank where they are mixed with hot (135 -155 ^{o}F) recirculated chemistry. The slurry is pumped to the attritors, where it is subjected to very high shear. The slurry then flows into the primary separation vessel (PSV). The circuit is maintained at approximately 145 ^{o}F with the pH controlled between 7.4 and 7.9. Specific gravity and conductivity are both used to control the concentration of chemistry and pH. Discharge from the attritors flows into the PSV, where it settles into three layers; bitumen, middlings (chemistry), and solids. Recovered bitumen can be further cleaned in a polishing step to eliminate almost all of the aqueous phase and trace fines. The polisher consists of two operations, an initial high shear field followed by a settling vessel, much like the attritor and PSV, only much smaller. Middlings or chemistry from the PSV flows to a surge tank where it is filtered and recirculated through a heat exchanger to maintain the circuit temperature. Hot chemistry then flows back to the slurry tank for immediate reuse. Solids are permitted to accumulate in the PSV, then removed, and weighed after completion of the run.

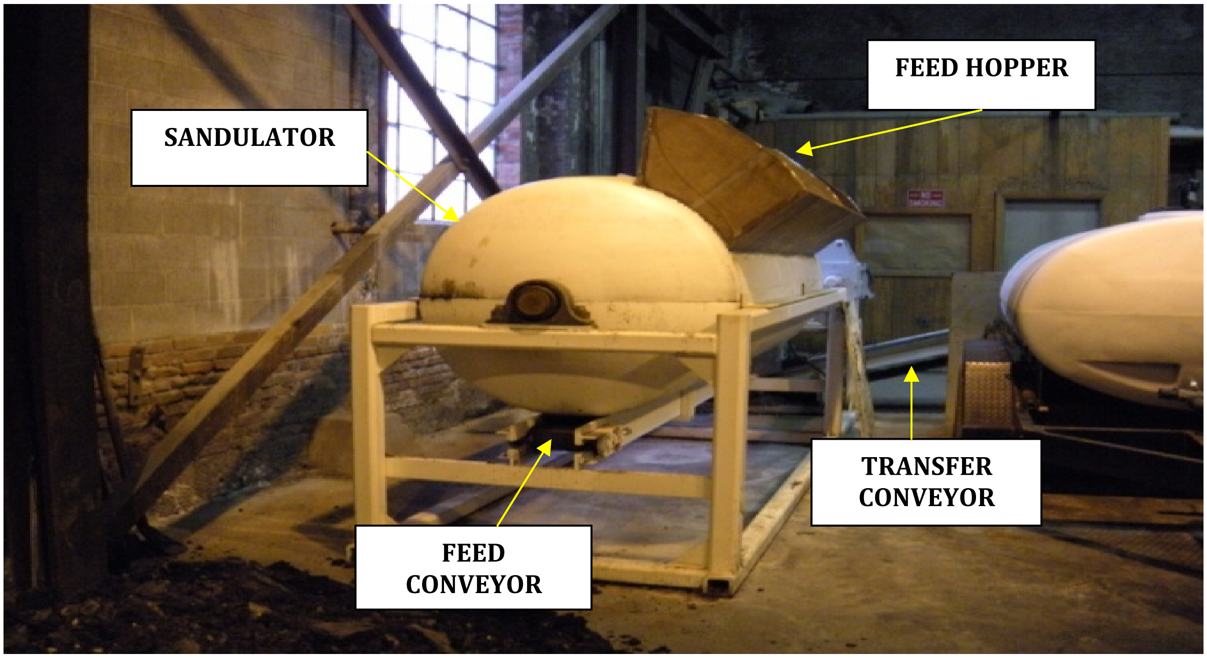
PROCESS FLOW DIAGRAM



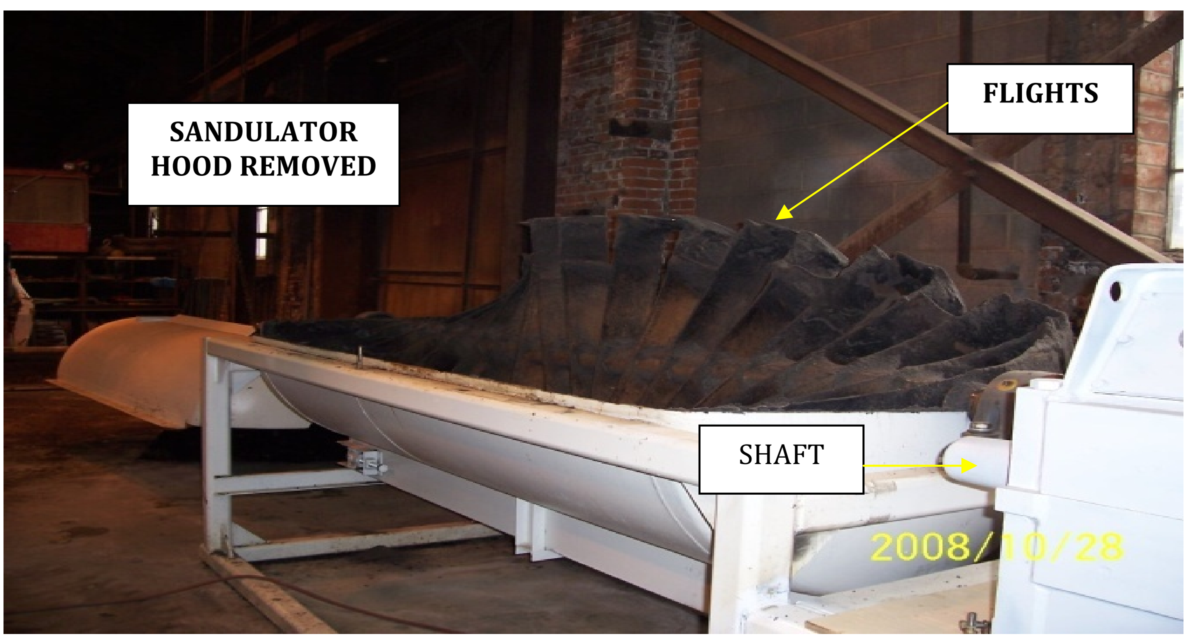
2.2. Equipment Description

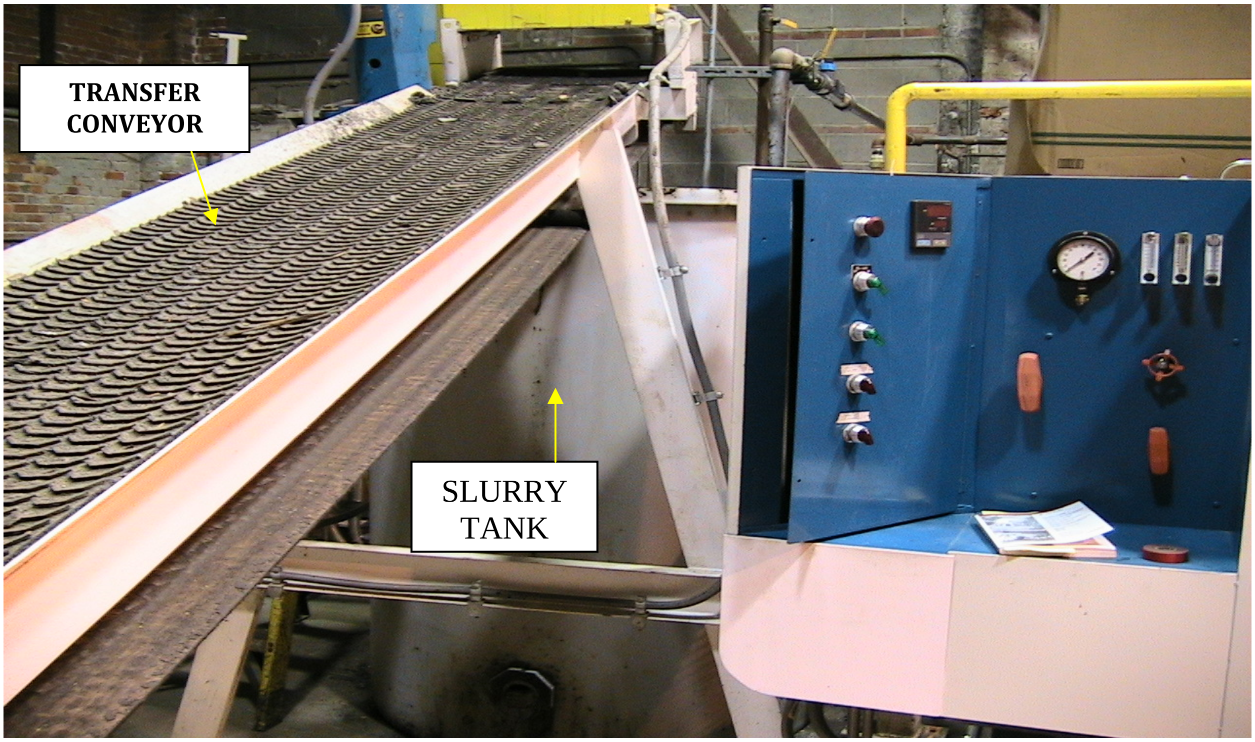


(1) General Arrangement of the Pilot Plant

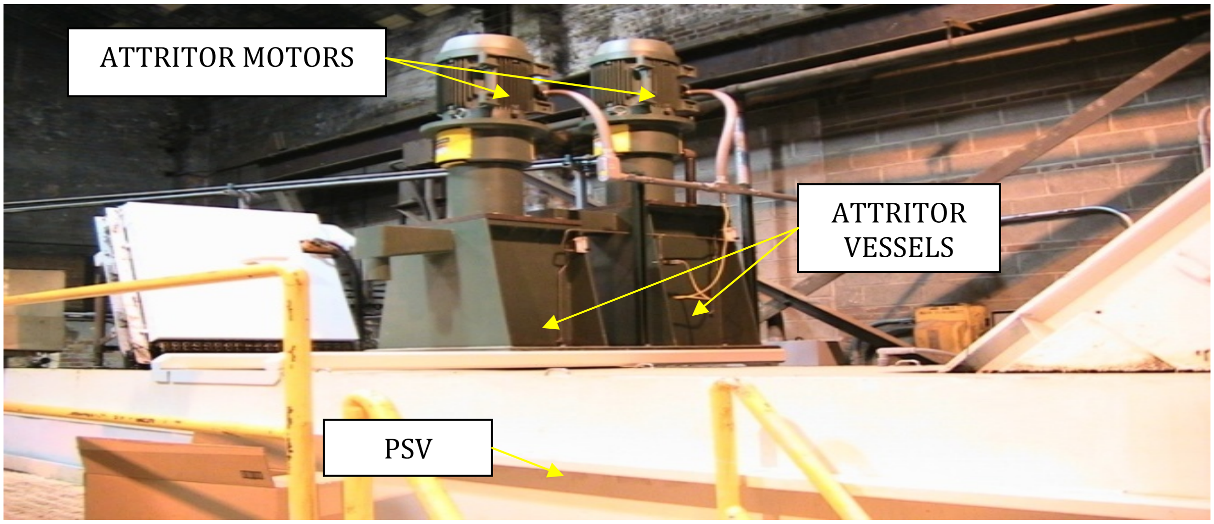


(2 & 3) Sandulator – This device is used to break up any lumps of raw oil sands so as to make it "flowable" and the associated load cells permit the feed rate to the slurry tank to be measured.

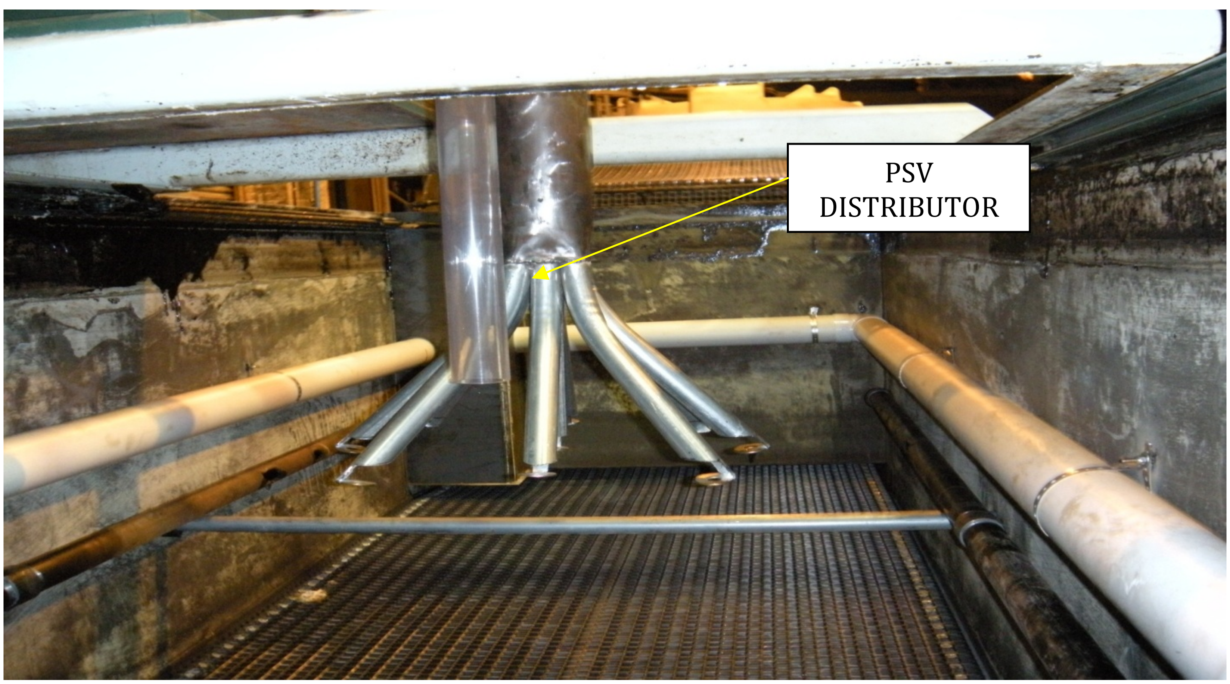




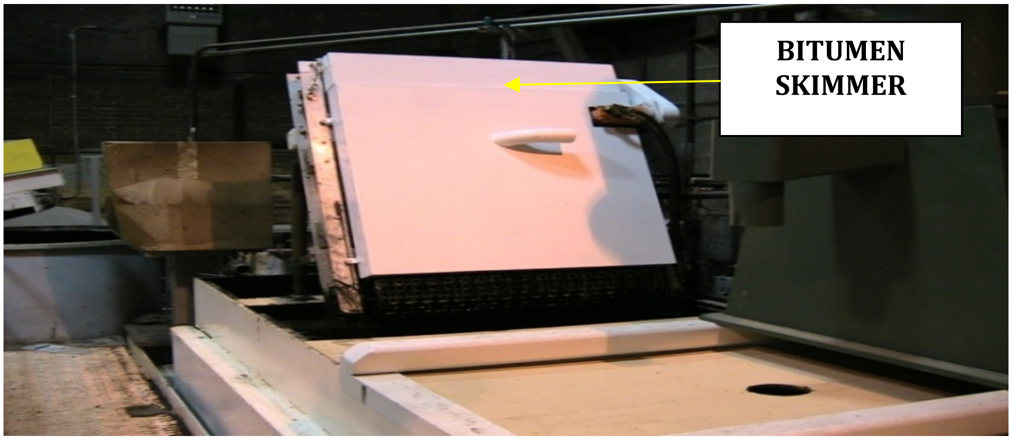
(4) Slurry Tank – This is the first place where raw oil sands are mixed with the chemistry, CAC-24. This is a mechanical mixing device that forms a slurry, which is pumped to the **attritors**. The mixture of CAC-24 to oil sands is 70/30 to 50/50.



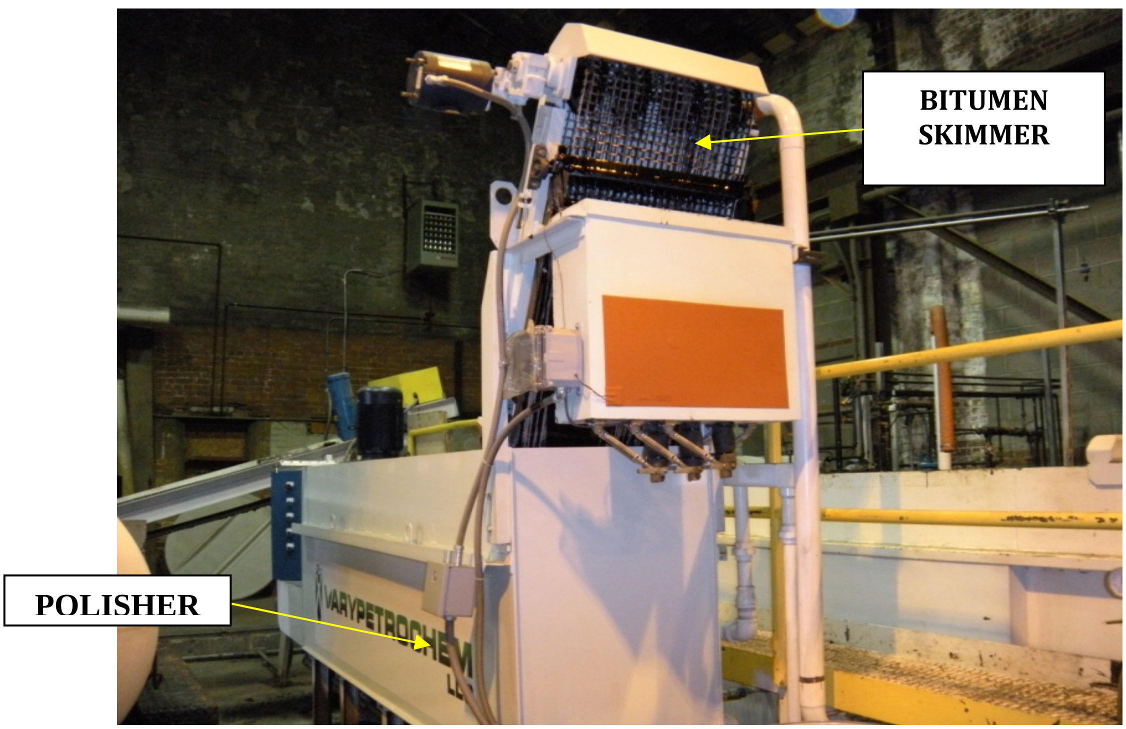
(5) **Attritors** – These high speed/high shear mechanical devices separate the bitumen from the solids and fines. The chemistry in the PSV prevents the re-association of bitumen, solids, and chemistry.



(6) Primary Separation Vessel – This vessel continuously receives the product from the attritors. After a short settling time, the mixture stratifies into three distinct layers: 1) the bitumen floats to the top; 2) middlings, primarily made up of CAC-24 with some suspended fines, settles in the middle and; 3) all of the solids, with most of the fines drop to the bottom.



(7) PSV Bitumen Tank – Floating bitumen is collected in the PSV by means of a skimmer and discharged into a heated holding tank before being pumped to the polishing unit, if required.



(8) Polisher – The polisher receives bitumen from the PSV Holding Tank. This unit is used to remove the last traces of fines and chemistry from the bitumen. When in use, virgin CAC-24 is introduced into the polisher. This process step was not needed when processing Athabasca oil sand due to the high quality of the bitumen from the PSV discharge.

(9) Clean Polished Bitumen Tank – Bitumen from this tank is 99+% pure and ready for upgrading to produce Synthetic Crude Oil (SCO).

(10) Heat Exchangers – Two are utilized, one to heat up the virgin CAC-24 before introduction into the process and the other to keep the process chemistry up to the operating temperature of 135-155°F.

(11) Surge Tank – This tank holds the excess recyclable chemistry and acts as a buffer so as never to be short of process-ready chemistry.

(12) Virgin CAC-24 – Virgin CAC-24 is introduced into the VARY system at the **polisher** when in use or it is into the **surge tank** as needed when the **polisher** is not in use.

(13) Solids Recovery Reservoirs – Solids and fines from the PSV and filters are collected and weighed here ready for landfill. If a solids filtration and washing stage is of interest to the user, it would be placed between here and the PSV.

3. PILOT PLANT OPERATION

On February 3, 2009, the VARY pilot plant was operated with Athabasca oil sands delivered to Cleveland in October 2008. Dr. C.E. St.Denis of TDI Technology of Edmonton, Alberta, Canada was in attendance during the trials to conduct this technical evaluation.

3.1. Chemistry Preparation and Inventory

A large plastic tank is used to prepare the CAC-24 chemistry. The tank is initially filled with deionised water and the weighed reagents are added and stirred. The circuit was then filled with chemistry and recirculated through the heat exchanger to raise the temperature to approximately 145 ^{o}F.

3.2. Oil Sands Feed

A total of 5608 # of oil sands were loaded into the **Sandulator** with a front-end loader in four weighed batches during the course of the day. Each loading took about 15 minutes to complete and required that the feed conveyor be halted but did not appear to disturb the circuit owing to the surge capacity of the **Slurry Tank.** Oil sands feed to the **Slurry Tank** was sampled each 1/2 hour.

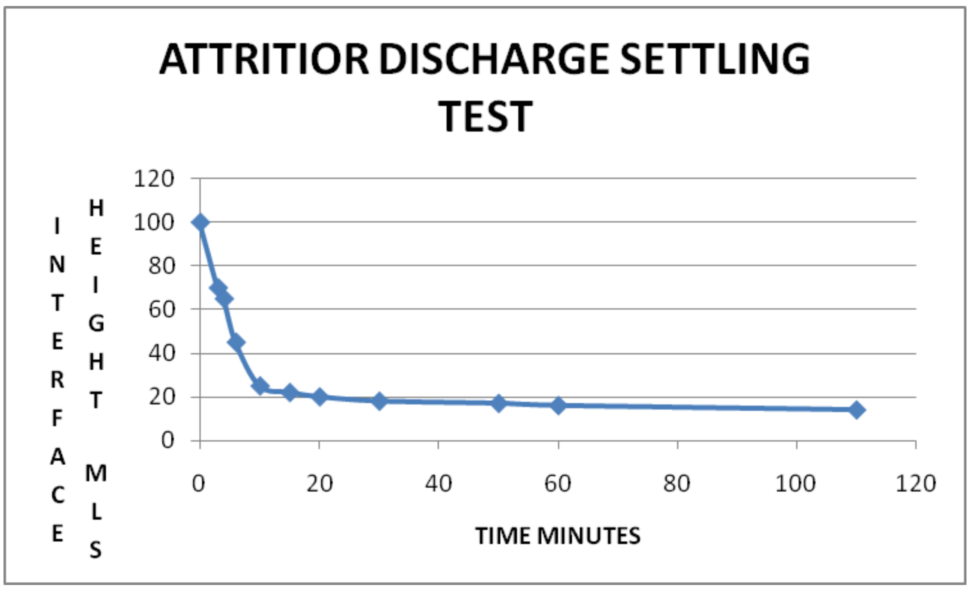
The feed conveyor to the **Slurry Tank** was shut off during the **Sandulator** loading and changing of the **Attritor** blades (described later) for a total of 2.5 lost hours leaving a run time of 4.5 hours (7.0-2.5). The average oils sands feed rate was then about 1250 #/hour (5608/4.5).

3.3. Attritors

The slurry was fed from the **Slurry Tank** to the **Attritors** at a nominal rate of 2,500 #/hour. It is in the **Attritors** where the oil sand and chemistry is subjected to the high shear necessary for bitumen separation. Wear on the stainless steel attritor blades was significant. The four blades, two from each unit, were replaced twice during the course of the day owing to excessive wear. The amperage draw when first installed was about 40 amps from 480 volt fifty horsepower motors. When the load fell to about 30 amps the attritors were shutdown and the blades replaced, which required about 35 to 45 minutes. The wear is concentrated at the curved tips of the blades. An enhanced wear resistant material will be required to extend the life of the blades.

3.4. Primary Separation Vessel

The **Attritor** discharges directly into the **PSV** where the solids, chemistry, and bitumen quickly separate into three layers. A sample was taken of the **Attritor** discharge and allowed to settle in a 100 ml graduated cylinder. Bitumen rose within a minute to the surface and the solids began to settle immediately, leaving a solids free relatively clear middlings zone. The following figure details the complete settling test.



The free settling zone with the distinctive "knee" before the compression phase bodes very well for the use of a thickener as the PSV.

The observations of rapid solids settling in the cylinder test was confirmed when the **PSV** was drained. All the solids were in a steep pile under the feed point with an angle of repose of greater than 45^{o}. A number of solids samples were collected for analysis by Maxxam Analytics (AppendixC)..

Immediately upon entering the **PSV**, bitumen appeared on the surface and over the course of the run it was "skimmed" into a heated bitumen storage tank. Samples of the skimmed bitumen were taken each ½ hour. The heated bitumen was "glossy" and free-flowing at 150 ^{o}F, an excellent indicator of a high quality product. Middlings samples were taken each ½ hour and were clear of solids but were discoloured by a yellowish tinge. All of the middlings discharged from the **PSV** were filtered but a negligible amount of solids were captured, providing a significant corroboration of the fines free middlings claim. As experienced in the bench scale test work, the solids settled rapidly, the bitumen quality was excellent, and the middlings were free of solids, which allowed immediate recirculation back to the circuit. The middlings are composed of CAC-24 with a trace amount of fines.

3.5. Polisher

Although the polishing step is necessary for Utah oil sands, it was not used to achieve the results listed in this report for the Athabasca material.

4. PILOT PLANT PERFORMANCE

All of the reported analytical results regarding the pilot plant performance were undertaken by an independent laboratory with significant oil sands experience, Maxxam Analytics of Edmonton, Alberta, Canada. The results are compiled in Appendix C. The environmental impact evaluation is discussed in section 4.4.

4.1. Bitumen Recovery

Two composite samples of the settled solids in the PSV were analysed for bitumen content (see C-6 and C-7). In both cases, the hydrocarbon content was below the detection limit. On this basis, the bitumen recovery is greater than 99%.

4.2. Bitumen Quality

Bitumen production from the first two hours of non-steady state operation was composited as were the final three hours of steady state running. The results were:

	NON STEADY STATE (%) Appendix C-5	STEADY STATE (%) Appendix C-10
BITUMEN	98.84	99.93
SOLIDS	0.87	0.06
WATER	0.29	0.01
TOTAL	100.00	100.00

The VARY process provides a bitumen product with less that 0.1% solids and water following the achievement of steady state operation. The appearance of the bitumen in the heated holding tank was “shinny” with a silky sheen and flowed readily at 150 ^{o}F.

4.3. Middlings Quality

The solids content of the middlings composite sample from the first two hours of operation was 0.4 wt. %, which fell to 0.08 wt. % for the steady state portion of the run. The analytical laboratory reported that “the fluid component was very clear in appearance” (Appendix C). This observation is confirmed in the settling test described previously. In addition, the inline filter meant to remove all solids from the middlings stream contained a negligible amount of material following completion of the run. The results indicate that the PSV middlings are suitable for immediate recycle back into the process following a suitable settling time. Conventional middlings generated in the Clark hot water process (the basis of current Athabasca commercial extraction technology) contain considerable fines and, to large degree, account for the excessive size of the tailings ponds in the Athabasca region. In addition, the immediate and continuous recycling of the middlings conserves energy.

4.4.Tailings Environmental Quality

The solid tailings contain both the coarse solids and fines with little or no bitumen (see C-6 and C-7). As observed earlier, the angle of repose of the solids in the PSV was over 45 degrees. Following filtration (described in 4.6), these dry tailings would be suitable for direct disposal back into the open pit mine, thereby permitting accelerated land reclamation. Since no solvents are employed in the process, the tailings are free of the associated toxic components.

Some chemistry loss with the solids tailings is unavoidable (see 4.7 below). Tests carried out on the tailings by Ohio EPA authorized laboratories: Cetec Laboratories of Cleveland (Appendix E) and the EA Group of Mentor, Ohio (Appendix D) concluded that: “The sample does not appear to exhibit the characteristics of a hazardous waste due to toxicity by TCLP protocol (metals, VOC, or SVOCs), ignitability/flashpoint; reactivity, or corrosivity.” Samples of middlings were collected and analysed by the North East Ohio Regional Sewer District, an arm of the EPA (Appendix B). They concluded ... “that it would not be a problem to discharge it to the sewer system.” Tailings from the VARY process are benign and suitable for direct disposal into the open pit mine.

4.5. Evaporative Losses

VARY calculated, by calibrated conductivity measurements, that 291 USG of water were lost through evaporation during pilot plant operation. In order to check VARY’s calculations, estimates of the opening and closing inventories of CAC-24 (Appendix A) were made and indicate that somewhat more than 200 USG of water were lost through evaporation or roughly 2% of the starting inventory. The loss calculated from the inventory estimates must be viewed as an approximation since the loss is only a small fraction of the total but does add credence to VARY’s estimate based upon conductivity. Little or no loss of the inorganic components of CAC-24 through evaporation is expected. To avoid the majority of the heat loss due to evaporation (see 4.8), conventional engineering techniques will be employed to significantly cut the losses. The evaporative losses will not be entirely eliminated since some loss is desirable to ensure there is adequate makeup water to wash the filtered solids to recover CAC-24 before tailing disposal(see 4.6).

4.6. Chemistry Recovery

Each USG of bitumen recovered is associated with 91.7 # of dry solids tailings, which in turn contains 9.07 # or 1.09 USG of CAC-24 at 9% moisture content of the solids, as discussed in the mass balance below. Such a loss of chemistry is economically unacceptable. It is proposed to filter and wash the tailings to recover the CAC-24. If it is conservatively assumed that filtration reduces the tailings moisture to 5% and the wash stage, using makeup water, is 80% efficient, then the CAC-24 loss is reduced to 0.12 USG per USG of bitumen recovered. A second wash stage with the same efficiency reduces the loss to about 0.02 USG per USG of recovered bitumen. Ample wash water is available from the makeup to compensate for the evaporative losses.

4.7. Mass Balance

A mass balance around the pilot plant was performed for the entire run to assess the accuracy of the estimated flow of material.

INPUTS

5608# of feedstock was charged into the **Sandulator**, as measured by the load cells. The feedstock was sampled each ½ hour. The first and last five of the ½ hourly samples were mixed together to form two composites and tested with the following results:

COMPONENT	COMP 1 (%)	COMP 2 (%)	AVERAGE (%)
BITUMEN	8.4	8.2	8.3
SOLIDS	91.3	91.5	91.4
WATER	0.3	0.3	0.3
TOTAL	100.00	100.00	100.00

Calculated component weights of feedstock, using the above average composition were:

COMPONENT	WEIGHT (#)
BITUMEN	465.5
SOLIDS	5125.7
WATER	16.8
TOTAL	5608.0

OUTPUTS

The total solids collected in the bottom of the PSV was 5530 #, composed of 625 # of “free” or drainable water and 441 # of retained moisture (9% moisture), leaving 4464 # of dry solids. The discrepancy between the input and output weights of solids is 12.9%. The total bitumen collected is 503 #, which is 8.1 % greater than the measured input.

A mass balance in a pilot plant of this nature should have a variance of close to 5 %, which points to the need to improve the measurement of the weights of the input and output components. None of the previously reported results, however, are impacted by the mass balance results.

4.8.Energy Requirements

The process energy requirements for the recovery of 503# or 1.44 barrels of bitumen were calculated based on three sources: oil sand feed, evaporative losses, and the attritors. Other energy consumers, such as pumps and conveyors, were considered negligible. The heat necessary to initially raise the CAC-24 inventory to 140^{o} F has not been estimated as it is a once only requirement before beginning operation.

<u>Oil Sand Feed</u>

The oil sand feed of 5608 #, with a heat capacity of 0.21 BTU/# ^{o}F, must be heated from the ambient temperature of 70 ^{o}F to 140 ^{o}F, which requires 82.4 x 10^{3} BTU.

<u>Evaporative Losses</u>

Assuming that 291 USG of water evaporated during the run, the heat required to offset the evaporative loss is 2.42 x 10^{6} BTU.

<u>Attritors</u>

The high shear in the attritors is dissipated as heat in the slurry. The average current draw for each attritor was 40 amps at 480 volts and assuming a power factor of 0.95 for five hours of operation, about 622 x 10^{3} BTU were added to the process for both units.

ENERGY LOSS SOURCE	ENERGY LOSS (BTU x 10^6)
OIL SAND FEED	0.0824
EVAPORATION	2.42
ATTRITORS	- 0.622
TOTAL	1.88

The net requirement for external heat, for the recovery of 503# of bitumen, is then about 1.88 x 10^6 BTU, arising largely from the evaporative water loss. Evaporative water loss can be reduced dramatically through conventional engineering practice.

5. CONCLUSION

On February 3, 2009, VARY’s Cleveland pilot plant was successfully operated for seven hours using Athabasca oil sands. The overall objective of the run was to demonstrate the efficacy of the process under continuous operation. The conclusions that can be made are as follows:

Bitumen Recovery Bitumen recovery exceeded 99 %.

Bitumen Quality The recovered bitumen contained less than 0.1% solids and water.

Middlings Quality The fines free middlings are suitable for recycle after a short settling time.

Tailings Quality The dry stackable solid tailings, including fines, are virtually free of bitumen and suitable for direct disposal back in the open pit mine. There is little or no liquid tailings as the middlings are free of solids and are continuously recycled directly back into the process.

Evaporative Losses About 291 USG of water was evaporated during the collection of 503 # of bitumen. Evaporative water loss will be dramatically reduced in a commercial plant through conventional engineering practice

Recovery of Chemistry It is believed that CAC–24 losses can be reduced to the equivalent of 0.02 USG of chemistry per USG of recovered bitumen if the solid tailings are filtered and washed.

Environmental Impact The solid tailings are free of bitumen and suitable for direct disposal back into the open pit mine. A small amount of chemistry is retained in the solids tailings. The EPA and two independent EPA approved laboratories have, however, determined that the tailings are benign and offer no environmental threat. In addition, since no diluents are used anywhere in the process, they will not appear in the liquid or solid effluent.

The VARY process appears to be robust in the face of variations in the oil sand feed quality. The oil sands used in the process were received in October but were not processed until February. During this period, the oil sands were oxidized and lost moisture. Oil sand of this quality would be expected to contain about 9% moisture but only 0.3% was detected. The conventional hot water process would be negatively impacted by this feed quality. The robust nature of the process bodes well for process control in the face of changing feed composition, which is an “every day” concern in the Athabasca oil sands operations. It also raises the prospect of a business opportunity for cleanup of terrestrial oil spills.

APPENDIX A

Beginning and Ending Inventories of Chemistry (Volume)

APPENDIX A

Beginning and Ending Inventories of Chemistry (Volume)

The beginning and ending inventory of chemistry, before and after the run, was as follows:

CAC-24 AQUIOUS BASE SOLUTION

	BEGINNING USG	ENDING USG
SLURRY TANK	150	170
ATTRITORS	60	60
PSV	3500	3500
SURGE TANK	275	275
PSV STORAGE TANK	4784	4438
FILTER	10	10
POLISHER FEED TANK	250	250
POLISHER TANK	500	500
SOLID TAILINGS		128
OIL SANDS FEED	2	
TOTAL	9531	9331

From the above data, the evaporated loss was calculated to be 200 USG (2%). As no makeup water was added during the run, the rising concentration of the chemistry resulted in a rise of specific gravity from the initial 1.01 to a final of 1.04.

APPENDIX F

Professional Qualifications (TDI Technology, Inc.)

SUMMARY RESUMES

of

S.D. JAYCOCK P.Eng

and

C. E ST.DENIS Ph.D., P.Eng.

of

TDI TECHNOOGY INC.

April 2009

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Resume-Sid Jaycock

S.D. Jaycock, B.E., P. Eng.

Mr. Jaycock is an independent oilsands development consultant, President of TDI Technology and acting CEO of the limited company formed for Nigerian oilsands development. Mr. Jaycock's specific oilsands experience highlights include:

- 1962-as an equipment application engineer for a large custom engineered process equipment manufacturer worked with the development team of Cities Services Athabasca Ltd. (forerunner of Syncrude) on development of sand tailings pumping systems. This work is referenced since it represents experience with early developers of oilsand technology in preparation for the first Canadian commercial project (a development period similar in many aspects to the current development state in Nigeria and other new locations in the world.
- 1963-64-worked as a process equipment supplier to GCOS (Suncor) through Bechtel Corporation, the U.S. contractor chosen for the development of the first commercial oilsands project. Provided equipment application engineering and start-up services.
- 1964-68 – worked as a consultant to several major oil companies developing enhanced oil recovery projects.
- 1968-72 – worked as Manager of the Industrial Engineering Division of Associated Engineering Services Ltd. (AESL), was responsible for a significant number of modification engineering projects for Suncor. (The original expectations for this project were far from being achieved in the initial construction). The 1964 to 1972 time period provided an understanding of many of the pitfalls associated with large-scale first time project development. This knowledge has been successfully applied to a number of subsequent new technology projects.
- 1972 – hired as a consultant to Esso (Exxon) as Project Engineering Manager for the conceptual development of a 100,000 Bbl/day in-situ oil sands recovery project at Cold Lake, Alberta. This assignment included design and construction of a 10,000 Bbl/day pilot plant facility to provide a database for the larger commercial facility. This experience is of particular interest as this project, which initially was representative of the mega project ($7.2 Billion) mentality of the day, was studied in depth by Esso resulting in the very successful decision to abandon the single large scale approach for a staged-modularized approach similar to that being proposed by TDI for other developments.
- 1973 based on AESL's experience with Suncor and Esso, AESL was awarded the detailed design contract for the oilsand extraction plant facilities for Syncrude (125,000 Bbl/day). S. Jaycock was assigned to the concept development team as the lead Mechanical engineer (process) for this project and served as the corporate engineering manager during the design period.
- 1974-78- worked as the Manager and Vice-President of AESL directing engineering teams undertaking numerous new oilsand process evaluation studies for the Alberta Oilsand Technology and Research Authority (AOSTRA)

providing comparative benefit analysis of proposed technologies relative to the state of the art Syncrude process.

- 1978-80 – Senior Vice President of Associated Pullman Kellogg Ltd. Worked extensively with Esso relative to their development strategy for the Cold Lake project development and with Shell Canada Ltd. on proposed development structures for their Alsands oil sands project.
- 1980-84 as President of Techman/Loram Ltd. Directed company's involvement in providing mine design and environmental impact assessment for Mobil Oil Co.'s Lease 30 Oil sands project and the company's joint venture with Bechtel Corporation as the managing contractor for Shell's Alsands $10 billion plus oil sands project
- 1983-84-When Shell cancelled their Alsands project due to excessive cost and risk, Mr. Jaycock assembled a team of industry experts lead by Shell's Alsands former project manager to work with Techman/Loram to study the conditions necessary for development of future Canadian oil sands projects. The study had senior representatives of all the then existing operations (Syncrude and Suncor) as well as all proposed participants and key stakeholders. This study focused on the business aspects of oilsand project development and the key concerns of ownership companies requiring resolution to make further development viable. The Government of Canada funded this study. A key finding of this work was the need for scale reduction technologies and more rapid modularized construction approaches.
- 1984-85 – Mr. Jaycock founded TDI Technology Inc. specifically targeted for the creation of ownership-technology partnerships for the development of smaller scale oilsands projects.
- 2005-08-TDI undertook the development of a small scale proprietary oil sand extraction technology, specifically targeted at the Utah deposit.

EXPERIENCE C.E. St.Denis

1998 to present **TDI Technology Inc.**

- Research and development of propriety small scale oil sands process,
- Experimental development and evaluation of process options for small scale tar sands facilities,
- Manager of Metallurgy during the development phase of a 50 000 t/y acid pressure leach lateritic nickel mine and refinery in Cuba, $US 1.4 billion,
- Technical consultant in the development of nickel laterite processing facilities in Cuba and the Philippines,
- Technical Manager for process development of cereal grain fractionating and renewable fuels production, and
- Conduct of investor due diligence and R&D program evaluations in project development using a proprietary risk management model.

Past experience **30 years of experience in Canada and offshore have included:**

- Technology manager in the development of processes for oil sands as well as coal and heavy oil upgrading; two patents are held in this field,
- Project technical manager for several international base metals hydrometallurgical projects,
- Partner and Vice President Technology in the development of three commercial cereal fractionating plants supplying ingredients to the food, fuel, pharmaceutical, cosmetics, and feedlot industries,
- Vice President Research and other management positions in several major Canadian R&D organizations,
- Establishment and management of a solids pipeline R&D facility,
- Production supervision in hydrometallurgical refining and base metals milling operations, and
- Military officer in a tactical communications unit.

EDUCATION

- BSc, MSc, (Queen's University, Canada) and PhD (University of New South Wales, Australia) in Chemical Engineering
- Graduate Banff School of Advanced Management